INDEPENDENT EXPERT ADVISORY PANEL FOR MINING

ADVICE RE:

METROPOLITAN COAL MINE

Stage 1: LONGWALLS 311-312

Date: 05/09/2024

Report No: IEAPM2024-9

EXECUTIVE SUMMARY

On 4 July 2024, the Director Resource Assessments, NSW Department of Planning, Housing and Infrastructure (DPHI) requested the Independent Expert Advisory Panel for Mining (IEAPM – "the Panel") to provide advice in relation to the proposed Extraction Plan (EP) for secondary coal extraction from Longwalls (LWs) 311-316 at the Metropolitan Coal Mine.

The scope of the Advice sought from the Panel on the following matters:

- *Whether the Panel's previous recommendations in the documents above have been adequately addressed, in particularly in relation to large swamps and water quality modelling and monitoring;*
- *The adequacy of large swamp impact predictions presented in the Large Swamp Assessment (Appendix H of the EP) and associated appendices;*
- *The adequacy of the proposed performance measures and indicators for large swamps required by condition 4(b) Schedule 3 of the consent and included in the Large Swamp Assessment (Section 7.2), and the need or otherwise to set more defined performance measures for large swamps beyond those related to threatened species, populations, or ecological communities;*
- *The need or otherwise to modify the mine plan to minimise/avoid impacts, particularly on large swamps, and ensure compliance with existing and proposed performance measures;*
- *The adequacy of the water and swamp monitoring programs;*
- *The water and swamp TARPs and whether they;*
    - *Enable measurement of compliance with existing and proposed performance measures established under the consent and proposed in the EP for large swamps; and*
    - *Have triggers (and associated performance indictors) that adequately reflect the existing and proposed performance measures.*

The Panel should feel free to provide any other advice it considers would assist the Department in reviewing the EP.

After the initial briefing by DPHI Assessments, preliminary review of information and Panel meetings; the IEAPM determined a staged approach is most suitable for this project. Stage 1 will consist of the following:

1. Reviewing whether the Panel's previous recommendations have been adequately addressed in relation to large swamps and water quality modelling and monitoring;
2. Restricting the Stage 1 advice to LW 311 and 312; and
3. Recommending clear and timely Performance Indicators that unambiguously define when impacts on biodiversity are greater than negligible.

The following sections of the report identify the following:

- Chapter 2 – Scope of works
- Chapter 3 – Method of Operation
- Chapter 4 – Background
- Chapter 5 – Metropolitan Coal's response to the Panel's previous recommendations
- Chapter 6 – Advice on LW 311 and 312 focussing on the large swamps
- Chapter 7 – Summary Conclusions
- Chapter 8 – Summary Recommendations

Based on the material presented to the Panel and the supplementary information supplied by Metropolitan Coal Pty Ltd, the Panel has made the following conclusions and recommendations for possible consideration in any Extraction Plan approval for Longwalls (LWs) 311 and 312:

CONCLUSIONS

Responses to previous Panel advice by Metropolitan Coal

- In relation to the Panel's previous advice *Water Quality Performance Measures for Metropolitan Coal Mine*, the responses by Metropolitan Coal indicate an intention to address the recommendations to some degree but in most cases lack information about timeframes and in some cases are vague or suggest an inadequate degree of commitment. These issues arising do not need to be urgently addressed in the context of Longwalls 311 and 312, except to ensure that total metals (rather than dissolved metals concentrations) are monitored at the outlet of Swamp 92.
- In relation to the Panel's previous advice *Large Swamp Environmental Assessment Requirements for the Extraction Plan for Longwalls 311 to 316*, most of the recommendations have not been addressed or have been addressed in a partial or unsatisfactory way. The major issues relevant to the consideration of Longwalls 311 and 312 are:
    - Due to the progression of Maingate 312 prior to assessment of the Extraction Plan the widths of Longwalls 311 and 312 are essentially fixed and reducing their width is now not a practical risk management option.
    - The large swamp TARPs remain unsatisfactory and need to be further refined in several aspects.
    - Aspects of the large swamp risk assessment are unsatisfactory, particularly for the downstream end of Swamp 77.
    - The baseline surveys of vegetation sub-communities are unsatisfactory.
    - The baseline surveys of threatened species are unsatisfactory.
    - Documented evidence of the absence of the Eastern Ground Parrot relied upon by the Extraction Plan is unavailable.
- In relation to the Panel's previous advice *Metropolitan Coal Mine: Independent Review of Environmental Performance to 2022*, plans are in place to install the recommended monitoring at site T6, but it was not yet in place at time of writing this advice.
- In relation to the Panel's previous advice *Metropolitan Coal Mine: Independent Review of Environmental Performance to 2022 and Metropolitan Mine Longwalls 308 – 310 Extraction Plan*, the recommended groundwater monitoring was not in place at time of writing this advice, limiting the value of that monitoring for understanding subsidence risks and for providing baseline data for assessing performance.

Significance of the large swamps

- For the purpose of assessing the Extraction Plan and considering suitable Performance Measures and Performance Indicators, Swamps 76, 77 and 92 are important upland swamps in terms of providing suitable habitat for threatened species and water supply protection, and because of their size and status as Threatened Ecological Communities. Swamps 77 and 92 meet criteria proposed by OEH (2016) for swamps of special significance on the Woronora Plateau.

The adequacy of large swamp impacts predictions

- The subsidence predictions for LWs 311-312 have been made using an appropriate method that has been reasonably applied; additionally, the subsidence reports are adequate when supported by the relevant management plans.
- The swamp groundwater modelling is useful and appropriate given its data constraints; however, due to the model uncertainty, little weight should be attached to the conclusion in the Large Swamp Assessment that "*The mining-related effects to Swamp 76 and Swamp 92 are expected to be minor with the water levels predicted to remain above the base of the substrate*".
- If subsidence impacts do occur along tributaries P, R and S, as predicted, this is likely to result in impacts to threatened species if and where they are present (presence is indicated in the BCS survey results presented to the Panel). If these impacts do occur, and result in loss of breeding habitat, they are unlikely to be considered negligible.
- The baseline surveys relied upon by the Extraction Plan for threatened frog species and for the Giant Dragonfly are inadequate. Therefore, the Panel lacks confidence in the impact predictions that there will be no significant impacts and that a negligible impact to threatened species can be achieved.
- The limitations in the baseline surveys cannot be properly addressed prior to the proposed commencing date of LW 311 or LW 312, but may be partially addressed prior to the proposed commencing date of LW 313.

The adequacy of the large swamp Performance Measures and Performance Indicators

- The proposed Performance Measure of "*Negligible impact on Threatened Species, Populations, or Ecological Communities*" is acceptable for the purpose of LWs 311 and 312 provided that this Performance Measure is supported by Performance Indicators that are relevant and have clear criteria that define when an impact is more than negligible.
- The proposed large swamp groundwater Performance Indicator "*Subsidence impacts are not expected to result in measurable changes to swamp groundwater levels when compared to control swamps or seasonal variations in water levels experienced by upland swamps prior to mining*" is acceptable for the purpose of LWs 311 and 312 if it is supported by triggers that clearly define when changes are significant enough to determine an exceedance of the Performance Measure.
- The large swamps warrant Performance Indicators and triggers that provide a higher level of confidence (than provided by those applied to previously undermined swamps) that impacts will be detected and managed appropriately.
- Increased groundwater recession rates leading to non-negligible loss of swamp groundwater is a sufficient and practical criterion for determining that the large swamp groundwater Performance Indicator has been exceeded. Due to the semi-quantitative assessment of recession rates, a technical document should clearly explain and demonstrate the method and criteria used. Any exceedance of this Performance Indicator should translate directly and irrespective of any subsequent assessment to an exceedance of the Performance Measure for the large swamps.
- Given the preceding conclusion, the Upland Swamp Vegetation Performance Indicator is unnecessary.
- The Performance Measure "*Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir*" and associated Performance Indicators are acceptable.
- The Amphibian Performance Indicator should only refer to threatened species, with exceedance of the Performance Indicator reviewed by species and monitoring location (e.g. a transect) rather than the "*amphibian assemblage as a whole*".

The adequacy of the large swamp TARPs

- The closure thresholds used in the large swamp valley closure TARP are not sufficiently conservative for Swamp 77.
- The rationale for the location of closure lines in Swamps 76 and 77 requires clarification.
- There would be benefit in adding the shallow (~10m depth) HBSS groundwater into the upland swamp groundwater TARPs as an early warning of potential (short or long-term) impacts to swamp hydrology.
- The highest-level upland swamp groundwater trigger defines exceedance of the Performance Indicator and should define exceedance of the Performance Measure. It is appropriate for this to be based, as is proposed, on semi-quantitative analysis of groundwater levels including recessions that lead to non-negligible reductions in swamp groundwater levels. Better allowance needs to be made for baseline period levels that may be below the logger level.
- The proposed water quality TARPs are appropriate for LW 311-312.
- The Amphibian TARP is viewed by the Panel to have a number of limitations related to the lack of focus on abundance of individual species and availability of habitat (particularly breeding pools) along individual waterways, and other details.

The need or otherwise to modify the mine plan

- Of the three large swamps, Swamp 92 is the most significant. The proposed extent of LW 312 presents an unacceptable risk to Swamp 92, which could easily be addressed by shortening of that longwall.
- The downstream end of Swamp 77, including a controlling rockbar, is at high risk. If shortening of LWs 312 and 313 or reduction of (one or more of) LWs 313-316 panel widths by at least 60 m to protect Swamp 77 are not considered appropriate for economic or other reasons, then it is highly likely that the large swamp groundwater Performance Indicator will be exceeded at Swamp 77.
- Further consideration of risks to Swamp 76, Swamp 77 and tributaries that may host threatened species, and to management options including possible changes to the mine plan for LWs 313-316, should be given in Stage 2 of the Advice.

The adequacy of the water and swamp monitoring programs

- The proposed Subsidence Monitoring Program is adequate for the purpose of LWs 311 and 312, except that there is a need for a transverse subsidence monitoring line towards the northern end of LW 311, cutting across LW 311 towards the northern end of LW 316 to monitor subsidence behaviour within the zone of influence of Woronora Reservoir.
- The existing or proposed groundwater monitoring at the large swamps is adequate, except for the absence of any monitoring in the downstream area of Swamp 77, which the revised subsidence predictions show to be at high risk. Even if monitoring sites are established in this area, an unsatisfactory baseline period will be achievable if LWs 311 and 312 proceed as planned. Unless this can be resolved, it may be reasonable to assume (based on the subsidence predictions) that the groundwater Performance Indicator is exceeded at this location irrespective of measurements.
- The surface water monitoring for the large swamps has been implemented consistent with previous Panel recommendations. Where threatened frogs are identified, additional tributary pool level monitoring is appropriate.
- The Panel generally supports the swamp vegetation monitoring proposed but is unable to determine the suitability of quadrat/transect monitoring locations. The sites in Swamp 92 and Swamp 77 under-represent the lower reaches of the swamp.

RECOMMENDATIONS

Metropolitan Coal's response to the Panel's previous recommendations

1. The site S92-GS water quality monitoring should include measurement of total metals concentrations.
2. Peabody should proceed as soon as practicable with event sampling of water quality using automatic samplers irrespective of the outcomes of preliminary load assessments. This applies to ETWQ AU and also WQWQ9 and WOWQ2 if these are not covered by WaterNSW event sampling.
3. Peabody should commit, subject to access permission, to monitoring the depth profiles of water quality of the Woronora Reservoir at WDFS1 or other suitable site including regular (at least bi-annual) sampling throughout the remaining mining period, plus sampling following level 3 triggers for water quality reaching the reservoir.
4. An analysis of historical water quality trends in Woronora Reservoir and their relation to mining development should be included in the Metropolitan Coal 2024 Annual Review, and this should not be provisional on further suitable data becoming available.
5. The conceptual models of the large swamps should be reviewed in 6-monthly reporting in the light of new monitoring data, and updated to represent vegetation communities.
6. The T6 standpipes and the multi-level VWPs for Swamps 92 and 77 and standpipes at two sites in Swamp 76 should be installed as soon as practicable.

The adequacy of large swamp impact predictions

7. It is recommended that updates to the 1-dimensional and 2-dimensional models and their predictions should be undertaken in annual reviews to refine understanding of reasons for any observed subsidence consequences and to refine predictions for subsequent longwalls.
8. Further baseline surveys are required for threatened frog species, using appropriate survey methods and effort, conducted at a suitable time of year with survey locations targeting breeding habitat through the upland swamps (where present) and along suitable reaches of Tributaries P, R and S.
9. Additional surveys are required for Swamps 92, 77 and 76 using best practice methods. The Panel recommends the company engage with BCS in developing a suitable survey method.

The adequacy of the proposed performance measures and indicators for large swamps

10. The special significance of the large swamps should be managed by maintaining the proposed Performance Measure, and developing Performance Indicators and associated triggers that provide a high level of confidence that non-negligible impacts to the swamps will be detected and appropriately managed.
11. It is recommended that the action "*Initiate assessment against the performance measure for threatened species"* is removed from the highest-level Upland Swamp Groundwater TARP so that the trigger of this TARP defines an exceedance of both the Performance Indicator and the Performance Measure for the large swamps.
12. It is recommended that the Performance Indicator under Upland Swamp Vegetation Monitoring is removed (while maintaining the monitoring, annual reporting and TARP) and instead the groundwater Performance Indicator is relied upon to assess the Performance Measure for the large swamps.

The adequacy of the large swamp TARPs

13. The trigger for Swamp 92 should be reviewed by the Technical Committee following mining of LW 311 and submitted for approval prior to mining of LW 312.
14. To inform assessment of proposals for LW 313 to LW 316, the proposed large swamp valley closure TARP document should be revised to include a map showing closure line locations and additional justification of proposed locations, including consideration of any rockbar controls.
15. The large swamp groundwater level 2 TARP should include a trigger for potential impacts on HBSS shallow (~10m) groundwater levels, at which frequency of analysis of swamp groundwater levels should increase.
16. The large swamp groundwater triggers should allow for the possibility that the baseline period levels have been below the logger level.
17. The highest-level large swamp groundwater trigger action should include reviewing the mine plan for longwalls yet to be mined.
18. The large swamp groundwater TARP should explicitly state that a trigger at any one site constitutes a trigger for that swamp.
19. The large swamp groundwater TARP should include quarterly reporting of level 2 triggers and associated analysis.
20. A technical document, which clearly defines how the large swamp groundwater TARP triggers are assessed including examples, should be appended to the management plan.
21. The Biodiversity Management Plan should present a set of TARPs for the large swamps that separately from the TARPs for other swamps.
22. The Amphibian Performance Indicator and TARP should focus on abundance of individual species and availability of habitat (particularly breeding pools) along individual waterways.
23. The Amphibian TARP Level 2 trigger should assess if there has been a reduction in abundance of a threatened species (Red-crowned Toadlet, Littlejohn's Tree Frog or Giant Burrowing Frog) along an impacted waterway which has not been observed at control sites for one year. The Level 3 trigger should assess if there has been a reduction in abundance of a threatened species (Red-crowned Toadlet, Littlejohn's Tree Frog or Giant Burrowing Frog) along an impacted waterway which has not been observed at control sites for greater than one year.
24. Both Level 2 and 3 triggers should also include a trigger for drying of pools resulting in loss of habitat. It is recommended that periods align with the trigger levels above (i.e. loss of habitat for one year (Level 2) and greater than one year (Level 3)).
25. Further detail should be provided on the analysis to be conducted in relation to threatened species. The wording of the final action/response should make reference to implementation of appropriate mitigation/remediation or provisions of offsets, as per Sections 9 and 10. Remove the word "consider".
26. A reduction in a frog abundance at an impact site should translate directly to exceedance of the Performance Measure, hence the action "*Initiate assessment against the performance measure for threatened species*" should be deleted from the action/response. Table 19 of the Biodiversity Management Plan should be reviewed to determine if this is required.

The need or otherwise to modify the mine plan

27. It is recommended that the southern end of LW 312 is shortened by 260 m to minimise risks to Swamp 92.
28. It is recommended that Metropolitan Coal should provide DPHI, prior to a decision regarding approval of LW 311 and LW 312, further justification of why the predicted subsidence impacts in the downstream length of Swamp 77 may be considered acceptable, including evaluation of the feasibility of shortening of one or both of LWs 312 and 313.

29. It is recommended that, if the currently proposed layouts of LWs 311 and 312 are approved then, within 6 weeks of this Advice being submitted to DPHI (so that it can be considered by the Panel in Stage 2 of this Advice), Metropolitan Coal should submit to the DPHI a site-specific contingency plan that explains how non-minor fracturing in the downstream length of Swamp 77 (including its rockbar, base of tributary, and underneath the swamp soil) would be managed.

The adequacy of water and swamp monitoring programs

30. It is recommended that Metropolitan Coal should revise the Subsidence Management Plan to include a transverse subsidence monitoring line towards the northern end of LW 311, cutting across LW 311 towards the northern end of LW 316 monitor subsidence behaviour within the zone of influence of Woronora Reservoir.
31. It is recommended that Metropolitan Coal continues its endeavours to install the planned shallow and deep groundwater monitoring in/near the large swamps as soon as practicable and prior to commencement of LW 311.
32. It is recommended that a shallow swamp groundwater monitoring piezometer is installed near to the end of Swamp 77 at its downstream extent and, if safely accessible, rockbars and pools within the lower end of Swamp 77 should also be monitored for loss of water and visual impacts (fracturing and iron staining).
33. It is recommended that if no satisfactory monitoring, including baselines, can be installed to assess impacts to the downstream end of Swamp 77 and if the proposed longwall layout progresses then the large swamp groundwater Performance Indicator should be assumed to be exceeded over at least the valley infill area of Swamp 77.
34. Monitoring locations should target habitats at greatest risk of impacts from subsidence (breeding habitat) as identified during baseline surveys.
    - Monitoring locations should not be situated on access tracks. These locations are unsuitable for monitoring of threatened frog species.
    - Giant Dragonfly surveys should include targeted surveys for exuviae in wetter sections of the Swamps 77 and 92 (and Swamp 76).
35. Timing of monitoring should target key lifecycle stages of the species being monitored.
    - For threatened frogs, this should include the breeding periods, including calling and when tadpoles are present. This may require multiple surveys per year.
    - For the Giant Dragonfly, surveys should target the key emergence period between December and January.
36. Monitoring techniques should be targeted at, and suitable for, the species being monitored.
37. Surveys for threatened frogs must include nocturnal visual-aural surveys along monitoring transects. Use of 100 m x 100 m (1 ha) monitoring sites is not considered a suitable monitoring technique.
38. Instead of the measures of abundance outlined in the Biodiversity Management Plan, monitoring for threatened frogs should be undertaken to compare abundance along monitoring transects year-on-year.
39. Monitoring for threatened frogs should include monitoring of pool water levels at breeding locations identified during baseline surveys, including additional monitoring locations along Tributary P and Tributary R with sites informed by adequate baseline surveys.
40. If detected during baseline surveys, monitoring for the Giant Dragonfly should target exuviae in suitable habitat, as per recommendations of BCS. The company may also wish to considered use of eDNA surveys at the lower reaches of the swamps.

41. Surveys for threatened frogs must include nocturnal visual-aural surveys along monitoring transects. Use of 100 m x 100 m (1 ha) monitoring sites is not considered a suitable monitoring technique.

