

Advice to decision maker on United Wambo Coal Mining Project

IESC 2016-079: United Wambo Open Cut Coal Mine Project (EPBC 2015/7600; SSD 7142) – Expansion

Requesting agency	The Australian Government Department of the Environment and Energy and The New South Wales Department of Planning and Environment
Date of request	30 August 2016
Date request accepted	6 September 2016
Advice stage	Assessment

Context

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) was requested by the Australian Government Department of the Environment and Energy and the New South Wales Department of Planning and Environment to provide advice on the United Collieries Pty Ltd (United Collieries) and Wambo Coal Pty Ltd (Wambo Coal) joint venture (collectively referred to as the proponent), the United Wambo Open Cut Coal Mine Project (the proposed project) in NSW. The proposed project is located in the Hunter Valley region.

This advice draws upon aspects of information in the Environmental Impact Statement, together with the expert deliberations of the IESC. The project documentation and information accessed by the IESC are listed in the source documentation at the end of this advice.

The proposed project is a modification to the existing Wambo Coal open cut mine layout located 16 km west of Singleton. The proposed project includes an extension to the area and depth of the approved Wambo Coal open cut pit and a new open cut pit, all to be managed by United Collieries. Extraction is stated to be 176 million tonnes of coal at a maximum rate of 10 million tonnes per year over 23 years. The proposed project will utilise existing infrastructure including the coal handling and preparation plant (CHPP) and train loading facilities at the Wambo Coal Mine Site.

The proposed project is located in an area of extensive historical and current coal mining, including both open cut and underground workings. Wambo Coal has undertaken coal mining operations in the vicinity of the proposed project site since 1969, and United Collieries since 1989. Currently, Wambo Coal has active open cut and underground (South Bates) mining operations, and proposed underground (South Wambo) operations adjacent to the proposed project site. United Collieries operations are in care and maintenance mode. Wambo Coal's existing approved projects discharge mine water to Wollombi Brook. Discharge from the proposed project is also proposed to occur through

this licenced discharge point. Wollombi Brook, the Hunter River and their associated alluvial aquifers are important water resources which will be affected by the proposed project.

Key potential impacts

Key potential impacts of the proposed project include:

- Changes to the quality of surface water, particularly in Wollombi Brook, and groundwater due to mine water discharges.
- Altered surface water-groundwater interaction causing reduced baseflow to the Hunter River and Wollombi Brook.
- The potential for one of the two proposed voids, Wambo void lake, to become a source of contamination to surface water and groundwater systems.
- Impacts to groundwater dependent ecosystems (GDEs) arising from drawdown in the alluvial aquifer.

Assessment against information guidelines

The IESC, in line with its Information Guidelines (IESC, 2015), has considered whether the proposed project assessment has used the following:

Relevant data and information: key conclusions

The water quality data provided in the assessment documentation for both groundwater and surface water was limited in spatial and temporal representation, preventing a clear identification of baseline conditions and potential impacts offsite. This is particularly the case for metals and nutrients. Water quality data was compared to some ANZECC guidelines, though comparison to existing site-specific trigger values was limited. The sole downstream monitoring site used to determine potential impacts of mine discharge was located well downstream of the licenced discharge point and could be affected by discharge from other activities. As a result, the proponent's conclusions regarding the lack of downstream impacts could not be substantiated. A geochemical assessment was not included in the assessment documentation, which limits the ability to evaluate potential water quality impacts.

Field studies on GDEs, including stygofauna, were not undertaken for the Hunter River alluvium preventing an assessment of potential impacts to GDEs in this area. The assessment of potential impacts to GDEs is further limited by a lack of discussion on groundwater levels in the regolith.

Application of appropriate methods and interpretation of model outputs: key conclusions

There is uncertainty in the surface water modelling results due to a lack of information on the construction, parameterisation and calibration of the individual models. This uncertainty reduces confidence in the flood predictions and the mitigation and management measures that are based on the surface water modelling outcomes.