Other matters

42. Drivage of MG313 should be delayed until an Extraction Plan covering LW 313 has been endorsed by the Department.

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Glossary

BCS	Biodiversity, Conservation and Science Group of Department of Climate Change, Environment, Energy and Water
DCCEEW	Department of Climate Change, Environment, Energy and Water
DPHI	Department of Planning, Housing and Infrastructure
EEC	Endangered ecological community
EP	Extraction Plan
IEAPM, The Panel	Independent Expert Advisory Panel for Mining
IEAPUM	Independent Advisory Panel for Underground
LW	Long walls
TARPs	Trigger Action Response Plans
TSC	NSW *Threatened Species Conservation Act 1995*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
VWP	Vibrating Wire Piezometer

1.0 INTRODUCTION

The Metropolitan Coal Mine is an operating underground coal mine located approximately 30 kilometres (km) north of Wollongong. Development consent was granted in June 2009 and has been subsequently modified several times.

Metropolitan Coal Pty Ltd is seeking approval for an Extraction Plan (EP) for secondary coal extraction from Longwalls (LWs) 311-316. This advice will focus on evaluating the elements of the EP pertaining to LWs 311-312.

As part of the preparation of the EP, Metropolitan Coal Pty Ltd consulted with agencies to assist with the preparation of the report and the Large Swamp Assessment. The Independent Expert Advisory Panel for Mining (the Panel) was provided with the following agency advice post submission of the EP:

- Department of Planning, Housing and Infrastructure (DPHI) Resource Assessments
- WaterNSW
- Heritage NSW
- DPIRD-Fisheries
- Mining, Exploration and Geosciences
- DCCEEW (Water Group)
- DCCEEW - Biodiversity, Conservation and Science Group
- Wollongong City Council

The catalyst for requesting the Panel's advice is concerns raised by WaterNSW and BCS regarding potential impacts to swamps and water quality and the associated impacts to threatened species, watercourses and the Woronora Reservoir.

The below Figure 1 illustrates the location of the longwalls and the wider mining area.

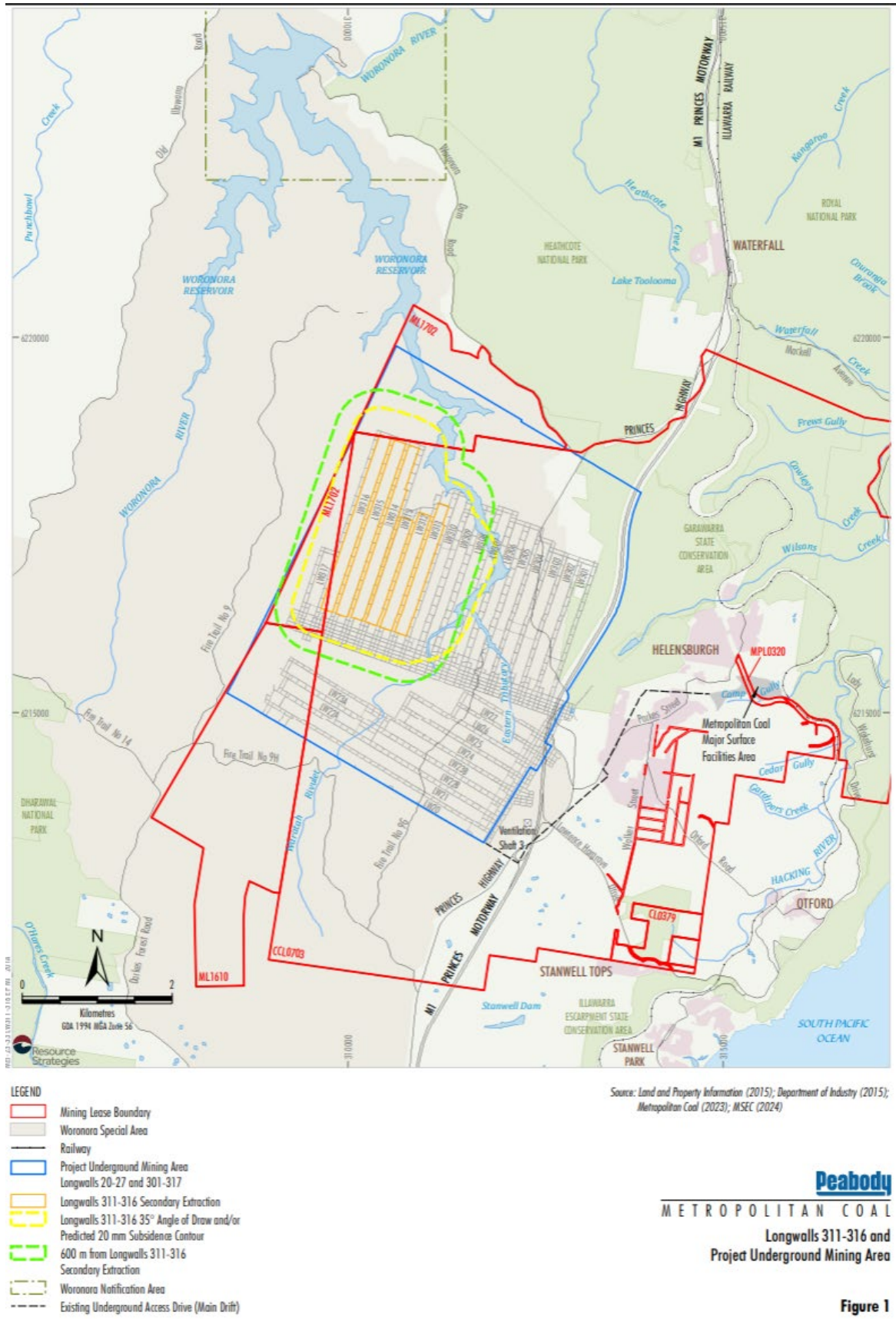


Figure 1: Map of Metropolitan Coal Longwall extraction areas

2.0 SCOPE OF WORKS

The NSW Department of Planning, Housing and Infrastructure (DPHI) established the Independent Expert Advisory Panel for Mining (the Panel). The Panel's purpose is to give DPHI and the Independent Planning Commission access to expert advice when assessing mining proposals under the *Environmental Planning and Assessment Act 1979*.

On 4 July 2024, the Director Resource Assessments, DPHI requested the Panel to provide advice in relation to the proposed EP for secondary coal extraction from LWs 311-316 at the Metropolitan Coal Mine (refer Appendix A). This follows four relevant previous sets of advice provided by the Panel and its predecessor, the Independent Advisory Panel for Underground Mining, on the Metropolitan Mine:

1. Advice Re: Water Quality Performance Measures for Metropolitan Coal Mine (IEAPM, 2023a)
2. Advice Re: Large Swamp Environmental Assessment Requirements for the Extraction Plan for Longwalls 311 to 316 (IEAPM, 2023b)
3. Advice Re: Metropolitan Coal Mine: Independent review of environmental performance to 2022 (IEAPM 2023c and IEAPM 2023d)
4. Advice Re: Metropolitan Mine Longwalls 308 – 310 Extraction Plan (IAPUM, 2022)

DPHI's Request for Advice sought advice from the Panel on the following matters:

- *Whether the Panel's previous recommendations in the documents above have been adequately addressed, in particularly in relation to large swamps and water quality modelling and monitoring;*
- *The adequacy of large swamp impact predictions presented in the Large Swamp Assessment (Appendix H of the EP) and associated appendices;*
- *The adequacy of the proposed performance measures and indicators for large swamps required by condition 4(b) Schedule 3 of the consent and included in the Large Swamp Assessment (Section 7.2), and the need or otherwise to set more defined performance measures for large swamps beyond those related to threatened species, populations, or ecological communities;*
- *The need or otherwise to modify the mine plan to minimise/avoid impacts, particularly on large swamps, and ensure compliance with existing and proposed performance measures;*
- *The adequacy of the water and swamp monitoring programs;*
- *The water and swamp TARPs and whether they;*
    - *Enable measurement of compliance with existing and proposed performance measures established under the consent and proposed in the EP for large swamps; and*
    - *Have triggers (and associated performance indictors) that adequately reflect the existing and proposed performance measures.*

The Panel should feel free to provide any other advice it considers would assist the Department in reviewing the EP.

After the initial briefing by DPHI Assessments, preliminary review of information and Panel meetings, the Panel determined a staged approach is most suitable for this project. As a result, DPHI requested that Stage 1 of the project provides the following advice:

1. Reviewing whether the Panel's previous recommendations have been adequately addressed in relation to large swamps and water quality modelling and monitoring;
2. Restricting the Stage 1 advice to LW 311 and 312; and
3. Recommending clear and timely Performance Indicators that unambiguously define when impacts on biodiversity are greater than negligible.

The Chair of the Panel (Em. Professor Jim Galvin) nominated the following members of the IEAPM to prepare the advice. Professor Neil McIntyre co-chaired this individual Panel and coordinated this advice report:

- Em. Professor Jim Galvin – Subsidence and Mining
- Mr John Ross – Groundwater
- Professor Neil McIntyre – Surface Water
- Dr Ann Young – Swamps
- Mr Nathan Garvey – Biodiversity and Ecology
- Professor David Waite – Water Quality

More background on the Panel can be viewed at Appendix B.

3.0 METHOD OF OPERATION

3.1. ACTIVITIES AND TIMELINE

The Panel convened by videoconference during the preparation of its advice and was administratively supported by the Panel Secretariat staff provided by DPHI – Major Projects Advisory.

The Panel convened on 23 July 2024 and received the supply of initial documentation and a virtual briefing. Additional information was then supplied to the Panel throughout August 2024 including a response to a further information request, post submission Agency Advice, and the Metropolitan Coal Mine response to Agency Advice.

The timeline relating to the IEAPM's assessment of the Metropolitan EP is summarised in Table 1.

Table 1: Timeline relating to IEAPM's assessment of Metropolitan Coal Mine EP.

Date	Milestone
4/7/2024	DPHI request for advice from IEAPM and supply of initial documentation
23/7/2024	Briefing from DPHI staff
23/7/2024	Panel teleconference to discuss issues and to resolve any advice queries
8/8/2024	IEAPM requested further information from Metropolitan Coal Mine
14/08/2024	Metropolitan Coal response to IEAPM questions and queries
16/08/2024	Panel teleconference to discuss issues and report structure
19/08/2024	Supply of additional information relating to response to agency advice.
23/08/2024	BCS briefing
27/08/2024	Panel teleconference to progress draft report
2/09/2024	Finalisation of IEAPM advice

3.2. REFERENCE DOCUMENTATION

Numerous key documents were provided through DPHI to support the Panel in preparing this Advice. These documents are listed in Table 2. A range of documents that the Panel has had regard to in compiling this advice are also recorded under References.

Table 2: Reference Documentation

Stage	Document Reference	Document Name
Initial documentation	Provided by DPHI	**Extraction Plan LW 311-316 including:** • Appendix 1 – Subsidence Report i. Appendix A Water Management Plan ii. Appendix B Land Management Plan iii. Appendix C Biodiversity Management Plan iv. Appendix D Heritage Management Plan v. Appendix E Public Safety Management Plan vi. Appendix F Subsidence Management Plan vii. Appendix G Coal Resource Recovery Plan viii. Appendix H Large Swamp Assessment • Appendix 2 – Subsidence Addendum Letter **Peabody Six Monthly Report** • Report and 10 attachments **Pre-submission Agency Advice** • DPI Fisheries • DCCEWW • BCS • BCS follow up • Heritage NSW • MEG • Subsidence Advisory • WaterNSW • Wollongong City Council **IEAPM High Level Review Report LW 311-316** **Metropolitan Coal Response to IEAPM Advice Report 2023** **LW 309 Waratah Rivulet TARP Results** **Metropolitan Coal Response to Submissions Letter**
Supplementary Documentation	Provided by DPHI	**Post Submission Agency Advice** • DCCEEW BCS • DCCEEW Heritage NSW • DPIRD Fisheries • DPIRD NSW Resources • WaterNSW • Wollongong City Council

Stage	Document Reference	Document Name
	Provided by Metropolitan Coal	**Response to Independent Expert Advisory for Mining Request for Information 14 August 2024** • Attachment 1 – Predicted Profiles of Subsidence, Upsidence and Closure along Tributaries • Attachment 2 - Eastern Tributary Water Levels Pre and Post Stream Remediation • Attachment 3 - Eastern Tributary Photography March 2024 • Attachment 4 – Fault Photos • Attachment 5 – Large Swamps Drone Survey **Response to Agency Advice Submissions 19 August 2024** • Appendix 1 Registered Aboriginal Parties Correspondence • Appendix 2 Subsidence Predictions based on Revised Layout, 30m and 60m Width Reductions • Appendix 3 Eastern Tributary Water Levels Pre and Post Stream Remediation Attachment 4 Metropolitan Coal Mine Eastern Tributary Stream Photos **Large Swamps and Adaptive Management** (issued 26 August 2024)

4.0 BACKGROUND

4.1. EXTRACTION PLAN AND ITS ENVIRONMENT

The proposed LWs 311 to 316 would undermine, either partially or fully, 19 Coastal Upland Swamps (Figure 2). Three of these, Swamps 76, 77 and 92 are the large swamps that are the subject of Metropolitan Coal's Large Swamp Assessment. A total of 39 swamps are located within the 35 degree angle of draw of the longwalls, including another large swamp, Swamp 106. The three main watercourses within the extraction plan area are tributaries P, R and S. These tributaries originate in Swamps 92, 77 and 76 respectively and drain to the Woronora Reservoir through the swamps and then through steep, incised valleys. The entry of Waratah Rivulet to Woronora Reservoir is just outside the subsidence-impacted area (as defined by the predicted 20 mm subsidence contour).

The groundwater system in the area may be considered, for the purpose of this advice, as having four components: the very shallow groundwater in the swamps that sits on the sandstone base of the swamps; the shallow groundwater in the sandstone underneath the swamp base which at some locations helps sustain swamp groundwater (i.e. has a hydraulic connection with the swamp groundwater); shallow groundwater in the slopes surrounding the swamps, which flows into the swamp; and deeper groundwater the surface of which is typically some tens of meters below the swamp base.

The layout of the mine and location of each longwall is shown in Figure 2 below. This shows the longwall outlines proposed in the Extraction Plan of July 2024 (Peabody 2024a), which are shortened from those proposed in the March 2024 Extraction Plan.

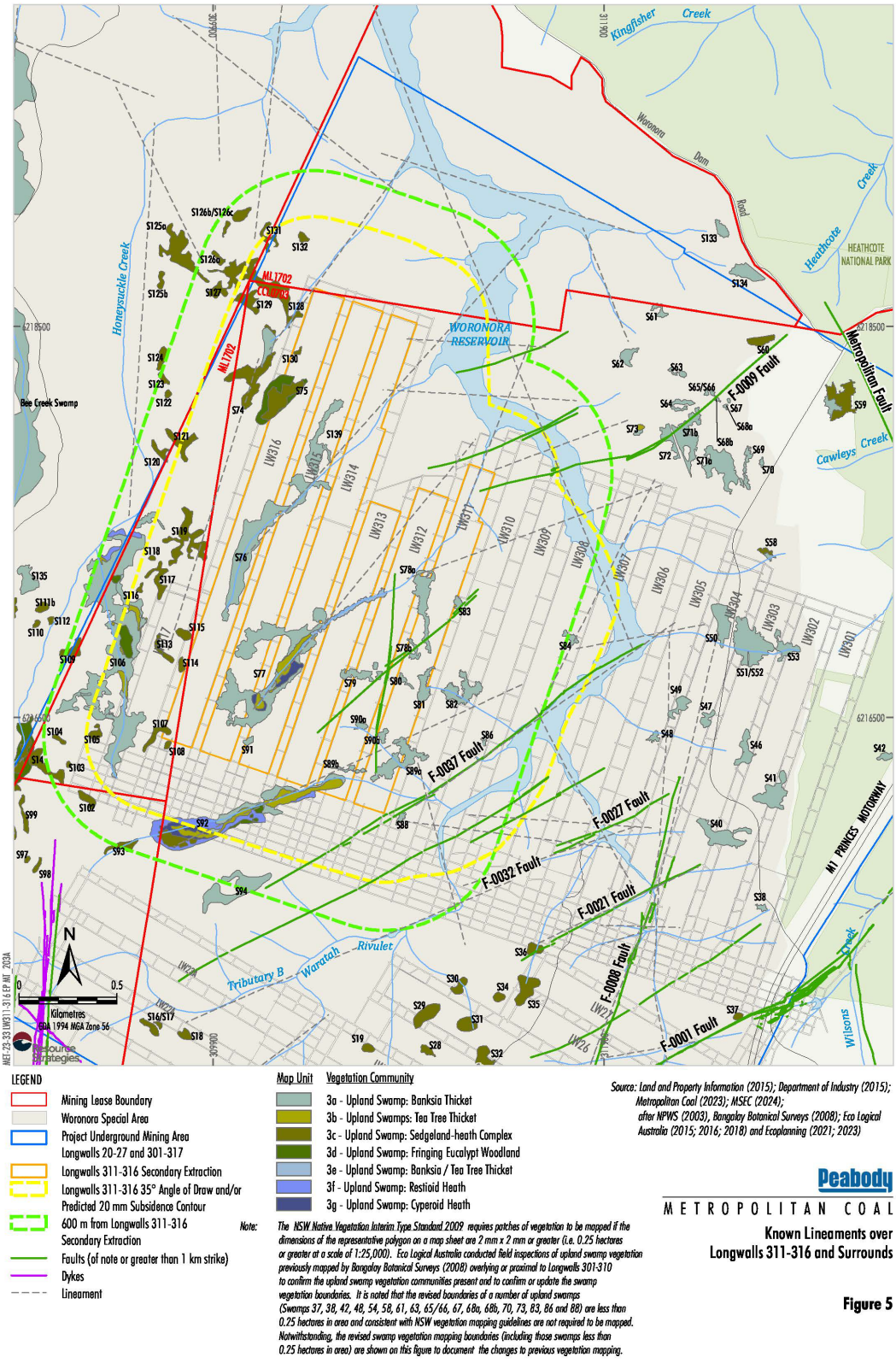


Figure 2 Longwalls 311-316 and upland swamp locations

4.2. PERFORMANCE MEASURES AND REQUIREMENTS OF CONDITION CONSENT NO. 4

The subsidence impact performance measures stated in the Consolidated Consent are described in Schedule 3 Condition 1 (Table 3).

Table 3: Subsidence impact performance measures (Table 6 of Peabody 2024a).

Water Resources	
Catchment yield to the Woronora Reservoir	Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir No connective cracking between the surface and the mine
Woronora Reservoir	Negligible leakage from the Woronora Reservoir Negligible reduction in the water quality of Woronora Reservoir
Watercourses	
Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P).	Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases)
Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases)
Biodiversity	
Threatened species, populations, or ecological communities	Negligible impact
Swamps 76, 77 and 92	Set through condition 4 below
Land	
Cliffs	Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall
Heritage	
Aboriginal heritage sites	Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts
Items of historical or heritage significance at the Garrawarra Centre	Negligible damage (that is fine or hairline cracks that do not require repair), unless the owner of the item and the appropriate heritage authority agree otherwise in writing
Built Features	
Built features	Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing

Note: The Proponent will be required to define more detailed performance indicators for each of these performance measures in the various management plans that are required under this approval (see condition 6 below).

Schedule 3 Condition 4 sets the following requirements for the large swamps (Swamps 76, 77 and 92) that are proposed to be undermined or partially undermined by LWs 311-316:

The Proponent shall not undermine Swamps 76, 77 and 92 without the written approval of the Director-General. In seeking this approval, the Proponent shall submit the following information with the relevant Extraction Plan (see condition 6 below):

(a) a comprehensive environmental assessment of the:

- *potential subsidence impacts and environmental consequences of the proposed Extraction Plan;*
- *potential risks of adverse environmental consequences; and*
- *options for managing these risks;*

(b) a description of the proposed performance measures and indicators for these swamps; and

(c) a description of the measures that would be implemented to manage the potential environmental consequences of the Extraction Plan on these swamps (to be included in the Biodiversity Management Plan – see condition 6(f) below), and comply with the proposed performance measures and indicators.

Schedule 6 Condition 6 states:

If the Proponent exceeds the performance measures in Table 1 of this approval and either

(a) the contingency measures implemented by the Proponent have failed to remediate the impact, or

(b) the Director-General determines that it is not reasonable or feasible to remediate the impact,

then the Proponent shall provide a suitable offset to compensate for the impact to the satisfaction of the Director-General.

Note: Any offsets required under this condition must be proportionate with the significance of the impact.

4.3. THE PANEL'S PREVIOUS RECOMMENDATIONS

The Panel and its predecessor, the Independent Advisory Panel for Underground Mining (IAPUM), have previously provided four sets of advice that are relevant to this current advice:

1. Water Quality Performance Measures for Metropolitan Coal Mine (IEAPM, 2023a)
2. Large Swamp Environmental Assessment Requirements for the Extraction Plan for Longwalls 311 to 316 (IEAPM, 2023b)
3. Metropolitan Coal Mine: Independent review of environmental performance to 2022 (IEAPM 2023c)
4. Metropolitan Mine Longwalls 308 – 310 Extraction Plan (IAPUM, 2022)

The recommendations from these four reports are listed in the tables in Section 5 of this Advice, along with the Panel's view on the adequacy of the Peabody responses[1].

[1] Only the responses to the second recommendation in *Metropolitan Coal Mine*: *Independent review of environmental performance to 2022* (IEAPM 2023c) is reviewed in Section 5.3; the other recommendations in IEAPM (2023c) are out of scope of this Advice.

5.0 METROPOLITAN COAL'S RESPONSE TO THE PANEL'S PREVIOUS RECOMMENDATIONS

Tables within Sections 5.1, 5.2, 5.3 and 5.4 provide an itemised review of Peabody's responses to the Panel's recommendations in IAPUM (2022) and IEAPM (2024 a,b,c).

5.1. WATER QUALITY PERFORMANCE MEASURES FOR METROPOLITAN COAL MINE (IEAPM, 2023A)

Ref	IEAPM (2023a) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
5.1.1	Performance indicators and associated trigger levels for water reaching the Woronora Reservoir should be assessed using total Fe, Mn and Al where sufficient baseline data exist. Both total and dissolved Fe, Mn and Al concentrations should be reported in six-month and annual reports.	It is proposed to monitor and report total metals as recommended at selected stream sites, noting that baseline data will not exist to allow Performance Indicators to feature total metals for LW 311-316 however total metals will be considered in cases where Performance Indicators are exceeded.	The site list for monitoring total metals (p104 of Peabody 2024a, Appendix A) is satisfactory, except that it should include the outlet of Swamp 92, site S92-GS. The approach to considering total metals for LW 311-316 is satisfactory given the lack of baseline data. Recommendation: site S92-GS water quality monitoring should include total metals.
5.1.2	Contaminant loads as well as concentrations should be considered in performance measure assessments and six-monthly and annual reporting as far as data allow. Current data limitations mean that reliance on concentrations for monthly assessment of Performance Indicators is appropriate for the current series of longwalls.	"*Metropolitan Coal will assist WaterNSW with the collection of data to undertake a Contaminant Load Assessment*". In the response to WaterNSW comments (Peabody 2024c): "*Metropolitan Coal agrees that it will take responsibility for the preparation of a contaminant load assessment. It is however noted that the contamination load assessment will be subject to the availability of suitable and complete data, which will include some WaterNSW data*".	Response satisfactory except that the time-frame for the contaminant load assessment is not necessarily satisfactory. The Panel notes that the 2024 Annual Review is not yet available on the Peabody Metropolitan Mine website, and so reliance on the 2023 Annual Review for reporting progress with the assessment (and other actions as a result of IEAPM 2023a) leaves doubt about timeliness. Reporting in a preceding six-monthly report is recommended. However, the Panel agrees that the assessment cannot reasonably be done in time to inform assessment of the LW 311-312 Extraction Plan. The Panel emphasises the importance of appropriate investment in obtaining the required data.

Ref	IEAPM (2023a) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
			Recommendation: Peabody should report progress in implementing recommendations of previous Panel advice *Re: Water Quality Performance Measures for Metropolitan Coal Mine* in six-monthly as well as annual reports.
5.1.3	Flow event water quality (including dissolved and total Fe, Mn and Al concentrations) using automatic samplers at ETWQ AU, WQWQ9 and WOWQ2 should be obtained to support analysis of contaminant loads. At the same sites, continuous measurements of electrical conductivity, pH, redox potential, and turbidity should also be obtained.	Peabody has committed to investigating the installation of an automatic sampler at site ETWQ AU. Peabody (2024c) states "*Following a meeting with WaterNSW to discuss available data, WaterNSW has provided Metropolitan Coal with a significant volume of water quality data collected by autosamplers on Waratah Rivulet and Woronora Reservoir. Metropolitan is currently reviewing this data to assess if any additional event-based water sampling is necessary to undertake a load assessment*".	The commitment implies that a preliminary investigation of loads will determine whether or not automatic samplers are needed. The Panel regards automatic sampling at all three sites as an urgent requirement for understanding loads of contaminants entering the Woronora Reservoir irrespective of outcomes of the data review or contaminant load assessment. Recommendation: Peabody proceeds as soon as practicable with event sampling of water quality using automatic samplers irrespective of the outcomes of preliminary load assessments. This applies to ETWQ AU; and also WQWQ9 and WOWQ2 if these are not covered by WaterNSW event sampling.
5.1.4	After a database of flow and concentration measurements has been built up, analysis should be conducted towards generalisation of flow-concentration relationships, and approximation of loads, and whether these have changed as mining has progressed. Initial results including total Fe, Al and Mn loads at	See above responses	See above responses

Ref	IEAPM (2023a) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	ETWQ AU, WQWQ9 and WOWQ2 should be reported in the 2024 Annual Report and updates provided in subsequent annual reports. Load estimates should be provided in future Annual Reports for Performance Indicator sites in future mining areas.		
5.1.5	For future mining areas, flow and contaminant concentrations should be measured at least two years in advance of mining at impact and control sites to allow BACI analysis.	This will be considered for future mining areas	Response satisfactory.
5.1.6	Suitable methods for improving the extension of the Eastern Tributary rating curves to improve high flow measurement accuracy should be undertaken by Peabody. WaterNSW should review whether the extension of the rating curve at the Waratah Rivulet could be improved. Selected watercourses in future mining areas should have flow gauges installed with validated rating curves. Where it is impractical to extend rating curves to high flows, alternative methods of high flow estimation should be considered	A commitment is made to investigate revising the rating curve for Eastern Tributary in the LWs 311-316 Extraction Plan and for the investigation to the reported in the 2024 Annual Review; and to investigate flow gauges in future mining areas; and to report outcomes in the Annual Review.	Response satisfactory except that rather than waiting until the 2024 Annual Report, also reporting in a preceding six-monthly report is advised. Recommendation: As item 5.1.2.
5.1.7	Temperature and water quality data should be obtained at various depths through the water column in the upper reservoir (at a location such as WDFS1 that is downstream of the entry of both the Waratah Rivulet and Eastern	A commitment is made in the Extraction Plan (Section 11.1 of Appendix A, Peabody 2024a) to "*investigate introducing a short-term sampling program in the upper Woronora Reservoir to obtain temperature and water*	The Panel considers that a "*short-term program*" is insufficient. Repeated sampling is required, and frequency of data collection should increase following significant flow

Ref	IEAPM (2023a) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	Tributary) to capture both the temperature stratification behaviour and the water quality at this point. Frequency of data collection should increase following significant flow events and following level 3 triggers for water quality reaching the reservoir.	*quality data at various depths through the water column*".	events and following level 3 triggers for water quality reaching the reservoir. Recommendation: Peabody should extend its commitment, subject to access permission, to monitoring the depth profiles of water quality of the Woronora Reservoir at WDFS1 or other suitable site to include regular (at least bi-annual) sampling throughout the remaining mining period, plus sampling following level 3 triggers for water quality reaching the reservoir.
5.1.8	An agreement be reached between WaterNSW and Peabody whereby a hydrodynamic and contaminant transport model set-up is designed to support assessments of potential mining impacts. Consideration should be given as to how the responsibility for the modelling is shared between WaterNSW and Peabody.	*Metropolitan Coal plans to work with WaterNSW regarding this recommendation. Development timing of the model to be agreed with WaterNSW and subject to collection of suitable data*.	Satisfactory. Progress should be reported in six-monthly reports and Annual Reports. Recommendation: As item 5.1.2.
5.1.9	Peabody should procure sediment cores at selected locations downstream of the confluence of Waratah Rivulet and Eastern Tributary within the reservoir and at control sites in the reservoir in order to assess the possible impacts of mining on alterations to sediment composition (with implications to	Peabody committed to investigating the suitability of gathering sediment cores in consultation with WaterNSW. Subject to consultation with WaterNSW, sediment cores will be collected at selected locations downstream of the confluence of Waratah Rivulet and Eastern Tributary within the reservoir and at control sites in the reservoir	Response satisfactory. The Panel notes importance of cores instead of grab samples for obtaining a historical record of past events and understanding its relation to mining development. While coring of soft sediments is non-trivial, it can be done using gravity or piston corers.

Ref	IEAPM (2023a) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	possible mobilisation of Fe and Mn should these sediments become anoxic).	and assessed. Time-frame: December 2024 subject to access permission.	
5.1.10	In any future mining areas, Performance Indicators and triggers should be based on loads as well as concentrations	Peabody commit to assessing loads as per previous responses.	Response satisfactory.
5.1.11	IEAPM recommended that when quality of water reaching the reservoir at Performance Indicator sites surpasses a level 3 trigger, analysis should be extended to: • once installed, water quality data collected at various depths at WDFS1 or similar site representing the confluence of the Eastern Tributary and Waratah Rivulet arms of the reservoir • if available, contaminant load estimates • if available, reference to results of a lake hydrodynamic and contaminant transport model run using relevant scenarios of increased contaminant loads.	Peabody has updated the Level 3 trigger analysis to incorporate the recommendations, noting that the assessment is to be finalised without this information if it is unavailable.	Response satisfactory, noting the importance of developing the necessary information. Recommendation: As item 5.1.7.
5.1.12	Irrespective of these recommendations for further analysis in response to triggers, the Panel recommends that a more detailed analysis be undertaken of historical reservoir	Peabody commit to do so in 2024 Annual Review if suitable data are available.	An analysis of historical water quality trends in Woronora Reservoir and their relation to

Ref	IEAPM (2023a) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	water quality and sediment cores in order to analyse potential trends and relations with mining development. This should be included in the 2023 Annual Review and updated in subsequent annual reviews		mining development would be useful even if further data cannot be obtained. Recommendation: An analysis of historical water quality trends in Woronora Reservoir and their relation to mining development should be included in the Metropolitan Coal 2024 Annual Review, and this should not be provisional on further suitable data becoming available.
5.1.13	Following IEPMC (2019), it is recommended that a broader study of potential long-term cumulative impacts of mining on water quality in the Special Areas is needed	Peabody committed to providing relevant data.	Response satisfactory.

5.2. LARGE SWAMP ENVIRONMENTAL ASSESSMENT REQUIREMENTS FOR THE EXTRACTION PLAN FOR LONGWALLS 311 TO 316 (IEAPM, 2023B)

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
5.2.1	Given that the gateroads (which determine the dimensions of LW 311) are already being driven: (a) performance measures for swamp S92 need to be specified as a matter of priority	Performance Measures for Swamp 92 and an assessment of mining-induced impacts and consequences from swamps overlying LWs 311-316 is included in the Large Swamp Assessment.	The recommendation has been met, noting item 5.2.2 below.

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	(b) the assessment of mining-induced impacts and consequences for swamps overlying LW 311 should be undertaken as a priority to provide timely warning of any need to change the width and/or the totally extracted length of LW 311	Based on the outcomes of the Large Swamp Assessment, there is no proposed change to the mining geometry of LW 311.	
5.2.2	Drivage of MG312 should be delayed until the large swamp impact assessment has been completed and the Extraction Plan for LW 311 and LW 312 has been endorsed by the Department	Metropolitan Coal has provided the Department of Planning, Housing and Infrastructure with a separate letter addressing this recommendation.	The Panel has not viewed the letter. MG312 had progressed to approximately one half the length of the proposed LW 312 by 19 July 2024 (DPHI 2024). The Panel considers that reducing the widths of the proposed LW 311 and LW 312 is not now a practical option.
5.2.3	A detailed conceptualisation of the hydrology/hydrogeology of each of the listed swamps including groundwater-surface water interactions, and a holistic assessment of connectivity with regional groundwater and groundwater dependent assets	Conceptualisation of the hydrology/hydrogeology of Large Swamps 76, 77 and 92 is included in the Large Swamp Assessment.	Satisfactory, noting that uncertainties in the conceptual model of interactions between shallow groundwater in the HBSS and swamp groundwater are yet to be addressed by additional monitoring. Recommendations related to this monitoring are in items 5.3.1 and 5.4.1 below.
5.2.4	Any updated groundwater model predictions that describe the impacts to these shallow groundwater systems, and their dependent environmental assets (i.e. stream baseflows and swamps)	Section 5.3 and Appendix B of the Large Swamp Assessment (Appendix H of Peabody 2024a) include 1D Water Balance Modelling and 2D SEEP-W modelling	The recommended modelling has been undertaken. The modelling is reviewed later in this Advice (Section 6.2) as relevant to LW 311-312.

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
5.2.5	An assessment of risk of subsidence impacts to upland swamps, including the risk of changes in groundwater levels and storage in swamp substrates and underlying weathered sandstone	A risk assessment has been undertaken for the LWs 311-316 Extraction Plan.	The relevant risks have been addressed in the Large Swamp Assessment (Section 6 and Appendix B of Appendix H of Peabody 2024a). The adequacy of the assessments is reviewed below in Section 6.2 of this Advice as relevant to LW 311-312.
5.2.6	Detailed analysis of groundwater levels and soil moisture, using the existing monitoring network, and how this relates to swamp sub-communities.	The Large Swamp Assessment will include detailed analysis of groundwater levels and soil moisture data using the existing monitoring network, and how this may relate to the mapped swamp sub-communities.	A detailed analysis of groundwater levels and soil moisture has been undertaken (Section 5.3.1 of the Large Swamp Assessment, which is Appendix H of Peabody 2024a). Monitoring data to relate to swamp vegetation sub-communities is not available
5.2.7	A commitment that prior to the commencement of extraction of LW 311, additional groundwater monitoring sites will be installed near the primary swamps, in Swamp S106 and within the western control swamps as recommended in Section 4.3.2	*Metropolitan Coal will investigate installation of additional groundwater monitoring sites near the Large Swamps, Swamp 106 and within the western control swamps*. *Where feasible, installations would be completed prior to Longwall mining within 400 metres of the site under the Longwalls 311-316 Extraction Plan*.	Response partially satisfactory. While a commitment has been made to further groundwater monitoring and a schedule provided (Peabody 2024c), this had not been implemented at time of writing this advice. Also, the subsidence predictions presented in the EP for Swamp 77 warrant additional swamp groundwater monitoring near its downstream end. Advice is provided in Sections 6.2, 6.5 and 6.6 below.
5.2.8	Revised TARPs that encompass the recommendations made by the Panel in its advice on LW 308-310 Extraction Plan, particularly improved time-independent	*It is not considered feasible to develop a workable TARP that would satisfy this recommendation. The existing upland swamp TARPs have been recommended with increased*	Not fully implemented – there are Performance Indicators and triggers nominated for swamp groundwater sites located within Swamp 76, Swamp 77 and

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	water level parameters for the paired swamp groundwater monitoring locations.	*analysis and reporting requirements to the DPHI* (Section 7.2.1 and Appendix A of the Large Swamp Assessment, which is Appendix H of Peabody 2024a).	Swamp 92, but these do not incorporate the HBSS shallow groundwater. Advice is provided in Sections 6.2, 6.5 and 6.6 below.
5.2.9	Characterisation of baseline surface flow dynamics.	*The Large Swamp Assessment will include characterisation of baseline surface flow dynamics*	Satisfactory (Appendix B of Large Swamp Assessment, which is Appendix H of Peabody 2024a).
5.2.10	Characterisation of baseline water quality at the outlet of swamp S92.	*The Large Swamp Assessment will include characterisation of baseline water quality at the outlet of Swamp 92*.	Metropolitan Coal commenced monthly water quality sampling at Swamp 92 weir (S92-GS) in December 2023 (Peabody 2024d).
5.2.11	Characterisation of the presence of drainage lines and major pools in swamp S92 to inform flora and fauna surveys, and as a baseline record of surface water storage features.	*The Large Swamp Assessment will characterise existing drainage lines/paths within the Large Swamps. There are no mapped pools within the swamps based on numerous field investigations and review of high-resolution LiDAR and aerial imagery*	Satisfactory.
5.2.12	A camera that captures images every half-hour (or less) of flow and debris conditions at the swamp S92-GS flow gauge.	*Metropolitan Coal will install a camera that captures images at daily frequency will be installed at the Swamp 92 Gauging Station (S92-GS). Additionally, a second camera will be installed at the Swamp 76 Gauging Station (G76-GS).*	Satisfactory.

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
5.2.13	A baseline survey (potentially by drone) of major pools within swamps S76, S77 and S92.	The results of a drone survey have been provided and no pools are observed. A commitment has been made to *Drone surveys of Swamps 76, 77, 92, 106 and Bee Creek will be conducted annually starting from September 2024* (Peabody 2024d)	Satisfactory.
5.2.14	Water quality monitoring at the swamp S92-GS site including a baseline period as far as practicable.	*Water quality samples will be collected from the Swamp 92 Gauging Station (S92-GS) to allow for a comparison of data between S92-GS and the water quality data collected downstream at SP1. If data is comparable, then water quality data collected at SP1 will be used as a proxy for S92-GS*. Monitoring to commence at the beginning of LW 311.	Partially satisfactory. Because LW 311-LW 316 are all predicted to have subsidence impacts at Swamp 92, water quality monitoring at S92-GS should extend until at least 6 months beyond the end of LW 316 so that subsidence impacts can be properly assessed, including distinguishing water quality consequences for the swamp outlet to those further downstream. Analyses should include total as well as dissolved metals (Fe, Al and Mn) concentrations. Recommendation: Water quality monitoring at S92-GS should extend until at least 6 months beyond the end of LW 316.
5.2.15	Development of a conceptual model (schematics) showing vegetation type, swamp gradients (including soil depths) and perched groundwater that sustains the primary swamps.	*A second conceptual model focusing on the swamps and shallow groundwater system (to the upper Hawkesbury Sandstone) was prepared as part of the Unsaturated Zone Modelling*.	Partially satisfactory. Potential refinements to the conceptual model, including new knowledge about exchanges between swamp and shallow HBSS groundwater, should be included in annual reports. Vegetation

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
			communities should be incorporated into the model. Recommendation: The conceptual models of the large swamps should be reviewed in 6-monthly reporting in light of new monitoring data, and updated to represent vegetation communities.
5.2.16	Revised baseline mapping of swamp sub-communities, using a replicable technique that will allow monitoring of changes in response to changes in hydrology. Comparison with previous mapping would be desirable.	*Metropolitan Coal has engaged Ecoplanning to prepare revised baseline mapping of Large Swamps 76, 77 and 92 using high resolution LiDAR and aerial imagery. As per the response above, Metropolitan Coal is also investigating the use of drones to improve the regular monitoring of vegetation within the Large Swamps*.	Unsatisfactory. The method used by EcoPlanning to update the mapping of upland swamps did not use a replicable technique that will allow comparison over time in relation to mining. The Panel understands Metropolitan Coal intends to include drone surveys as a part of their regular monitoring. Recommendation: The Panel encourages the company to undertake this work prior to commencement of mining noting several years of baseline survey would be beneficial. At a minimum, baseline mapping must be prepared prior to commencement of any secondary extraction.
5.2.17	If suitable access is possible, install a cross section of swamp substrate piezometers in the upper reaches of swamp S92. Piezometers should be representative of the vegetation communities, especially	*The installation of additional monitoring sites within Swamp 92 would require additional clearing of vegetation for access and monitoring equipment. Given the upper reaches of Swamp 92 are away from the secondary*	Satisfactory with respect to the current application. The Panel believes that monitoring to investigate the link between water levels, vegetation sub-community mapping and refined water balance in line

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	cyperoid heath/tea tree thicket v banksia heath v restioid sedgeland in S92.	*extraction area and that monitoring is being undertaken at three locations within the swamp, the additional impacts associated with further installations is not considered to be warranted.*	with Cairns et al. (2024) would be beneficial for future applications including Swamp 106.
5.2.18	Include an assessment of the potential impacts to swamp S106 and include this swamp in other assessment and monitoring programs for biodiversity.	*Predictions for Swamp 106 are included in Subsidence Report for the Longwalls 311-316 Extraction Plan… Metropolitan Coal will install additional groundwater monitoring sites west of the Longwalls 311-316 extraction area, including sites within Swamp 106. Baseline ecological surveys will also be conducted in Swamp 106 well prior to the commencement of Longwall 316.* Groundwater (~1 m and ~10 m depths) at three sites in S106 are planned are to be installed in 2024/2025	Satisfactory with respect to groundwater, pending confirmation of site locations and installation dates.
5.2.19	Baseline surveys for swamp related species, such as the Giant Dragonfly (Petalura gigantea), with larval surveys recommended for this species, and threatened flora species.	*Baseline surveys for the Giant Dragonfly in the Large Swamps have been undertaken by Dragonfly Environmental. No Giant Dragonflies were recorded during surveys in the large swamps. Further discussion on the surveys is included in the Large Swamp Assessment.*	Unsatisfactory. Baseline surveys for the Giant Dragonfly are considered inadequate for the purposes of providing revised impact predictions, as required by Schedule 3 Condition 6 and to inform locations of monitoring. Further detail is provided below in Section 6.
5.2.20	Baseline surveys for Littlejohn's Tree Frog (Litoria littlejohni), Giant Burrowing (Heleioporus australiacus) and aquatic	*Baseline surveys for the amphibians in the Large Swamps have been undertaken by Dragonfly Environmental. Little Johns Tree*	Unsatisfactory. Baseline surveys for the threatened amphibians are considered inadequate for the purposes of providing

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	ecology, including upland swamps and also in large pools identified in the streams below the swamps.	*Frog was recorded at Swamp 92. Further discussion on the surveys is included in the Large Swamp Assessment.* *In addition, annual amphibian monitoring has been undertaken across the Metropolitan Coal Project since 2009. This includes sites within the Longwalls 311-316 extraction area since 2019.*	revised impact predictions, as required by Schedule 3 Condition 6 and to inform locations of monitoring. Further detail is provided below in Section 6.
5.2.21	Baseline surveys for the Eastern Ground Parrot (Pezoporus wallicus).	*A research program, Conservation of the Eastern Ground Parrot on the Woronora Plateau, funded by Metropolitan Coal was conducted by the Office of Environment and Heritage (OEH). The research program involved a targeted survey for the Eastern Ground Parrot (Pezoporus wallicus wallicus) (classified as Vulnerable under the Biodiversity Conservation Act 2016) and the establishment of a network of bio-acoustic monitoring stations (35 sites) in 2013. A total of 588 days and approximately 3,000 hours of data were recorded from the stations, however, no Eastern Ground Parrots were detected. Spot checks of recordings from a range of sites, confirmed the recogniser was performing accurately (i.e. no Eastern Ground Parrot calls*). *The results of the research program were considered by OEH to indicate that Eastern Ground Parrots are not likely to be resident on*	Given this report cannot be found the Panel recommends baseline surveys are undertaken using contemporary survey techniques as a priority. Further detail is provided below in Section 6.2 and 6.3.

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
		the Woronora Plateau. The occasional records of single parrots on the Woronora Plateau in the past ten years suggest isolated birds are dispersing through the area and are not part of a larger resident population.	
5.2.22	Depending on the finding of the baseline surveys: • Incorporation of macroinvertebrate monitoring in pools into the program to document changes in macroinvertebrate assemblages as an indicator of water quality. • Nocturnal surveys for threatened frog species using standardised transects, including comparison of abundance. • Ongoing monitoring of the Ground Parrot if this species is detected.	As noted above, no pools have been identified within the Large Swamps. Amphibian monitoring programs have been implemented annually in spring/summer for LWs 20-22 (2009 – 2022), LWs 23-27 (2010 – 2022), LWs 301-307 (2015 – 2022) LWs 308-317 (2019 – 2022). All sites are displayed in Attachment 1. Fifteen amphibian species have been monitored including three threatened species: the Giant Burrowing Frog (H*eleioporus australiacus*), Red crowned Toadlet (*Pseudophryne australis*) and Littlejohn's Tree Frog (*Litoria littlejohni*). Two six-day survey periods are utilised for each spring/summer survey, typically over the periods October to December and January to February. Each site is surveyed once during a standard 30-minute general area day search (early morning and late afternoon) supplemented by an evening 30-minute search/playback session using handheld spotlights and head lamps. Within Large Swamps 76, 77 and 92, one songmeter	Satisfactory for macroinvertebrates, given the absence of suitable pools within the large swamps Unsatisfactory for frogs and Ground Parrot. The monitoring proposed is not situated located in the in an appropriate location or to be conducted using best practice methods. Further detail is provided below in Section 6.

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
		will be deployed at each of the sites sampled for a minimum of one night. As noted above, the Eastern Ground Parrot has not been identified at the Metropolitan Coal Mine.	
5.2.23	Rewording of the TARP to remove reference to the implication that surface cracking must be visible as the cause for changes in groundwater.	This recommendation has been incorporated into the LWs 311-316 Extraction Plan TARP.	Satisfactory.
5.2.24	Revise the Performance Measures (not only Performance Indicators) set for upland swamps, and TARPs that include triggers based on temporal changes to perched groundwater in the swamp sediments and the underlying weathered sandstone.	*The Performance Measures are set in the Project Approval conditions and therefore it is proposed that they remain the same in the management plans (i.e. consistent with the Project Approval).* *Metropolitan Coal and specialist consultant are reviewing and revising the TARPs as part of the Longwalls 311-316 Extraction Plan. The groundwater related TARPs for the swamps include temporal based triggers*	Not satisfactory. The proposed TARPs omit shallow groundwater in the underlying sandstone. Advice on the adequacy of the proposed performance measures, indicators and TARPs is included in Sections 6.3 and 6.6 below.
5.2.25	Prepare a comprehensive risk assessment that clearly articulates all the mining-induced risks to swamps S76, S77 and S92 including:	*The Large Swamp Assessment was prepared in consideration of the risk identified during the environmental risk assessment for the Longwalls 311-316 Extraction Plan*.	Partially satisfactory. Comments and recommendations on the comprehensiveness and clarity of elements of the Large Swamp Assessment are addressed in Section 6 of this Advice.

Ref	IEAPM (2023b) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
	• the risk of subsurface cracking and other bedrock structural changes likely to enhance vertical drainage extending beneath the swamps • the risk of accelerated drainage of shallow groundwater systems • the consequential impact to surface water and dependent ecosystems.		
5.2.26	Identify appropriate actions to avoid, mitigate or manage the environmental risks.	The Large Swamp Assessment was prepared in consideration of the risk identified during the environmental risk assessment for the LWs 311-316 Extraction Plan. The Large Swamp Assessment will include actions to avoid, mitigate or manage the environmental risk.	Partially satisfactory. Advice on the adequacy of the mine planning considerations and proposed management actions (TARPs) is given in Sections 6.4 and 6.6 of this Advice.

5.3. METROPOLITAN COAL MINE: INDEPENDENT REVIEW OF ENVIRONMENTAL PERFORMANCE TO 2022 (IEAPM, 2023C)[2]

Ref	IEAPM (2023c) recommendation	Summary of Peabody response (Peabody 2024b)	Panel's comments, conclusions and recommendations
5.3.1	Additional bores (standpipes) be established at the T6 monitoring location and at other	*Metropolitan Coal will investigate the installation of additional groundwater bores*	Satisfactory.

[2] Only the responses to the second recommendation in *Metropolitan Coal Mine*: *Independent review of environmental performance to 2022* (IEAPM 2023c) is reviewed in Section 5.3; the other recommendations in IEAPM (2023c) are out of scope of this Advice.

	accessible locations overlying the proposed LW 311 to LW 316 panels as soon as practicable to monitor the natural vertical piezometry in the Hawkesbury Sandstone below this western ridgeline area.	*at the T6 monitoring location … Investigation to be undertaken in 2024*	Recommendation: The T6 standpipes should be installed as soon as practicable to maximise their value for understanding groundwater response to mining.

5.4. METROPOLITAN MINE LONGWALLS 308 – 310 EXTRACTION PLAN (IAPUM, 2022)

Ref	IAPUM recommendation[3]	Summary of Peabody response (references listed below)	Panel's comments, conclusions and recommendations
5.4.1	Groundwater monitoring should be increased by adding two, and possibly three, additional multi-level VWP (Vibrating Wire Piezometer) bores in the vicinity of Swamps 77 and 92 to monitor the (shallow and) deep groundwater behaviour above the predicted constrained zone	VWP sites are proposed for Swamps 92 and 77 and standpipes at two sites in Swamp 76, all scheduled Q1 2025 subject to approval, weather and access (Peabody 2024c),	Partially satisfactory. Delays to installing these bores means a reduction in the baseline period and hence reduction in their value for understanding groundwater response to mining Recommendation: The proposed multi-level VWPs for Swamps 92 and 77 and standpipes at two sites in Swamp 76 should be installed as soon as practicable.
5.4.2	10 m deep bores should be added to each of the swamp monitoring points where this measurement depth is currently missing for Swamps 76, 77 and 92	Six new 10 m piezometers (two additional for each of the three swamps) are proposed to be installed in August 2024, ground conditions permitting (Peabody 2024c). The drilling for the additional monitoring bores is planned to resume 19 August 2024 (Peabody 2024d).	Satisfactory.

[3] Some of the recommendations in IAPUM (2022) are not covered here because they are not relevant to assessment of the current Extraction Plan.

Ref	IAPUM recommendation[3]	Summary of Peabody response (references listed below)	Panel's comments, conclusions and recommendations
5.4.3	a) The TARPs for Upland Swamp Groundwater monitoring should be redeveloped to employ consistent, time-independent parameter values for the triggers; b) adopt consistent TARPs across all longwalls; c) address the inadequacy of the triggers if historical substrate minimum groundwater levels are at the base of the substrate; d) review how lowering of trigger levels can occur and relate a lowering of a trigger level to assessment of impacts rather than climate variation; and e) increase the focus of the responses on assessing impacts of mining on the Swamps	a) The "time independent" recommendation by the Panel has been addressed by a note in the TARP table explaining " *Post-subsidence substrate water levels are determined by measuring the water level above the logger such that any changes in relative saturation can be determined*". b) Revised TARP tables have been proposed in the relevant management plans (Appendix A, C and H of Peabody 2024a). c, d and e) Groundwater level triggers are proposed in Appendix C of Peabody (2024a).	a) Satisfactory, although the Panel suggests that a better and simpler way to communicate impacts to swamp groundwater levels is to report changes relative to the logger height. b) Satisfactory. c) Not satisfactory - see Section 6.6 of this Advice. d) Satisfactory subject to Section 6.6 of this Advice. e) Satisfactory subject to Section 6.6 of this Advice.
5.4.4	The Panel recommends that the Level 1, Level 2 and Level 3 observed valley closure trigger values are revised and justified based on re-consideration of the relationship between risk of Type 3 impacts and observed valley closure at the Waratah Rivulet.	Table 30 of Appendix A of Peabody (2024a) (LW 311 Waratah Rivulet Valley Closure Trigger Action Response Plan) has reduced the closure triggers compared to the corresponding table in the LW 308-310 EP (Table 29 of Appendix A of Peabody 2024a) to reasonable values and with reference to history of observed closures.	Satisfactory.
5.4.5	All sites within the large swamps S76, 77 and 92 should be added to monitoring sites in this TARP. The aim is to provide early warning of any changes in these swamps.	All three existing sites within each of S76, 77 and 92 have been included in the Upland Swamp Groundwater Monitoring TARP (Table 15 of Appendix C of Peabody 2024a).	Partially satisfactory. Although all sites are included, the TARP is not explicit about how many of the sites need to be impacted prior to a trigger.

Ref	IAPUM recommendation[3]	Summary of Peabody response (references listed below)	Panel's comments, conclusions and recommendations
			Recommendation: Triggers in the Swamp Groundwater Monitoring TARP should clearly define that a trigger at any site is regarded as a trigger for that swamp.
5.4.6	The Significance levels/Triggers should be re-drafted to specify quantitative values for observed declines, the time periods over which they have occurred and the statistical difference to control swamps.	The response to a WaterNSW query regarding why the Panel's recommendation has not been adopted (Peabody 2024c), states "*The introduction of more prescriptive and quantitative triggers (e.g. specific decline limits, time-periods or statistical differences) may produce false positive triggers due to the high climatic variability and may not provide any additional useful information to enable management decisions to be made*." The Swamp Groundwater Monitoring TARP includes the footnote "*The semi-quantitative analysis includes analysis of the rate of recession from high to low water levels and analysis of rates of recovery from low to high water levels, compared to control swamps*"	Partially satisfactory. The Panel accepts that a semi-quantitative approach to assessing swamp groundwater level decline and recovery rates can be appropriate. The recession analysis method presented in Section 5.2 of Appendix B or Appendix H of Peabody (2024a), which is based mainly on visual comparison of pre- and post-mining and control site recessions is an appropriate element of the assessment. Similar approaches have worked well in mining impact assessment contexts. Because of the qualitative element: • A technical document, which clearly explains the approach and criteria used, with examples, should be referred to in the TARP and appended. This is not presently done. • TARP actions include prompter reporting of analysis results. Level 2 should lead to 6-monthly reporting and level 3 to immediate reporting. Section 5.2 of Appendix B or Appendix H of Peabody (2024a) somewhat explains and demonstrates the method; however, it mentions

Ref	IAPUM recommendation[3]	Summary of Peabody response (references listed below)	Panel's comments, conclusions and recommendations
			regression analysis but is unclear whether and how regression is incorporated and it is unclear what recovery criteria are applied and how. Recommendations: Swamp Groundwater Monitoring TARPs should include quarterly reporting of level 2 triggers and associated analysis. A stand-alone technical document, which defines how the Swamp Groundwater Monitoring TARP triggers are assessed including examples, is appended to the TARP. Further recommendations on the Swamp Groundwater Monitoring TARP are in Section 6.6 below.
5.4.7	The Panel recommends that in redrafting the swamp groundwater TARP: • The Performance Indicator should be re-worded as it implies that visible surface cracking must be the cause of changes in groundwater position within a swamp. It needs to recognise that cracking below swamp sediments is usually not discernible and that 'cracking' may include dilation of	*This recommendation has been incorporated into the Longwalls 311-316 Extraction Plan TARP*	Satisfactory.

Ref	IAPUM recommendation[3]	Summary of Peabody response (references listed below)	Panel's comments, conclusions and recommendations
	joints, rather than fracturing of intact sandstone. • '*Surface cracking within upland swamps resulting from mine subsidence is*..' should be replaced with '*Subsidence impacts are*..'.		
5.4.8	For all future approvals, Performance Measures (not only Performance Indicators) set for Swamps 76, 77 and 92 should include measures based on changes to groundwater in the swamp sediments and the underlying sandstone	*The Performance Measures are set in the Project Approval conditions and therefore it is proposed that they remain the same in the management plans (i.e. consistent with the Project Approval).* (Peabody 2024b)	Satisfactory, conditional on suitable definition of Performance Indicators and thresholds that unambiguously define a Performance Measure exceedance. Refer to Section 6.3 of this Advice.

6.0 ADVICE ON LW 311 AND 312 FOCUSSING ON THE LARGE SWAMPS

6.1. THE SIGNIFICANCE OF THE LARGE SWAMPS

BCS consider that the special significance of the swamps is "*Swamps 76, 77,92,106 (and other medium-large swamps) within the subject area have additional "significance", or "importance" which warrant special protection. This is reflected in the consent requirement for additional environmental assessment and written approval prior to undermining from the Director General (Consent authority)*" (BCS 2024b), while Peabody's view (Peabody 2024c) is "*...the identified Swamps 76, 77 and 92 are not considered to be of 'special significance' as defined by the Southern Coalfield Inquiry Report and this position has not changed as a result of the baseline data that has been collected since this report*", citing the NSW Planning Assessment Commission (2009) (PAC) conclusions that "*There is no convincing evidence before the Panel [the PAC] that identifies any individual swamp or group of swamps in the Project Area as being sufficiently unique or different so as to require identification as being of 'special significance' and thus requiring special consideration in a risk assessment framework*".

In their review of the Metropolitan Coal Project, the PAC recommended that the significance of upland swamps be reviewed on a case by case to determine whether individual upland swamps "*should be afforded 'special significance' status*" and recommended use of objective criteria, including "substantial size, unusual complexity, contiguous habitat, presence of endangered ecological community (EEC) or threatened species". In 2012 the (former) Office of Environment and Heritage (now BCS DCCEEW) drafted guidance for proponents when undertaking environmental impact assessment for upland swamps, including recommendations on interpretation of the criteria defined by the PAC. These Upland Swamp Environmental Assessment Guidelines (OEH 2012) were released in draft form. To the Panel's knowledge they were never finalised. However, it is the Panel's view that these guidelines provide a reasonable interpretation of the views of the PAC.

The Panel's assessment of Swamps 76, 77 and 92 against these guidelines is presented in Table 4 below and supports the view that two of the large swamps should be afforded 'special significance' status. Furthermore, the Panel views the intent of Schedule 3 Condition 4 as being that advances in knowledge (for example, of the large swamp hydrology and biodiversity, advances in knowledge about risks from mining, and developments in the protected status of the swamps) should be considered in setting Performance Measures and Performance Indicators for the large swamps. The Panel's view is that contemporary understanding has led to the view that the Coastal Upland Swamps in general are threatened ecological communities, as formalised under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2012 and 2014 respectively. Further, the three large swamps have large areas and large catchment areas (Table 2 of Appendix B of Appendix H of Peabody 2024a) relative to upland swamps generally and therefore, as well as having high biodiversity value, have a relatively important role in regulating flows and sediments reaching Woronora Reservoir. The Panel therefore concurs with BCS's view that the large swamps above LWs 311-316 are swamps of special significance, with Swamps 77 and 92 meeting the criteria of OEH (2012) and Swamps 76 having records of threatened species.

Table 4: Assessment of Swamps 76, 77 and 92 against criteria of special significance (OEH 2012)[4]

Criterion	Swamp 76	Swamp 77	Swamp 92
Statutory thresholds	**Yes** Community listed as Coastal Upland Swamps endangered ecological community in 2012 (post approval of the Metropolitan Coal Project). Excluding this, the swamp is known to support records of threatened species including *Leucopogon exolasius*[1], the Giant Burrowing Frog[3], Littlejohn's Tree Frog[3] and Ground Parrot[1].	**Yes** Community listed as Coastal Upland Swamps endangered ecological community in 2012 (post approval of the Metropolitan Coal Project). Excluding this, the swamps is known to support records of threatened species including Giant Burrowing Frog[3].	**Yes** Community listed as Coastal Upland Swamps endangered ecological community in 2012 (post approval of the Metropolitan Coal Project). Excluding this, the swamps is known to support records of threatened species including the Leafless Tongue Orchid (*Cryptostylis hunteriana*)[2], Prickly Bush-pea (*Pultenaea aristata*)[1], the Red-crowned Toadlet[3], Littlejohn's Tree Frog[3] and Ground Parrot[3].
Swamp size	**No** Swamp 76 is 6.0 ha in size.	**Yes** Swamp 77 is 11.4 ha in size.	**Yes** Swamp 92 is 9.9 ha in size
Unusual complexity	**No** Swamp 76 is dominated by a single community – Banksia Thicket[2]. A total of 89 species have been recorded across Swamp 76 over all survey seasons and monitoring programs.	**Yes** Swamp 77 supports Banksia Thicket, Cyperoid Heath and Tea Tree Thicket[2]. A total of 69 species have been recorded from Swamp 77 over all survey seasons and monitoring programs.	**Yes** Swamp 92 supports Sedgeland-heath Complex, Restioid Heath, Cyperoid Heath, Banksia Thicket and Tea Tree Thicket[2]. Swamp 92 shows significant surface water and is "wet" when compared to other swamps. It is also the most floristically diverse. A total of 108 species have been recorded across

[4] OEH (2012) states that a swamp should be considered of special significance if it meets three of the following criteria:
- Statutory thresholds, indicated by the presence of threatened environmental communities (TECs) or threatened species
- Swamp size (greater than 7.4 ha)
- Unusual complexity (supporting tea-tree Thicket)
- Close proximate habitat (within one of the four key clusters of swamps)
- Importance for scientific research.

Criterion	Swamp 76	Swamp 77	Swamp 92
			Swamp 92 over all survey seasons and monitoring programs.
Close proximate habitat	**No** Swamp 76 is not located within one of the four key clusters of swamps identified in OEH (2012).	**No** Swamp 77 is not located within one of the four key clusters of swamps identified in OEH (2012).	**No** Swamp 92 is not located within one of the four key clusters of swamps identified in OEH (2012).
Importance for scientific research[4]	**No** Swamp 76 is not identified in OEH (2012) and is not currently used as a reference swamp.	**No** Swamp 76 is not identified in OEH (2012) and is not currently used as a reference swamp.	**No** Swamp 76 is not identified in OEH (2012) and is not currently used as a reference swamp.

1. BioNet Atlas of NSW Wildlife
2. EcoPlanning 2024, Appendix C in Appendix H of Peabody 2024a
3. BCS – data provided to the Panel, August 2024.
4. Since 2009, the scientific value of upland swamps has been more fully recognised. The three large swamps, and particularly S92, are repositories of significant volumes of organic sediments which may represent several thousand years of climatic record. Peat at the downstream end of Flat Rock Creek Swamp gave a radiocarbon age of 1500-2000 years CalBP (Tomkins and Humphreys 2006) and sediments that had been eroded from further upstream may have been older. Sediments in the large swamps, especially S92, are likely to be of similar ages.

6.2. THE ADEQUACY OF LARGE SWAMP IMPACT PREDICTIONS

Subsidence

The large swamp impact predictions are underpinned by the subsidence predictions (Appendix I of Peabody 2024a) and revised predictions (MSEC 2024) that allow for the shortened panel lengths proposed in the most recent Extraction Plan (Peabody 2024a). The proposed layout of the panels is in Figure 1 and 2 above.

The empirical based subsidence prediction methodology is established and fit-for-purpose. Consistent with previous approval conditions and good risk management when relying on empirically based procedures, predicted versus measured outcomes have been reviewed using subsidence measurements above previous longwalls and the methodology has been updated/recalibrated to better predict field outcomes. There is a sensible reason for this recalibration, being that the mining dimensions (depth, panel width, mining height, etc) and the lateral extent over which they extend is unique and, therefore, the database on which the previous predictions were based was not fully representative. This is a characteristic of using an empirical approach. Whilst the recalibration has resulted in an increase in predicted vertical subsidence, this has resulted in only a minimal increase in associated surface tilt and strain, too insignificant to form the basis for changing associated impact and consequence predictions.

The reduction in the proposed length of some longwall panels has resulted in localised minor increases in some subsidence effects in some areas and decreases in other areas. This is a reflection that subsidence behaviour at the starting and finishing ends of a longwall panel is slightly different to that along a panel and so the revised starting positions will result in increased subsidence effects at the new starting lines. However, these are of no greater magnitude than in some other areas.

In summary, the two relevant subsidence reports, being Appendix I of Peabody (2024a) and MSEC (2024), are adequate when supported by the relevant management plans.

Groundwater

The shallow groundwater in the swamp substrates has been modelled using 1-dimensional (vertical flow) and 2-dimensional (vertical and downslope flow) hydrological models as reported in Appendix B of Appendix H of Peabody (2024a). The models have been calibrated separately for Swamps 76, 77 and 92 using the baseline piezometer data from November 2020 to December 2023. The increase in sandstone hydraulic conductivity to represent the impacts of mining is calibrated on the Swamp 20 piezometer data. The modelling is useful for quantifying the possible response of the swamp groundwater levels to increased hydraulic conductivity of the underlying sandstone due to subsidence effects. The approach to the modelling is reasonable considering the limitations of input and calibration data.

The limitations to the modelling principally relate to:

- The twofold increase in hydraulic conductivity of the HBSS used to represent the potential subsidence effect is based on observations from one site (Swamp Substrate and Shallow Groundwater Piezometer) at Swamp 20. This is a reasonable approach although it may substantially underestimate or overestimate the effect at sites in Swamps 76, 77 and 92 due to differences in subsidence impacts, differences in swamp hydrology, differences in sandstone stratigraphy and differences in connectivity to the shallow HBSS groundwater.
- To account for the relatively high subsidence effects predicted at Swamp 77, a scenario of a five-fold increase in hydraulic conductivity of the HBSS has been applied. This is conservative in terms of the overall impact on Swamp 77; however, the high values of predicted valley closure at the downstream end of Swamp 77 may lead to much higher impacts in that area than predicted by the model. This includes a moderate likelihood of fracturing of the rock bar that is a downstream control on water levels in the lower swamp (the rockbar is mapped in Appendix 5 of Appendix A of Peabody 2024a).
- The 1-dimensional and 2-dimensional models do not aim to represent potential hydraulic connection between the shallow HBSS groundwater and the swamp groundwater and the potential consequences of mining-induced drawdown of that shallow groundwater. If that groundwater drains (horizontally and/or vertically) due to subsidence impacts, its contribution to the swamp inflow from sideslope areas or its role in preventing or reducing downward hydraulic gradients from the swamp will be adversely impacted.
- The 1-dimensional and 2-dimensional models do not aim to represent the propagation of loss of water at a rockbar control to further upstream in the swamp.
- Limitations in supporting data include lack of in-situ climate data, limited spatial coverage of swamp groundwater measurements in the large swamps, limited period of flow data for the large swamps, uncertainty in soil moisture data due to lack of calibration of sensors to local soils, and lack of soil property data to define hydraulic properties including the storage function.

In summary, the swamp water balance and swamp groundwater modelling is reasonable given the data available; however, due to its various limitations, little weight should be attached to the conclusion in the Large Swamp Assessment that "*The predictions of the large swamp unsaturated zone modelling*

indicate the following (ATC Williams, 2024): The mining-related effects to Swamp 76 and Swamp 92 are expected to be minor with the water levels predicted to remain above the base of the substrate".

The possibility of leakage as mining intersects mapped faults was considered in Appendix G of Peabody (2024a). Three faults – F0037, F0051 and F0053 - are mapped intersecting LWs 311-316. No moisture had been evident in association with F0037 during mining of longwalls since LW 306 and photographs provided at seam level in LW 310 confirmed this (Peabody 2024e).

Surface water

The surface water predictions (Appendix B of Appendix H of Peabody 2024a) address potential water losses from within Swamps 76, 77 and 92 due to subsidence effects. These are modelled using the 2-dimensional swamp water balance model and impact scenarios as reviewed above. Based on the assumption that the basal seepage losses translate to baseflow losses at the swamp surface flow outlets, the modelling implies that the surface flow losses from swamps may be minor to negligible. This is possibly correct; however, given the preliminary state of the modelling as reviewed above, the predictions of potential surface water losses are not a strong basis for assessing environmental consequences.

It should also be noted that the hydrologic model does not include water quality aspects with increased penetration of surface waters to the subsurface and increased rate of groundwater transport in the subsurface as a result of fracturing almost certain to increase discharge of elements such as Fe, Mn and Al to surface streams and, eventually, Lake Woronora.

The Panel does not consider it necessary that additional surface water monitoring or modelling are undertaken prior to determination of the Extraction Plan for LW 311 and 312 because this would not achieve the level of accuracy required to instruct decisions within the relevant timeframe. Nevertheless, updating the models and their predictions annually is useful to refine understanding of reasons for any observed subsidence consequences and to refine predictions for subsequent longwalls.

It is recommended that updates to the 1-dimensional and 2-dimensional models and their predictions should be undertaken in annual reviews to refine understanding of reasons for any observed subsidence consequences and to refine predictions for subsequent longwalls.

Biodiversity

Impacts to biodiversity values are outlined in the Biodiversity Management Plan (Appendix C of Peabody 2024) and Large Swamp Assessment (Appendix H of Peabody 2024a).

The key impact to terrestrial biodiversity, particularly amphibians, will arise from reduced streamflow and/or reduction in pool water levels which provide habitat for breeding frogs. Subsidence impacts, including cracking of bedrock, leakage from pools and diversion of surface water flow, is predicted to occur along the lower lengths of Tributaries P, R and S given predicted valley closure levels (Appendix I of Peabody 2024a and MSEC 2024). If subsidence impacts do occur along these tributaries, this is highly likely to result in impacts to threatened species where they are present (presence is indicated in the BCS survey results presented to the Panel on 23 August 2024), particularly the Littlejohn's Tree Frog and Giant Burrowing Frog who both rely on pools for breeding. If these impacts do occur, and result in loss of breeding habitat, they are unlikely to be considered negligible.

The Biodiversity Management Plan (Appendix C of Peabody 2024a) predicts that while there may be subsidence impacts such as surface cracking, changes to hydrological impacts, localised impacts to riparian vegetation, reduction in quality of terrestrial habitat and potential for a reduction in pool water

levels, this *"does not change the assessment of environmental consequences on terrestrial fauna and their habitats provided in the Project EA and Preferred Project Report"* (Appendix C of Peabody 2024a, p.91). It is the Panel's view that baseline surveys for threatened frogs are inadequate. As such, the Panel lacks confidence in the impact predictions that there will be no significant impacts and that a negligible impact to threatened species can be achieved. These baseline surveys are a key part of developing the impact predictions and would be used to design suitable mitigation strategies and inform ongoing monitoring. The following outlines the Panel's concerns.

- Survey locations are generally unsuitable and do not target key habitat at risk of impact. The majority of survey locations are located along access tracks; these areas provide minimal habitat for the threatened frog species targeted, other than habitat for the Red-crowned Toadlet in drainage channels. Survey locations in the upland swamps shown in the Large Swamp Amphibian Assessment (Appendix D to Appendix H of Peabody 2024a) are generally in the mid to upper reaches of the swamps and are less suitable. Surveys have not been undertaken along streams at the base of and below the upland swamps which include breeding habitat at greatest risk of impact. Additional survey locations are required.

- Surveys have generally not been conducted at an appropriate time of year for the Littlejohn's Tree Frog and Giant Burrowing Frog. Surveys for the Littlejohn's Tree Frog should be conducted between July and November. Surveys for Giant Burrowing Frog should be conducted between February and May to maximise detection of tadpoles and should be conducted within one week of heavy rainfall to maximise detection of adult frogs. Two survey periods are required.

- Survey methods are unsuitable for the species. Daytime searches for these frogs are unsuitable, with nocturnal surveys required. A single 30-minute search and call playback session is insufficient survey effort to reliably detect these species. The NSW Survey Guide for Threatened Frogs (NSW DPIE 2020) requires 480 minutes across four replicates (120 minutes per replicate) for every 500 m transect for Littlejohn's Tree Frog and 960 minutes across eight replicates (120 minutes per replicate) for every 500 m transect for the Giant Burrowing Frog. Acoustic recorders are not recommended for surveying for the Red-crowned Toadlet or Giant Burrowing Frog (DPIE 2020) and should be restricted to use for the Littlejohn's Tree Frog. As such, they cannot be used to replace other survey methods.

The inadequacy of surveys is demonstrated by surveys presented to the Panel by BCS at the meeting of 23rd August 2024. These surveys were undertaken by BCS over 5 days and 2 nights in September to November 2023 using a combination of aural visual surveys (2 nights in Swamp 92, no effort in Swamp 76 or 77), tadpole searches (3 half days in Swamp 92 and 3 days in Swamp 76, no effort in Swamp 77) and acoustic surveys (2 devices in Swamp 77 – yet to be retrieved). Littlejohn's Tree Frog and Red-crowned Toadlet were observed in Swamp 92 and Tributary P below Swamp 92. The Giant Burrowing Frog was recorded at the upstream extent of Swamp 77. Littlejohn's Tree Frog and Giant Burrowing Fog were observed in Swamp 76 and in Tributary S below Swamp 76.

Further baseline surveys are required for these threatened frog species, using appropriate survey methods and effort, conducted at a suitable time of year with survey locations targeting breeding habitat through the upland swamps (where present) and along suitable reaches of Tributaries P, R and S.

Impacts to upland swamps may arise from fracturing of bedrock below swamps and changes in groundwater within and below the swamps. The EP predicts that *"cracking of the bedrock beneath the swamps is expected to be isolated an of a minor nature"* (Appendix I of Peabody 2024a, p.49). At the Metropolitan Coal Mine, impacts to the shallow perched groundwater system in the upland swamps has been limited to observations in Swamps 20 and 28 to date with consequent changes in vegetation

observed in Swamp 28 (Appendix A to Peabody 2024a). However, it is noted that the majority of swamps mapped over LWs 20-27 and 301-310 are valley side swamps, except for Swamp 20 which is a valley infill swamp (EcoPlanning 2024). Swamp 21, an unmonitored swamp, is also a valley infill swamp. In their submission, BCS (2024a) noted that '*no impacts... on upland swamps*' were predicted in the 2008 Environmental Assessment for the Metropolitan Coal Project, which was approved in 2009. BCS presented to the Panel the view that of the swamps above or to the side of Metropolitan Colliery longwalls, nine swamps (Flatrock Swamp, S16, S17, S20, S21, S25, S46, S51 and S50 have been hydrological impacted) while five monitored swamps (S35, S40, S52, S53 and S72) appear to not have been impacted. Flat Rock Swamp and Swamp 21 are relatively large valley infill swamps.

There are a number of threatened species with potential to rely on the upland swamps, including the Giant Dragonfly and Ground Parrot. The soil moisture profiles for Swamps 77 and 92, especially S92, show that high soil moisture conditions persisted at depths accessible by Giant Dragonfly larvae from November 2020 to November 2023, despite dry climatic conditions during this time. Hence these sites may provide important habitat for these species.

As for the threatened frogs, it is the Panel's view that baseline surveys for the Giant Dragonfly are inadequate. As such, the Panel lacks confidence in the impact predictions provided. Baseline surveys for the Giant Dragonfly were undertaken on three days in October 2023, November 2023 and January 2024. Of these dates, only January 2024 surveys were undertaken with the recognised survey period for the species (December to mid-January). Surveys across all three large swamps are limited to a single day. Review of survey effort (Figure 3.1 in Appendix D to Appendix H of Peabody 2024a) also indicates that surveys have sampled a very small portion of the upland swamps – it is unclear what survey effort was taken on which day. Surveys undertaken by BCS using eDNA sampling in Swamp 92 and Swamp 14 detected the Giant Dragonfly in Swamp 14. Swamp 14 is located less than one kilometre to the west of Swamp 92. No sampling by the company's consultants was undertaken in Swamps 76 or 77. Given these results, the Panel believes that additional surveys are required for Swamps 92 and 77 (and Swamp 76) using best practice methods. In their advice, BCS recommends systematic surveys are undertaken using a mix of surveys for exuviae and adults, with surveys to be undertaken in December and early-mid January. Given the limited expense and time involved, the company may wish to undertake eDNA surveys at the base of Swamps 77 and 92 (and Swamp 76) during an appropriate time of year to determine whether the species are present. If they are detected, additional surveys are recommended to understand the distribution of the species in these swamps. The Panel recommends the company engage with BCS in developing a suitable survey method.

No survey has been undertaken for the Ground Parrot, with Metropolitan Coal stating that extensive surveys were undertaken in 2013 as a part of the research project Conservation of the Eastern Ground Parrot on the Woronora Plateau. The Panel has been unable to sight this report and, as such, is unable to review the extent of surveys in relation to LWs 311 and 312 and is unable to determine whether surveys methods align with more contemporary techniques. It is the Panel's view that given this report cannot be found that baseline surveys are required to be undertaken as a priority using contemporary survey techniques.

6.3. THE ADEQUACY OF THE PROPOSED PERFORMANCE MEASURES AND INDICATORS FOR LARGE SWAMPS

Performance Measures

The Extraction Plan proposes that the Performance Measures relevant to the large swamps are unchanged from the those in preceding Extraction Plans, being:

- *Negligible impact on Threatened Species, Populations, or Ecological Communities*
- *Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir*

The Panel notes that the Performance Measure for Negligible Impact on Threatened species, Populations and Ecological Communities is defined in the Extraction Plan as applying to '*Threatened species, populations and ecological communities include those listed under the TSC Act, EPBC Act or Fisheries Management Act 1994 at the time of Project Approval (i.e. the lists current as at 22 June 2009)*'. In that case, the Performance Measure would not apply to an Upland Swamps as an ecological community, because Upland Swamps were listed in 2012 and 2014 under the TSC Act and EPBC Act respectively.

However, the Panel interprets the intent of Schedule 3 Condition 4 as being that the Performance Measure may be revised or redefined in light of advances in knowledge (for example, of the large swamp hydrology and biodiversity, advances in knowledge about risks from mining) and the current status of Coastal Upland Swamps as threatened ecological communities. Therefore, the Panel's advice on Performance Measures and Performance Indicators is not constrained by the definition of threatened species, populations and ecological communities at the date of project approval.

Impacts to threatened species such as the Giant Burrowing Frog, Littlejohn's Tree Frog, Red-crowned Toadlet, Giant Dragonfly and Eastern Ground Parrot (which were listed under the TSC Act at the time of the project approval) can be assessed in accordance with the existing and company-proposed Performance Measure requiring negligible impact.

In its previous advice (IEAPM 2023b), the Panel advised "*Revise the Performance Measures (not only Performance Indicators) set for upland swamps, and TARPs that include triggers based on temporal changes to perched groundwater in the swamp sediments and the underlying weathered sandstone*." This advice was based on the view (IAPUM 2022, IEPMC 2019) that: *By definition, swamps are groundwater-dependent ecosystems. Therefore, a change in piezometric levels should be the primary gauge of impacts on the ecosystem. If maintenance of ecosystem functionality is to be mandated for any swamp, then piezometric variation must be used not only in the TARPs but also in performance measures.*

The current Panel maintains that view. If the Performance Measure is solely vegetation or biodiversity-based (rather than also groundwater-based), due to the long timescale (possibly decades) for biodiversity to react to groundwater changes, identification and management of a Performance Measure exceedance may be challenging and unsuccessful. This arguably applies to all the upland swamps that are subject to subsidence impacts, but particularly applies to the large swamps where a high level of confidence that impacts are detected and managed is warranted. To satisfy the Panel's concern, either the previous recommendation "*Revise the Performance Measures (not only Performance Indicators) set for upland swamps…*" should be applied to the large swamps 76, 77 and 92; or, accepting Peabody's proposed Performance Measure, the exceedance of an appropriately specified groundwater Performance Indicator and trigger should translate directly and irrespective of any subsequent vegetation or biodiversity assessment to an exceedance of the Performance Measure. The rest of this advice is based on the latter viewpoint, noting that new Performance Measures may be needed if suitable

groundwater triggers cannot be developed. The proposed Performance Measure *Negligible impact on Threatened Species, Populations, or Ecological Communities* is considered acceptable by the Panel on that basis.

The Performance Measure *Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir* is acceptable.

Large swamp groundwater Performance Indicators

The proposed groundwater Performance Indicator that addresses the Performance Measure *Negligible impact on Threatened Species, Populations, or Ecological Communities* for the large swamps is:

- *Subsidence impacts are not expected to result in measurable changes to swamp groundwater levels when compared to control swamps or seasonal variations in water levels experienced by upland swamps prior to mining*.

The Upland Swamp Groundwater TARP (Table 1 of Appendix A of Peabody 2024a) implies that a level 3 trigger of that TARP equates to the Performance Indicator being exceeded. Peabody's proposed actions following that trigger include increasing the frequency of data analysis, initiating assessment against the performance measure for threatened species, and considering the need for management measures. Hence, exceedance of the proposed Performance Indicator (i.e. thresholds defined in the level 3 trigger) would not directly define an exceedance of the Performance Measure. The Panel concludes that:

- Because of the potentially long time-delay between exceedance of the Performance Indicator and measurable impacts on biodiversity, for the large swamps, it is not suitable to rely on the action "*Initiate assessment against the performance measure for threatened species*" before determining an exceedance of the *Threatened Species, Populations, or Ecological Communities* Performance Measure.
- The groundwater trigger that defines an exceedance of the Performance Indicator (i.e. the highest-level trigger in the large swamp groundwater TARP) should translate directly to exceedance of the Performance Measure for the large swamps, hence the action "Initiate assessment against the performance measure for threatened species" should be deleted.
- The proposed Upland Swamp Groundwater Performance Indicator is adequate for the large swamps subject to a suitably defined trigger.
- Recommendations regarding the trigger are in Section 6.5 of this advice and include changes in groundwater levels and recession rates and at levels 2 and 3, changes to 10m groundwater levels and soil moisture changes.

It is recommended that the action "*Initiate assessment against the performance measure for threatened species"* is removed from the highest-level Upland Swamp Groundwater TARP so that the trigger of this TARP defines an exceedance of both the Performance Indicator and the Performance Measure for the large swamps without reliance on potential biodiversity changes.

Recommendations regarding the trigger are in Section 6.6 of this advice.

Surface water Performance Indicators

The proposed Performance Indicators that address the Performance Measure *Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir* are adequate for the purpose of LW 311 and 312, with detailed advice on their longer-term applicability, including the need to move towards assessing loads of total metals, given in IEAPM (2023a).

Swamp vegetation Performance Indicators

In light of the recommendation above regarding the groundwater Performance Indicator, and subject to the recommendations around trigger levels and actions/response outlined in Section 6.6, the Panel is of the view that the Performance Indicator under Upland Swamp Vegetation Monitoring is unnecessary. It is recommended that the Performance Indicator under Upland Swamp Vegetation Monitoring is removed (while maintaining the monitoring, annual reporting and TARP).

Biodiversity Performance Indicators

For biodiversity, as for other issues, the performance measure, Performance Indicators and trigger levels proposed do not differ from those for LWs 308-310 and the current Performance Indicator is:

The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites.

The Performance Indicator has been taken to refer to *"the amphibian assemblage (17 amphibian populations) as a whole"* (Appendix C of Peabody 2024a, p. 64). This interpretation does not represent the intent of the Performance Measure with the intended focus on threatened species. The Performance Indicator should only refer to threatened species, with exceedance of the Performance Indicator reviewed by species and monitoring location. For example, a greater than negligible impact on a threatened species along one tributary would represent an exceedance if control sites showed no change and the decline occurred over successive monitoring periods. The Panel recommends the Performance Indicator be refined to focus on reductions in frog populations along monitoring transects.

Performance Indicators may be required for additional threatened species if these species are detected during targeted surveys to recommended by the Panel.

Further detail is provided in Section 6.5.

6.4. THE NEED OR OTHERWISE TO MODIFY THE MINE PLAN

Constraints on modifying the mine plan for LW 311 and LW 312 related to the current status of mining

The maingate between LW 312 and LW 313 (MG312) had progressed to approximately one half the length of the proposed LW 312 by 19 July 2024 (DPHI 2024). The Panel understands that reducing the widths of the proposed LW 311 and LW 312 is now not a practical option; however, it does not constrain options for shortening LW 311 or LW 312.

Risks that might be managed by modifying the mine plan (LW 311 and LW 312) and assessment of options

Water quality. Risks to the quality of water reaching Woronora Reservoir stem from the potential generation of metal-rich runoff due to water diversions through subsidence-induced fractures both within and downstream of the swamps, and from potential erosion of the swamps. The predicted valley closures in the tributaries (P, R and S) downstream of the swamps following LW 311 and 312 are up to approximately 800 mm, which, based on previous experience in the Southern Coalfield (the "rockbar

model"), will likely lead to extensive Type 3[5] fracturing of the tributary base and its rockbars. This is acknowledged in the Extraction Plan. This will lead to pulses of water of deteriorated quality and, additionally, may contribute to longer-term water quality consequences as explained in IEAPM (2023a). These potential consequences to Woronora Reservoir and recommendations on their management are covered in IEAPM (2023a).

Swamp 92. Following LW 312, maximum valley closure within Swamp 92 is predicted to be approximately 70 mm (Peabody 2024a and MSEC 2024). Following LW 316 this increases to 100 mm. Predicted compressive and tensile strains are up to approximately 1 mm/m after LW 316 (data not available for LW 312). Peabody (2024) includes an analysis of options for shortening LW 312 by 130 m or 260 m. The latter is predicted to halve maximum curvature to 0.03 that translates to halving tensile strains to less than 0.5 mm/m, which is considered by the Panel to equate to a very low risk of subsidence impact. The predicted valley closure for the original proposal and also for the two shortening options correspond to a near-zero likelihood of Type 3 fracturing.

The Panel considers that, of the three large swamps, Swamp 92 is the most significant. This swamp is of special significance, as it is large and highly complex, supporting all sub-communities within the Coastal Upland Swamp EEC. It has a significant perched groundwater system and stable high soil moisture levels from the surface to its base at approximately 1200 mm. Hence, it provides suitable habitat for a number of threatened species. Baseflow from this swamp also supports pools downstream which are habitat for Littlejohn's tree frog, based on the BCS Survey (presentation to the Panel on 23 August 2024). Hence, Swamp 92 should be regarded as a priority for minimising risk. The proposed extent of LW 312 (i.e. with no shortening at southern end) leaves a low likelihood that conventional strains or valley closure will lead to fracturing with rapid consequences for swamp hydrology, ecology, and possibly sediments and water quality. Nevertheless, even if cracks are small, and even if they are infilled with fine colluvial sediments, this will not necessarily maintain in the long-term the perched groundwater in the swamp – infilled cracks are still higher permeability pathways than is naturally the case. Although the likelihood of impacts that would lead to exceedance of the Performance Indicators is low, the Panel considers the risk (likelihood x consequence) to be moderate and incommensurate with the high value of Swamp 92, and easily managed by shortening of LW 312 by 260 m.

It is recommended that the southern end of LW 312 is shortened by 260 m to minimise risks to Swamp 92.

Swamp 77. Following LW 312, the maximum valley closure within Swamp 77 is predicted in the Extraction Plan to be approximately 175 mm at the downstream end of the swamp, reducing rapidly in the upstream direction. Following LW 316 the predicted maximum valley closure is up to 325 mm. Tensile strains are predicted to be up to 0.5 mm/m after LW 316 (data not available for LW 312). LWs 312 and 313 have the greatest (both >100 mm) incremental effect on predicted valley closure at the downstream end of Swamp 77. It is likely that one or both of these longwall panels would need to be shortened to provide a high degree of protection to the swamp base and rockbar at the downstream end of Swamp 77 (i.e. the rockbar shown in Figure 14 of Appendix 5 of Appendix A of Peabody 2024a). A degree of protection would be provided by reducing panel widths of LWs 313 to 316 (Peabody 2024d). A 60 m reduction in the width of all these panels would reduce predicted valley closure at the downstream of Swamp 77 from 325 mm to approximately 180 mm. Generally, in the Southern Coalfields, 180 mm predicted valley closure has been associated with a low (< 10%) likelihood of Type 3 rockbar fracturing. If the currently proposed mine plan progresses and non-minor subsidence impacts to the Swamp 77 rockbar occur, consistent with the Panel's advice on large swamp groundwater

[5] Type 3 fracturing is fracturing which has resulted in pool water levels dropping more than expected after considering the rainfall and surface and groundwater flow conditions. The Southern Coalfields "rockbar model" indicates that likelihood of Type 3 fracturing is zero when predicted valley closure is less than 80 mm, and less than 0.05 when predicted valley closure is less than 160 mm (IEPMC 2019).

Performance Indicators, this is likely to lead to the conclusion that the Performance Measure has been exceeded. While grouting of rockbar fractures has been a successful management measure at other locations for repair of rockbars, it is not useful if the bedrock below swamps has been cracked so the groundwater levels are compromised (IEPMC 2019). Also, the difficult accessibility of this part of Swamp 77 may discount grouting. The Panel concludes that, if shortening of LW 312 and LW 313 or reduction of (one or more of) LW 313-316 panel widths by at least 60 m to protect Swamp 77 are not considered appropriate for economic or other reasons, then it is highly likely that the large swamp groundwater Performance Indicator will be exceeded. As commented on below in this Advice, monitoring of groundwater levels, pool levels and rockbar fracturing in this area of Swamp 77, including a sufficient baseline period, would be required to assess impacts. The Panel is concerned also that impacts at the downstream end could lead to lowering of water levels, soil moisture and potentially gully erosion progressing upstream through the swamp.

It is recommended that Metropolitan Coal should provide DPHI, prior to a decision regarding approval of LW 311 and LW 312, further justification of why the predicted subsidence impacts in the downstream length of Swamp 77 may be considered acceptable, including evaluation of the feasibility of shortening of one or both longwalls.

It is recommended that, if the currently proposed layouts of LW 311 and LW 312 are approved, then within 6 weeks of this Advice being submitted to DPHI (so that it can be considered by the Panel in Stage 2 of this Advice), Metropolitan Coal should submit to the DPHI a site-specific contingency plan that explains how non-minor fracturing in the downstream length of Swamp 77 (including its rockbar, base of tributary, and underneath the swamp soil) would be managed.

Swamp 76. The maximum predicted valley closure is up to approximately 130 mm after LW 316. Tensile strain is up to 1.0 mm/m, which reduces to less than 0.5 mm/m under both (30 m and 60 m) scenarios of panel width reduction. For the proposed and reduced panel widths, the impacts of LW 311 and 312 on Swamp 76 are predicted to be negligible (i.e. indiscernible in the MSEC 2024 or Peabody 2024d results). Further, Table 4 concludes that this swamp does not meet the OEH (2012) criteria of special significance. The Panel concludes that further consideration of risks to Swamp 76 and management considerations should be given in Stage 2 of the Advice.

Tributary S. Recent surveys by BCS have identified a population of Littlejohn's Tree Frog and Giant Burrowing Frog in Tributary S, both within Swamp 76 and downstream of the swamp to the waterfall. The maximum predicted valley closure is less than 50 mm after LW 312 and up to approximately 250 mm after LW 316. For the proposed panel widths, the impacts of LW 311 and 312 on Tributary S are predicted to be negligible (i.e. indiscernible in the MSEC 2024 or Peabody 2024d results). The Panel concludes that further consideration of risks to threatened species habitat within Tributary S and management considerations should be given in Stage 2 of the Advice.

Further consideration of impacts to Tributary R may be required following completion of targeted surveys.

6.5. THE ADEQUACY OF THE WATER AND SWAMP MONITORING PROGRAMS

Subsidence

The proposed Subsidence Monitoring Program (Appendix F of Peabody 2024a) is adequate for the purpose of LW 311 ad LW 312, except that there is a need for a transverse subsidence monitoring line towards the northern end of LW 311, cutting across LW 311 towards the northern end of LW 316 to monitor subsidence behaviour within the zone of influence of Woronora Reservoir.

It is recommended that Metropolitan Coal should revise the Extraction Plan to include a transverse subsidence monitoring line towards the northern end of LW 311, cutting across LW 311 towards the northern end of LW 316 monitor subsidence behaviour within the zone of influence of Woronora Reservoir.

Groundwater

In a response to agency comments, Peabody (2024d) presents the status of groundwater monitoring in and under the swamps including a schedule for installing the remaining bores. As noted in Section 5.5 of this Advice, the proposed swamp and shallow HBSS groundwater monitoring meets the previous recommendations of the IAPUM (2022) and IEAPM (2023b) if it is installed prior to commencement of LW 311. There are three piezometers measuring shallow swamp groundwater levels in each of the three large swamps, all installed in November 2020. There is one HBSS (~10 m depth) piezometer already installed in each of the three swamps co-located with a swamp piezometer. Two further HBSS piezometers per swamp were proposed to be installed in mid-2024, but delays caused by adverse weather and ground conditions mean these were not installed (Peabody 2024d). The current absence of baseline data at these six proposed shallow HBSS (~10m) sites is not ideal with regards to the minimum baseline data recommended to support the Panel's advice regarding TARPs (see commentary in Section 6.6 below). These sites should be installed as soon as practicable, and the limited baseline period at these sites will need to be considered in the design of the TARPs if they are revised according to this Advice. The proposal for deeper groundwater monitoring at the large swamps (as in page 17 of Peabody 2024c and in Section 11.2 of Appendix A of Peabody 2024a) is satisfactory, noting that it should be installed as soon as practicable.

It is recommended that Metropolitan Coal continues its endeavours to install the planned shallow and deep groundwater monitoring in/near the large swamps as soon as practicable and prior to commencement of LW 311.

If the proposed layout of LW 311 and 312 is approved, given the likelihood of impacts at the lower end of Swamp 77 that might not be observed at the other Swamp 77 monitoring sites, a shallow swamp groundwater monitoring piezometer is needed near to the end of Swamp 77 at its downstream extent. If safely accessible, rockbars and pools within the lower end of Swamp 77 should also be monitored for loss of water and visual impacts (fracturing and iron staining). If the proposed mine plan is approved, an unsatisfactory baseline period will be achievable at the piezometer location (estimated as only 2 months – see Table 5). The Panel does not see any solutions to this. Unless a suitably designed TARP can be provided for this location that does not rely on a swamp groundwater baseline, or unless the mine plan is delayed to allow an adequate baseline (including a sample of swamp groundwater recessions and recoveries covering a range of dry and wet conditions prior to possible subsidence impacts), then based on the subsidence predictions it may be reasonable to assume that the groundwater Performance Indicator is exceeded at this location irrespective of measurements.

It is recommended that a shallow swamp groundwater monitoring piezometer is installed near to the end of Swamp 77 at its downstream extent; and, if safely accessible, rockbars and pools within the lower end of Swamp 77 should also be monitored for loss of water and visual impacts (fracturing and iron staining).

It is recommended that if no satisfactory monitoring, including baselines, can be installed to assess impacts to the downstream end of Swamp 77 and if the proposed layout of LW 311 and LW 312 progresses then the large swamp groundwater Performance Indicator should be assumed to be exceeded over at least the valley infill area of this swamp.

Table 5: The Panel's approximate estimates of achievable baseline periods at proposed/recommended swamp groundwater monitoring sites if the proposed mine plan schedule is approved.

Site	Start date of LW that will be within ~400 m of site	Assumed start of baseline period	Estimated baseline period (months)
Swamp 77 shallow piezometer (recommended site at lower end)	Nov 2024 (LW 311)	Sept 2024 (hypothetical earliest possible date)	2
S92-1 HBSS piezometer (southern)	March 2025 (LW 311)	Aug 2024 (assumed based on Peabody 2024e)	8
S77-1 HBSS piezometer	Feb 2025 (LW 311)	Aug 2024 (assumed based on Peabody 2024e)	6
S76-1 HBSS piezometer	Jul 2025 (LW 312)	Aug 2024 (assumed based on Peabody 2024e)	12

As mining progresses past faults F-0037, F-0053 and F-0051, monitoring of in-mine leakage and assessment of mine water balance should be continued and further risk analysis undertaken if required.

Surface water

The surface water monitoring for the large swamps has been implemented consistent with previous Panel recommendations. In light of new biodiversity information, recommendations are made below for additional tributary pool level monitoring where threatened frogs are identified. It is noted that a flow gauge at Swamp 77 was not installed due to accessibility challenges. Due to the importance of regular access to the flow gauges for maintenance, and because the two other large swamps have flow gauges downstream of their outlets, the Panel agrees that this is reasonable. Similarly, the monitoring of water quality downstream of two of the three swamps is reasonable, considering that these are minor (second order) tributaries of Woronora Reservoir.

Biodiversity

Swamps

Monitoring of upland swamp vegetation is outlined in Section 8.1 of the BMP (Appendix C to Peabody 2024) and includes a mix of visual inspections, transect/quadrat monitoring and indicator species monitoring, in addition to groundwater monitoring. The Panel generally supports the monitoring proposed, but is unable to determine the suitability of quadrat/transect monitoring locations. Section 8.1 refers to monitoring locations shown in Figure 9 and 14; however, monitoring locations are not shown on these maps. A review of Figure 2.1 of the EcoPlanning (2024) report (Appendix C in Appendix H of Peabody 2024a) appears to show just two monitoring locations in Swamp 92 (METH11 and METH12) and two in Swamp 77 (METH19 and METH20). Sites in Swamp 92 are in the upper reaches of the swamp, with no monitoring locations in the lower reaches with greatest potential for impact. Similarly, in Swamp 77 the two monitoring locations are in the upper reaches of the swamp. The Panel recommends addition of one additional site per swamp at the locations suggested.

As per our high-level review of the Large Swamp Environmental Assessment Requirements (IEAPM 2024b), the Panel would also recommend the company undertake revised baseline mapping of swamp sub-communities, using a replicable technique that will allow monitoring of changes in response to changes in hydrology. This will allow the company to undertake comparison with previous mapping to determine whether any changes in groundwater are resulting in changes in vegetation subcommunities. As outlined in Section 6.2, the Panel does not feel this recommendation has been adequately addressed.

Threatened species

As outlined in Section 6.2, the baseline surveys undertaken are considered inadequate for understanding the biodiversity values over LWs 311-312 (and 313-316) and characterising the potential impacts. Without adequate baseline data it is difficult for the Panel to comment on the monitoring proposed as the monitoring should be designed around the results of the baseline surveys to target known habitat for threatened species. As such, the Panel makes a number of high-level recommendations below:

- Monitoring locations should target habitats at greatest risk of impacts from subsidence (breeding habitat) as identified during baseline surveys.
    - The majority of threatened frog monitoring locations are situated on access tracks. These locations are unsuitable for monitoring of threatened frog species.
    - Giant Dragonfly surveys should include targeted surveys for exuviae in wetter sections of the Swamps 77 and 92 (and Swamp 76).
- Timing of monitoring should target key lifecycle stages of the species being monitored.
    - For threatened frogs, this should include the breeding periods, including calling and when tadpoles are present. This may require multiple surveys per year.
    - For the Giant Dragonfly, surveys should target the key emergence period between December and January.

Monitoring techniques should be targeted at and suitable for the species being monitored.

- As outlined above, Songmeters are not considered a suitable survey technique for the Giant Burrowing Frog or Red-crowned Toadlet. Surveys for threatened frogs must include nocturnal visual-aural surveys along monitoring transects. Use of 100 m x 100 m (1 ha) monitoring sites is not considered a suitable monitoring technique.
- The measures of abundance outlined in Section 8.6 of the BMP (Appendix C of Peabody 2024a) are considered unsuitable for species which are often detected in low numbers. It is the Panel's view that they are unnecessary and monitoring for threatened frogs should be undertaken to compare abundance along monitoring transects year-on-year.
- Monitoring for threatened frogs should include monitoring of pool water levels at breeding locations identified during baseline surveys. There is currently only one pool monitoring location along Tributary P and one along Tributary R. The Panel recommends additional monitoring locations with sites informed by adequate baseline surveys.
- If detected during baseline surveys, monitoring for the Giant Dragonfly should target exuviae in suitable habitat, as per recommendations of BCS. The company may also wish to considered use of eDNA surveys at the lower reaches of the swamps.

Following the completion of reliable targeted surveys, and an understanding of the baseline biodiversity values present over LWs 311 to 316, the Panel recommends the company undertake a review of monitoring locations and techniques to address the items raised above.

The Panel notes that the Biodiversity Monitoring Program is to be reviewed at the end of each longwall to identify potential impacts and consequences (Peabody 2024c, Section 8.8).

6.6. THE ADEQUACY OF THE LARGE SWAMP TARPS

The Panel notes the request for 'clear and timely performance indicators' and suggests the following principles be adopted in the definition of new TARPs, focussing on Swamps 92, 77 and 76 in particular. These TARPs may need to be revised in the future as the results of monitoring programs become available.

Subsidence

Peabody (2024e) presents a large swamp valley closure TARP, based on the closure lines shown in the subsidence monitoring plan (Figure 5 and Plan 7 of Appendix H of Peabody 2024a). The valley closure TARPs for Swamp 92/tributary P and Swamp 77/tributary R are relevant for LW 311 and LW 312. Valley closures will be measured using GNSS units across the three closure lines. The proposed level 2 and level 3 triggers are based on comparing measured valley closures with predicted valley closures. As the Panel has previously advised in context of Waratah Rivulet (IAPUM 2022), this is not necessarily a useful comparison because predicted valley closures tend to be higher (typically 0-200% higher based on the data shown in IAPUM 2022) than measured valley closures. Therefore, by the time a level 3 trigger for Swamp 77 of >325 mm observed closure has been activated, it is highly likely that a subsidence impact leading to drainage of Swamp 77 will already have occurred. Furthermore, the maximum closures in Swamp 77 are predicted to occur well downstream of the closure line. The Panel concludes that the trigger for Swamp 77 is not conservative enough. However, the predicted valley closure at the closure line for Swamp 77 is negligible for LW 311 and LW 312, and therefore further review of the Swamp 77 TARP is deferred to Stage 2 of this Advice.

The Panel recommends that the trigger for Swamp 92 be reviewed by the Technical Committee following mining of LW 311 and submitted for approval prior to mining of LW 312. The valley closure TARPs will be considered further in Stage 2 of this advice.

The TARP footnotes in Peabody (2024e) include "*Swamps 76, 77 and 92 are not rockbar controlled, rather they are valley infill swamps controlled by shallow gradient of the terrain*." While this may be correct for Swamp 76, and the majority of Swamps 77 and 92, it is not consistent with the reconnaissance of tributaries P and R in the Appendix A of Peabody (2024a), which notes controlling rockbars at the downstream ends of these swamps. The TARP also notes "*At each large swamp GNSS valley closure monitoring pairs will be established across the valleys at the furthest downstream groundwater monitoring point. This strategy will tie valley closure monitoring trends to the swamp groundwater monitoring occurring at the lower end of each large swamp*." This is difficult to reconcile with the large swamp closure line locations (Figure 5 or Plan 7 of Appendix H of Peabody 2024a), which for Swamps 76 and 77 seem to be well upstream of the most downstream piezometer locations.

It is recommended that, to inform assessment of proposals for LW 313 to LW 316, the proposed large swamp valley closure TARP document is revised to include a map showing closure line locations and additional justification of proposed locations, including consideration of any rockbar controls referred to in the stream reconnaissance that is included in the Extraction Plan.

Groundwater

The Panel has the following observations about the upland swamp groundwater TARPs (Appendix C of Peabody 2024a)[6]:

[6] The TARPs are different in Appendix C (Table 15) and Appendix H (Table 20) both dated July 2024 – the commentary here is for the more elaborate one from Appendix C.

- The TARP omits the HBSS shallow groundwater level, which if impacted could provide an early warning of groundwater impacts to the swamps.
- There may be cases where the 7-day minimum baseline period swamp groundwater level is not a useful benchmark, for example when that level is below the logger level or affected by extreme dry weather. This could be largely resolved by adding "OR the water level falls below the logger level".
- The water level recession rates and recovery rates are the most relevant and practical measures of impact. For the highest-level trigger to be activated, it is appropriate that changes in recessions should lead to significant changes in levels (as proposed, noting the previous point).
- The Level 3 Action includes "*Initiate assessment against the performance measure for threatened species*". The Panel considers that the highest-level trigger, i.e. exceedance of the swamp groundwater Performance Indicator, should directly translate to exceedance of the performance measure (as justified in Section 6.3 of this Advice).
- The Level 3 Action includes "*Consider the need for management measures, in accordance with Sections 9 and 10*". Section 9 (Appendix C of Peabody 2024a) describes remediation actions and Section 10 other management measures but excludes the possibility that the mine plan be reviewed and potentially adapted. In the Panel's opinion that possibility should be considered. For example, an exceedance of the Performance Indicator due to mining of LW 311 or LW 312 should warrant a review of the mine plan for LW 313 to LW 316.

The Panel recommends that:

- The upland swamp groundwater level 2 TARP includes a trigger for potential impacts on HBSS shallow (~10m) groundwater levels, at which frequency of analysis of swamp groundwater levels should increase, for example based on changes in recessions OR changes in swamp groundwater levels OR changes in HBSS shallow groundwater levels.
- The upland swamp groundwater levels 2 and 3 TARP includes a trigger for potential impacts on soil moisture, at which analysis of soil moisture changes in relation to recession rates and groundwater levels should be undertaken
- The upland swamp groundwater triggers should allow for the possibility that the baseline period levels have been below the logger level, for example based on the seven-day moving average being below the minimum established for the baseline period OR being below the logger level.
- The highest-level upland swamp groundwater trigger action should include a review of the mine plan for longwall panels yet to be mined that are predicted to potentially impact the large swamps.
- The upland swamp groundwater TARP should explicitly state that a trigger at any one site constitutes a trigger for that swamp.
- Like in the large swamp assessment document (Appendix H of Peabody 2024a), the BMP (Appendix C of Peabody 2024a) should have a separate set of TARPs for the large swamps.

Other recommendations on the upland swamp groundwater TARPs are in Section 6.6 of this Advice.

Surface water

There are no surface water flow TARPs applicable to LW 311 and LW 312. Consistent with previous mining areas, the small tributary flow gauges provide data for performance analysis in six-monthly and annual reporting rather than being used in TARPs. Although the surface flow monitoring data at outlets of Swamps 76 and 92 might be used to indicate changes to swamp storage, the flow gauges are prone to interference from debris and subsidence effects, and the piezometers provide a more direct and reliable measure of changes to swamp groundwater for the purpose of TARPs and Performance Indicators.

Advice regarding surface water quality TARPs is included in IEAPM (2023a). The proposed water quality TARPs are appropriate for LW 311-312. Review of total metal data in the 2024 annual report will be important for considering its potential inclusion in future TARPs.

Biodiversity

Threatened species

The Amphibian TARP is viewed by the Panel to have a number of limitations:

- There is inadequate baseline data (see above).
- Whilst the parameters to be measured (diversity and abundance) are considered suitable parameters, this should be focused on abundance of individual species and availability of habitat (particularly breeding pools) along individual waterways.
- The trigger levels are viewed as broadly suitable subject to some minor changes in wording.
    - The Level 2 trigger should assess if there has been a reduction in abundance of a threatened species (Red-crowned Toadlet, Littlejohn's Tree Frog or Giant Burrowing Frog) along an impacted waterway which has not been observed at control sites for one year.
    - The Level 3 trigger should assess if there has been a reduction in abundance of a threatened species (Red-crowned Toadlet, Littlejohn's Tree Frog or Giant Burrowing Frog) along an impacted waterway which has not been observed at control sites for greater than one year.
- For known breeding pools, both Level 2 and 3 triggers should also include a trigger for drying of pools resulting in loss of habitat. It is recommended that periods align with the trigger levels above (i.e. loss of habitat for one year (Level 2) and greater than one year (Level 3).
- The actions/response
    - Further detail should be provided on the analysis to be conducted in relation to threatened species. It is unclear what this refers to.
    - The wording of the final action/response should make reference to implementation of appropriate mitigation/remediation or provisions of offsets, as per Sections 9 and 10. Remove the word "consider".
    - A reduction in a frog abundance at an impact site should translate directly to exceedance of the Performance Measure, hence the action "Initiate assessment against the performance measure for threatened species" should be deleted from the action/response. Table 19 of the BMP (Appendix C of Peabody 2024a) should be reviewed to determine if this is required.

Further TARPS may be required for threatened species dependent on the outcomes of targe

6.7. OTHER MATTERS

Following its advice in IEAPM (2023b) the Panel remains concerned that panel widths are being effectively locked in prior to adequate assessments. It is recommended that drivage of MG313 should be delayed until an Extraction Plan covering LW 313 has been endorsed by the Department.

In light of the uncertainty around impacts to the large swamps, and to ensure offsets can be secured if Performance Measures are exceeded, the Panel recommends that further detail is provided on how an offset for the upland swamps can be secured with regard to the guidance in OEH (2016).

7.0 CONCLUSIONS

Responses to previous Panel advice by Metropolitan Coal

- In relation to the Panel's previous advice *Water Quality Performance Measures for Metropolitan Coal Mine*, the responses by Metropolitan Coal indicate an intention to address the recommendations to some degree but in most cases lack information about timeframes and in some cases are vague or suggest an inadequate degree of commitment. These issues arising do not need to be urgently addressed in the context of Longwalls 311 and 312, except to ensure that total metals (rather than dissolved metals concentrations) are monitored at the outlet of Swamp 92.
- In relation to the Panel's previous advice *Large Swamp Environmental Assessment Requirements for the Extraction Plan for Longwalls 311 to 316*, most of the recommendations have not been addressed or have been addressed in a partial or unsatisfactory way. The major issues relevant to the consideration of Longwalls 311 and 312 are:
    - Due to the progression of Maingate 312 prior to assessment of the Extraction Plan the widths of Longwalls 311 and 312 are essentially fixed and reducing their width is now not a practical risk management option.
    - The large swamp TARPs remain unsatisfactory and need to be further refined in several aspects.
    - Aspects of the large swamp risk assessment are unsatisfactory, particularly for the downstream end of Swamp 77.
    - The baseline surveys of vegetation sub-communities are unsatisfactory.
    - The baseline surveys of threatened species are unsatisfactory.
    - Documented evidence of the absence of the Eastern Ground Parrot relied upon by the Extraction Plan is unavailable.
- In relation to the Panel's previous advice *Metropolitan Coal Mine: Independent Review of Environmental Performance to 2022*, plans are in place to install the recommended monitoring at site T6, but it was not yet in place at time of writing this advice.
- In relation to the Panel's previous advice *Metropolitan Coal Mine: Independent Review of Environmental Performance to 2022 and Metropolitan Mine Longwalls 308 – 310 Extraction Plan*, the recommended groundwater monitoring was not in place at time of writing this advice, limiting the value of that monitoring for understanding subsidence risks and for providing baseline data for assessing performance.

Significance of the large swamps

- For the purpose of assessing the Extraction Plan and considering suitable Performance Measures and Performance Indicators, Swamps 76, 77 and 92 are important upland swamps in terms of providing suitable habitat for threatened species and water supply protection, and because of their size and status as Threatened Ecological Communities. Swamps 77 and 92 meet criteria proposed by OEH (2016) for swamps of special significance on the Woronora Plateau.

The adequacy of large swamp impacts predictions

- The subsidence predictions for LWs 311-312 have been made using an appropriate method that has been reasonably applied; additionally, the subsidence reports are adequate when supported by the relevant management plans.
- The swamp groundwater modelling is useful and appropriate given its data constraints; however, due to the model uncertainty, little weight should be attached to the conclusion in the Large Swamp Assessment that "*The mining-related effects to Swamp 76 and Swamp 92 are expected to be minor with the water levels predicted to remain above the base of the substrate*".

- If subsidence impacts do occur along tributaries P, R and S, as predicted, this is likely to result in impacts to threatened species if and where they are present (presence is indicated in the BCS survey results presented to the Panel). If these impacts do occur, and result in loss of breeding habitat, they are unlikely to be considered negligible.
- The baseline surveys relied upon by the Extraction Plan for threatened frog species and for the Giant Dragonfly are inadequate. Therefore, the Panel lacks confidence in the impact predictions that there will be no significant impacts and that a negligible impact to threatened species can be achieved.
- The limitations in the baseline surveys cannot be properly addressed prior to the proposed commencing date of LW 311 or LW 312, but may be partially addressed prior to the proposed commencing date of LW 313.

The adequacy of the large swamp Performance Measures and Performance Indicators

- The proposed Performance Measure of "*Negligible impact on Threatened Species, Populations, or Ecological Communities*" is acceptable for the purpose of LWs 311 and 312 provided that this Performance Measure is supported by Performance Indicators that are relevant and have clear criteria that define when an impact is more than negligible.
- The proposed large swamp groundwater Performance Indicator "*Subsidence impacts are not expected to result in measurable changes to swamp groundwater levels when compared to control swamps or seasonal variations in water levels experienced by upland swamps prior to mining*" is acceptable for the purpose of LWs 311 and 312 if it is supported by triggers that clearly define when changes are significant enough to determine an exceedance of the Performance Measure.
- The large swamps warrant Performance Indicators and triggers that provide a higher level of confidence (than provided by those applied to previously undermined swamps) that impacts will be detected and managed appropriately.
- Increased groundwater recession rates leading to non-negligible loss of swamp groundwater is a sufficient and practical criterion for determining that the large swamp groundwater Performance Indicator has been exceeded. Due to the semi-quantitative assessment of recession rates, a technical document should clearly explain and demonstrate the method and criteria used. Any exceedance of this Performance Indicator should translate directly and irrespective of any subsequent assessment to an exceedance of the Performance Measure for the large swamps.
- Given the preceding conclusion, the Upland Swamp Vegetation Performance Indicator is unnecessary.
- The Performance Measure "*Negligible reduction to the quality or quantity of water resources reaching the Woronora Reservoir*" and associated Performance Indicators are acceptable.
- The Amphibian Performance Indicator should only refer to threatened species, with exceedance of the Performance Indicator reviewed by species and monitoring location (e.g. a transect) rather than the "*amphibian assemblage as a whole*".

The adequacy of the large swamp TARPs

- The closure thresholds used in the large swamp valley closure TARP are not sufficiently conservative for Swamp 77.
- The rationale for the location of closure lines in Swamps 76 and 77 requires clarification.
- There would be benefit in adding the shallow (~10m depth) HBSS groundwater into the upland swamp groundwater TARPs as an early warning of potential (short or long-term) impacts to swamp hydrology.
- The highest-level upland swamp groundwater trigger defines exceedance of the Performance Indicator and should define exceedance of the Performance Measure. It is appropriate for this to

be based, as is proposed, on semi-quantitative analysis of groundwater levels including recessions that lead to non-negligible reductions in swamp groundwater levels. Better allowance needs to be made for baseline period levels that may be below the logger level.

- The proposed water quality TARPs are appropriate for LW 311-312.
- The Amphibian TARP is viewed by the Panel to have a number of limitations related to the lack of focus on abundance of individual species and availability of habitat (particularly breeding pools) along individual waterways, and other details.

The need or otherwise to modify the mine plan

- Of the three large swamps, Swamp 92 is the most significant. The proposed extent of LW 312 presents an unacceptable risk to Swamp 92, which could easily be addressed by shortening of that longwall.
- The downstream end of Swamp 77, including a controlling rockbar, is at high risk. If shortening of LWs 312 and 313 or reduction of (one or more of) LWs 313-316 panel widths by at least 60 m to protect Swamp 77 are not considered appropriate for economic or other reasons, then it is highly likely that the large swamp groundwater Performance Indicator will be exceeded at Swamp 77.
- Further consideration of risks to Swamp 76, Swamp 77 and tributaries that may host threatened species, and to management options including possible changes to the mine plan for LWs 313-316, should be given in Stage 2 of the Advice.

The adequacy of the water and swamp monitoring programs

- The proposed Subsidence Monitoring Program is adequate for the purpose of LWs 311 and 312, except that there is a need for a transverse subsidence monitoring line towards the northern end of LW 311, cutting across LW 311 towards the northern end of LW 316 to monitor subsidence behaviour within the zone of influence of Woronora Reservoir.
- The existing or proposed groundwater monitoring at the large swamps is adequate, except for the absence of any monitoring in the downstream area of Swamp 77, which the revised subsidence predictions show to be at high risk. Even if monitoring sites are established in this area, an unsatisfactory baseline period will be achievable if LWs 311 and 312 proceed as planned. Unless this can be resolved, it may be reasonable to assume (based on the subsidence predictions) that the groundwater Performance Indicator is exceeded at this location irrespective of measurements.
- The surface water monitoring for the large swamps has been implemented consistent with previous Panel recommendations. Where threatened frogs are identified, additional tributary pool level monitoring is appropriate.
- The Panel generally supports the swamp vegetation monitoring proposed but is unable to determine the suitability of quadrat/transect monitoring locations. The sites in Swamp 92 and Swamp 77 under-represent the lower reaches of the swamp.

8.0 RECOMMENDATIONS

Metropolitan Coal's response to the Panel's previous recommendations

1. The site S92-GS water quality monitoring should include measurement of total metals concentrations.
2. Peabody should proceed as soon as practicable with event sampling of water quality using automatic samplers irrespective of the outcomes of preliminary load assessments. This applies to ETWQ AU and also WQWQ9 and WOWQ2 if these are not covered by WaterNSW event sampling.
3. Peabody should commit, subject to access permission, to monitoring the depth profiles of water quality of the Woronora Reservoir at WDFS1 or other suitable site including regular (at least bi-annual) sampling throughout the remaining mining period, plus sampling following level 3 triggers for water quality reaching the reservoir.
4. An analysis of historical water quality trends in Woronora Reservoir and their relation to mining development should be included in the Metropolitan Coal 2024 Annual Review, and this should not be provisional on further suitable data becoming available.
5. The conceptual models of the large swamps should be reviewed in 6-monthly reporting in the light of new monitoring data, and updated to represent vegetation communities.
6. The T6 standpipes and the multi-level VWPs for Swamps 92 and 77 and standpipes at two sites in Swamp 76 should be installed as soon as practicable.

The adequacy of large swamp impact predictions

7. It is recommended that updates to the 1-dimensional and 2-dimensional models and their predictions should be undertaken in annual reviews to refine understanding of reasons for any observed subsidence consequences and to refine predictions for subsequent longwalls.
8. Further baseline surveys are required for threatened frog species, using appropriate survey methods and effort, conducted at a suitable time of year with survey locations targeting breeding habitat through the upland swamps (where present) and along suitable reaches of Tributaries P, R and S.
9. Additional surveys are required for Swamps 92, 77 and 76 using best practice methods. The Panel recommends the company engage with BCS in developing a suitable survey method.

The adequacy of the proposed performance measures and indicators for large swamps

10. The special significance of the large swamps should be managed by maintaining the proposed Performance Measure, and developing Performance Indicators and associated triggers that provide a high level of confidence that non-negligible impacts to the swamps will be detected and appropriately managed.
11. It is recommended that the action “Initiate assessment against the performance measure for threatened species” is removed from the highest-level Upland Swamp Groundwater TARP so that the trigger of this TARP defines an exceedance of both the Performance Indicator and the Performance Measure for the large swamps.
12. It is recommended that the Performance Indicator under Upland Swamp Vegetation Monitoring is removed (while maintaining the monitoring, annual reporting and TARP) and instead the groundwater Performance Indicator is relied upon to assess the Performance Measure for the large swamps.

The adequacy of the large swamp TARPs

13. The trigger for Swamp 92 should be reviewed by the Technical Committee following mining of LW 311 and submitted for approval prior to mining of LW 312.
14. To inform assessment of proposals for LW 313 to LW 316, the proposed large swamp valley closure TARP document should be revised to include a map showing closure line locations and additional justification of proposed locations, including consideration of any rockbar controls.
15. The large swamp groundwater level 2 TARP should include a trigger for potential impacts on HBSS shallow (~10m) groundwater levels, at which frequency of analysis of swamp groundwater levels should increase.
16. The large swamp groundwater triggers should allow for the possibility that the baseline period levels have been below the logger level.
17. The highest-level large swamp groundwater trigger action should include reviewing the mine plan for longwalls yet to be mined.
18. The large swamp groundwater TARP should explicitly state that a trigger at any one site constitutes a trigger for that swamp.
19. The large swamp groundwater TARP should include quarterly reporting of level 2 triggers and associated analysis.
20. A technical document, which clearly defines how the large swamp groundwater TARP triggers are assessed including examples, should be appended to the management plan.
21. The Biodiversity Management Plan should present a set of TARPs for the large swamps that separately from the TARPs for other swamps.
22. The Amphibian Performance Indicator and TARP should focus on abundance of individual species and availability of habitat (particularly breeding pools) along individual waterways.
23. The Amphibian TARP Level 2 trigger should assess if there has been a reduction in abundance of a threatened species (Red-crowned Toadlet, Littlejohn's Tree Frog or Giant Burrowing Frog) along an impacted waterway which has not been observed at control sites for one year. The Level 3 trigger should assess if there has been a reduction in abundance of a threatened species (Red-crowned Toadlet, Littlejohn's Tree Frog or Giant Burrowing Frog) along an impacted waterway which has not been observed at control sites for greater than one year.
24. Both Level 2 and 3 triggers should also include a trigger for drying of pools resulting in loss of habitat. It is recommended that periods align with the trigger levels above (i.e. loss of habitat for one year (Level 2) and greater than one year (Level 3)).
25. Further detail should be provided on the analysis to be conducted in relation to threatened species. The wording of the final action/response should make reference to implementation of appropriate mitigation/remediation or provisions of offsets, as per Sections 9 and 10. Remove the word "consider".
26. A reduction in a frog abundance at an impact site should translate directly to exceedance of the Performance Measure, hence the action "Initiate assessment against the performance measure for threatened species" should be deleted from the action/response. Table 19 of the Biodiversity Management Plan should be reviewed to determine if this is required.

The need or otherwise to modify the mine plan

27. It is recommended that the southern end of LW 312 is shortened by 260 m to minimise risks to Swamp 92.
28. It is recommended that Metropolitan Coal should provide DPHI, prior to a decision regarding approval of LW 311 and LW 312, further justification of why the predicted subsidence impacts in the downstream length of Swamp 77 may be considered acceptable, including evaluation of the feasibility of shortening of one or both of LWs 312 and 313.

29. It is recommended that, if the currently proposed layouts of LWs 311 and 312 are approved then, within 6 weeks of this Advice being submitted to DPHI (so that it can be considered by the Panel in Stage 2 of this Advice), Metropolitan Coal should submit to the DPHI a site-specific contingency plan that explains how non-minor fracturing in the downstream length of Swamp 77 (including its rockbar, base of tributary, and underneath the swamp soil) would be managed.

The adequacy of water and swamp monitoring programs

30. It is recommended that Metropolitan Coal should revise the Subsidence Management Plan to include a transverse subsidence monitoring line towards the northern end of LW 311, cutting across LW 311 towards the northern end of LW 316 monitor subsidence behaviour within the zone of influence of Woronora Reservoir.
31. It is recommended that Metropolitan Coal continues its endeavours to install the planned shallow and deep groundwater monitoring in/near the large swamps as soon as practicable and prior to commencement of LW 311.
32. It is recommended that a shallow swamp groundwater monitoring piezometer is installed near to the end of Swamp 77 at its downstream extent and, if safely accessible, rockbars and pools within the lower end of Swamp 77 should also be monitored for loss of water and visual impacts (fracturing and iron staining).
33. It is recommended that if no satisfactory monitoring, including baselines, can be installed to assess impacts to the downstream end of Swamp 77 and if the proposed longwall layout progresses then the large swamp groundwater Performance Indicator should be assumed to be exceeded over at least the valley infill area of Swamp 77.
34. Monitoring locations should target habitats at greatest risk of impacts from subsidence (breeding habitat) as identified during baseline surveys.
    - Monitoring locations should not be situated on access tracks. These locations are unsuitable for monitoring of threatened frog species.
    - Giant Dragonfly surveys should include targeted surveys for exuviae in wetter sections of the Swamps 77 and 92 (and Swamp 76).
35. Timing of monitoring should target key lifecycle stages of the species being monitored.
    - For threatened frogs, this should include the breeding periods, including calling and when tadpoles are present. This may require multiple surveys per year.
    - For the Giant Dragonfly, surveys should target the key emergence period between December and January.
36. Monitoring techniques should be targeted at, and suitable for, the species being monitored.
37. Surveys for threatened frogs must include nocturnal visual-aural surveys along monitoring transects. Use of 100 m x 100 m (1 ha) monitoring sites is not considered a suitable monitoring technique.
38. Instead of the measures of abundance outlined in the Biodiversity Management Plan, monitoring for threatened frogs should be undertaken to compare abundance along monitoring transects year-on-year.
39. Monitoring for threatened frogs should include monitoring of pool water levels at breeding locations identified during baseline surveys, including additional monitoring locations along Tributary P and Tributary R with sites informed by adequate baseline surveys.

40. If detected during baseline surveys, monitoring for the Giant Dragonfly should target exuviae in suitable habitat, as per recommendations of BCS. The company may also wish to considered use of eDNA surveys at the lower reaches of the swamps.

41. Surveys for threatened frogs must include nocturnal visual-aural surveys along monitoring transects. Use of 100 m x 100 m (1 ha) monitoring sites is not considered a suitable monitoring technique.

Other matters

42. Drivage of MG313 should be delayed until an Extraction Plan covering LW 313 has been endorsed by the Department.

REFERENCES

BCS 20/05/2024 [Biodiversity Conservation and Science Group, DPHI Resource Assessment], letter from Michael Saxon, BCS to Melanie Hollis, DPHI Resource Assessments

BCS 2024a. Re: Metropolitan Coal - Longwalls 311-316 Extraction Plan. Letter to the Department of Planning, Housing and Infrastructure, 20 May 2024. DOC24/348173.

BCS 2024b. Re: Metropolitan Coal Extraction Plan LW 311-316: Response to Agency Submissions . Letter to the Department of Planning, Housing and Infrastructure, 25 July 2024. DOC24/583146 .

DPHI 2024. Metropolitan Coal – Extraction Plan for Longwalls 311 to 316 Independent Expert Advisory Panel for Mining – Stage 1 Briefing, July 2024

IAPUM 2022. Advice Re: Metropolitan Mine Longwalls 308-310 Extraction Plan. dated September 2022

IEPMC 2019. Independent Expert Panel for Mining in the Catchment Report: Part 2. Coal Mining Impacts in the Special Areas of the Greater Sydney Water Catchment. Galvin, J.M., McIntyre, N., Young, A., Williams, R.M., Armstrong, C., Canbulat, I. Sydney: NSW Office of NSW Chief Scientist and Engineer

IEAPM 2023a. Advice Re: Water Quality Performance Measures for Metropolitan Coal Mine. Report IEAPM 202310-1(R1) dated October 2023

IEAPM 2023b. Advice Re: Metropolitan Coal Mine: High Level Review - Large swamp environmental assessment requirements for the Extraction Plan for Longwalls 311 to 316. Report IEAPM 202311-1 dated November 2023

IEAPM 2023c. Advice Re: Metropolitan Coal Mine: Independent review of environmental performance to 2022 (Dupen, 2023). Report IEAPM 202309-2 dated September 2023

MSEC 2024. Metropolitan Mine – Revised Layout for Longwalls 311 to 316 Mine Subsidence Overview. Letter to Jon Degotardi dated 2 June 2024.

NSW DPIE 2020. NSW Survey Guide for Threatened Frogs - A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method.

NSW Planning Assessment Commission (2009). The Metropolitan Coal Project Review Report, NSW Planning Assessment Commission, Sydney

OEH 2012, Upland Swamp Environmental Assessment Guidelines, Office of Environment and Heritage, Sydney.

Peabody 2024a. Metropolitan Coal Longwalls 311-316 Extraction Plan - Main Text

Peabody 2024b. File named “Metropolitan Coal - Response to IEAPM Recommendations LW 308-310”, Undated

Peabody 2024c. Letter to DPHI. Metropolitan Coal Longwalls 311-316 Extraction Plan – Response to Submissions, dated 3 July 2024

Peabody 2024d. Metropolitan Coal – Longwalls 311-316 Extraction Plan Response to Independent Expert Advisory for Mining Request for Information, Received by Panel 14 August 2024

Peabody 2024e. File named “LW311-316 EP - Large Swamps 76 77 92 - Proposed New TARP”, Received by Panel 26/08/2024

SLR (2023a) Groundwater Six-Monthly Report – 1 January to 30 June 2023. SLR Project No. 665.10000-R10 dated 3 October 2023

SLR (2023b) Groundwater Investigation 2023 Transect Bores T3-R and T5. Memo dated 27 November 2023

APPENDIX A – DPHI REQUEST FOR ADVICE AND REVISED REQUEST FOR ADVICE

Department of Planning, Housing and Infrastructure

Our ref: MP 08_0149

Emeritus Professor Jim Galvin
Chair - Independent Expert Advisory Panel for Mining

By email: j.galvin@bigpond.net.au

4 July 2024

Subject: Request for Advice – Metropolitan Coal Mine – Longwalls 311 to 316 Extraction Plan

Dear Prof Galvin

I am writing to you to request advice from the *Independent Expert Advisory Panel for Mining* (the Panel) in relation to the Metropolitan Coal Mine (MP 08_0149).

Metropolitan Coal is seeking approval for an Extraction Plan (EP) for secondary coal extraction from Longwalls (LW) 311 to 316 which are a continuation of the longwall series undermining the Woronora Reservoir. A copy of the EP application is provided as **Attachment 1**.

Metropolitan Coal has consulted with several agencies in the preparation of this EP. A copy of agency advice and Metropolitan Coal's response to this advice is attached for your consideration (see **Attachment 2**).

Further feedback is being sought from these agencies by the Department and will be provided to the Panel when received (to be provided as **Attachment 3**).

The Department considers the key technical issues for LWs 311 to 316 are the potential impacts to swamps and water quality, as raised in the advice from the Department of Climate Change, Energy, the Environment and Water (DCCEEW), Biodiversity, Conservation and Science (BCS) and WaterNSW. In particular, the impacts of mining on three large swamps (i.e. S76, S77 and S92) and their associated threatened species, and water quality of watercourses and the Woronora Reservoir, have been raised as specific concerns.

The Panel has previously provided advice on the Metropolitan Mine which included recommendations relevant to the LW 311 to 316 EP. This advice included:

- *Advice re: Metropolitan Mine Longwalls 308 – 310 Extraction Plan* (September 2022);

- *Independent review of environmental performance to 2022* (September 2023);
- *Water Quality Performance Measures for Metropolitan Coal Mine* (October 2023);
- *High Level Review – Large swamp environmental assessment requirements for the Extraction Plan for Longwalls 311 to 316* (November 2023).

Metropolitan Coal provided responses to recommendations made in these documents (see Attachments 4 and 5).

The Department is seeking advice from the Panel on the LW 311 to 316 EP, including:

- whether the Panel's previous recommendations in the documents above have been adequately addressed, particularly in relation to large swamps and water quality modelling and monitoring;
- the adequacy of the large swamp impact predictions presented in the *Large Swamp Assessment* (Appendix H of the EP) and associated appendices;
- the adequacy of the proposed performance measures and indicators for large swamps required by condition 4(b) Schedule 3 of the consent and included in the *Large Swamp Assessment* (Section 7.2), and the need or otherwise to set more defined performance measures for large swamps beyond those related to threatened species, populations, or ecological communities;
- the need or otherwise to modify the mine plan to minimise/avoid impacts, particularly on large swamps, and ensure compliance with existing and proposed performance measures;
- the adequacy of the water and swamp monitoring programs;
- the water and swamp TARPs and whether they:
  - enable measurement of compliance with existing and proposed performance measures established under the consent and proposed in the EP for large swamps; and
  - have triggers (and associated performance indicators) that adequately reflect the existing and proposed performance measures.

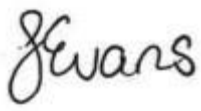
The Panel should feel free to provide any other advice it considers would assist the Department in reviewing the EP.

To assist the Panel, I have attached a copy of Metropolitan Coal's six-monthly report January to June 2023, and the most recent Waratah Rivulet Technical Committee Valley Closure Meeting for LW 309 (see **Attachment 6** and 7).

It would be appreciated if the Panel can provide advice on the EP by **16 August 2024.**

Please contact me on 8274 1274 or jessie.evans@dpie.nsw.gov.au if you have any questions or require additional information for your review.

Yours sincerely,



Jessie Evans

Director
Energy and Resource Assessments

Attachments:

1. LW 311 to 316 EP
2. Agency Advice to Metropolitan Coal
3. Agency Advice to the Department
4. Metropolitan Coal's response to agency comments
5. Metropolitan Coal's responses to Panel recommendations on the EPs for LW 308-310 and LW 31-316
6. Metropolitan Coal Six Monthly Report January to June 2023
7. Waratah Rivulet Technical Committee Valley Closure Meeting for LW 309 – 1 March 2024

Department of Planning, Housing and Infrastructure

Our ref: MP 08_0149

Emeritus Professor Jim Galvin
Chair - Independent Expert Advisory Panel for Mining

By email: j.galvin@bigpond.net.au

2 August 2024

Subject: Request for Advice – Metropolitan Coal Mine – Longwalls 311 to 316 Extraction Plan

Dear Prof Galvin

Thank you for your letter dated 26 July 2024, outlining the Panel's staged approach for providing advice on the Metropolitan Coal Mine Extraction Plan for Longwalls 311 to 316 (Extraction Plan). I note the staged approach will comprise:

1. Reviewing whether the Panels' previous recommendations have been adequately addressed in relation to large swamps and water quality modelling and monitoring;
2. Restricting the Stage 1 advice to LW311 and 312; and
3. Recommending clear and timely performance indicators that unambiguously define when impacts on biodiversity are greater than negligible.

The Department accepts this staged approach.

As the Panel is aware, the Department has requested that government agencies provide advice on the Revised Extraction Plan. WaterNSW and BCS have requested additional information on performance measures and indicators and adequacy of monitoring programs.

The Department will request that Metropolitan Coal provides a response to agency comments for Stage 1. To aid in providing a timely response to the Panel, the Department will request that Metropolitan Coal's response is focused on proposed performance measures and indicators, and monitoring programs, for LWs 311 and 312.

It would be appreciated if the Panel can provide advice on the EP by **23 August 2024.**

Please contact me on 8274 1274 or jessie.evans@dpie.nsw.gov.au if you have any questions or require additional information for your review.

Yours sincerely,

Jessie Evans

Director
Energy and Resource Assessments

APPENDIX B – PANEL BIOGRAPHY

Jim Galvin (Chair)

Professor Galvin is an Emeritus Professor (University of New South Wales) in Mining Engineering and former member of the NSW Planning Assessment Commission. Professor Galvin is one of the world's foremost experts on underground coal mining and subsidence and has extensive experience in geomechanics, mine management and risk management. He was a member of the Independent Panel for the Southern Coalfield Inquiry (2008), several subsequent reviews of mining projects in the Southern Coalfield and most recently, Chair of the Independent Expert Panel on Mining in the Catchment.

John Ross

John Ross is a Senior Principal Hydrogeologist with over 40 years' experience specialising in water resource, site contamination, infrastructure, mining and natural resource impact assessment and management. His specialty is sedimentary basin hydrogeology, particularly the Great Artesian Basin, Sydney-Gunnedah and Gloucester basins here in NSW. John has held specialist management roles in public and private corporations and environmental consultancies. He has a Bachelor of Science (Geology) and a Certificate in Engineering Hydrology and Groundwater Hydrology.

John provides technical hydrogeological expertise and advice across the spectrum of water resource development, environmental/water planning, assessment and management projects, including environmental impact assessments, environmental audits and technical peer reviews, monitoring programs, remedial action plans, modelling and groundwater licensing matters. John also has extensive experience in community and regulatory consultation across the eastern seaboard.

Neil McIntyre (co Chair for this Advice)

Neil McIntyre is Professor of Hydrology and Water Resources at The University of Queensland. He holds a BEng in Civil Engineering from Edinburgh University, and an MSc in Environmental Engineering and PhD in water quality modelling from Imperial College London. He is a Chartered Civil Engineer (UK Engineering Council), with expertise including surface water hydrology, water security assessments, and impacts of land use changes and mining on hydrology and water quality. His advisory roles have included serving on the Institution of Civil Engineer's Water Expert Panel (UK), the Steering Committee of the Commonwealth Leading Practice Sustainable Development Program, and the NSW Independent Expert Panel for Mining in the Catchments.

Ann Young

Dr Young is a retired academic who worked at the University of Wollongong's School of Earth and Environmental Sciences. Her PhD was a seminal study into the upland swamps on the Woronora Plateau. Between 2006 and 2017, she was a member of community consultative committees at two mines in the Southern Coalfield. She was involved with the Commonwealth Government's review of Temperate Highland Peat Swamps on Sandstone EEC and a member of the NSW Government's Independent Expert Panel for Mining in the Catchment.

Nathan Garvey

Nathan is an experienced ecologist with over 20 years' practice in biodiversity assessment and approvals across eastern Australia. Nathan holds a Bachelor of Science and Graduate Diploma in Biological Science from the University of NSW and is a Certified Environmental Practitioner and a Biodiversity Assessment Method (BAM) accredited assessor under the Biodiversity Conservation Act.

Nathan has experience across a diverse range of sectors including mining, oil and gas, linear infrastructure, renewable energy and residential development, including biodiversity assessment for major projects, offsetting and EPBC Act referrals. He has strong expertise and experience in the assessment of impacts to biodiversity arising from subsidence, as well as impacts to groundwater dependent ecosystems arising from groundwater drawdown. He is one of NSW's leading experts in biodiversity approvals and offsetting.

David Waite

David Waite is a Scientia Professor in the School of Civil and Environmental Engineering at the University of New South Wales. Professor Waite obtained his PhD from the Massachusetts Institute of Technology and has served as the Head of the Department of Water Engineering (1993-1999), Director of the Centre for Water and Waste Technology (1993-2006), Head of the School of Civil and Environmental Engineering (2007-2013) and Deputy Dean of the Faculty of Engineering (2013-2018) at UNSW. His principal research areas are that of investigation of physico-chemical processes in natural and engineered systems and biogeochemical transformation and fate of contaminants. Professor Waite is the CEO of the UNSW Centre for Transformational Environmental Technologies (CTET) and is an Associate Editor of the journal Environmental Science & Technology. He was honoured with international membership of the US National Academy of Engineering in 2018 for his distinguished service to engineering.