The groundwater modelling did not include a discussion of the potential influence of faults, which occur within the proposed project area, on groundwater flow. Information relating to the style, throw, thrust and penetration of the faults is needed to determine if faults are likely to be acting as barriers or conduits to groundwater flow.

The proposed underground water storage facility (historical workings) was not included in the numerical model. Considering the proponent expects this storage to reduce groundwater drawdown, there is a potential for this to become a point source of contamination. The exact location of this store

is also unclear. Without identifying the location of the underground water storage facility, an assessment of its potential impacts cannot be undertaken.

Advice

In response to the requesting agencies' specific questions the IESC's advice provided below is presented as a summary response followed by further detailed explanation (where required).

Question 1: Do the groundwater, surface water and ecological assessments provide adequate mapping and delineation of surface and groundwater resources? Does the analysis, including any numerical modelling, provide reasonable estimates of the likely impacts to water resources and water dependent ecosystems, with particular reference to the Wollombi Brook/Redbank Creek and Waterfall Creek sub-catchments and the water quality and flows in the downstream reaches of the Hunter River? Consideration should include, but not necessarily be limited to, potential changes to water quality, water quantity, aquifer connectivity, depressurisation, flow and recharge regimes, ecological community composition and cumulative impacts.

Response

1. No. Adequate mapping and delineation of the condition and extent of surface water and groundwater resources has not been provided. Further consideration should be made regarding:
 - a. The spatial and temporal presentation and analysis of baseline data for surface water and groundwater quality.
 - b. Including additional water quality analytes in the sampling program (e.g. metals, nutrients and organics).
 - c. Groundwater levels of the regolith groundwater system overlaid with the location of groundwater dependent terrestrial vegetation, especially critically endangered ecological communities (CEECs).
2. The numerical modelling and analysis presented in the assessment documentation do not provide reasonable estimates of the likely impacts of the proposed project on water resources. Further consideration of the following is needed to better understand the nature and magnitude of impacts to water resources and GDEs:
 - a. Surface water assessment and flood modelling, particularly details of model construction, parameterisation, calibration, validation, and sensitivity and uncertainty analysis.
 - b. Groundwater assessment and modelling:
 - i. The potential for the Wambo void lake and the tailings storage facilities (TSFs) to become a recharge source for the Permian groundwater system and subsequently the alluvial aquifers and surface waters through upwards leakage.
 - ii. Use of the United Collieries underground workings as a water storage facility and the potential impact this could have on groundwater quality.
 - iii. The potential influence of faults (i.e. to act as either barriers or conduits) on groundwater flow within the groundwater model domain.

- c. Groundwater dependent ecosystems:
 - i. Potential combined effects on GDEs due to groundwater drawdown and a reduction in surface water flows. For example, the effects of reduced baseflow on low-flow conditions and aquatic biota in Wollombi Brook.
 - ii. Characterisation of GDEs (including stygofauna) in the Hunter River alluvium where the proposed project is predicted to cause up to 10m of groundwater drawdown.
- d. Impacts arising from leaching from TSFs and materials used in the final landforms.

Explanation

Mapping and Delineation

3. For both surface water and groundwater, site specific temporal and spatial variability of water quality was not shown for all analytes. Additionally, the range of water quality analytes monitored is limited. This prevents delineation of the current condition and pre-mining variability at specific sites and identification of baseline conditions against which predicted impacts can be assessed. The data should also be compared to site-specific trigger values where available. Data used for modelling (e.g. climate data) should also be presented in a manner that highlights the temporal variability within these datasets. This would allow an assessment of the range of conditions included in modelling.
4. Groundwater depths in the regolith need to be shown and compared to the occurrence of potentially groundwater dependent terrestrial vegetation. Mapping should also clearly define where aquifers will experience complete desaturation.

Surface Water

5. There is uncertainty in the water balance and flood modelling results due to the lack of information provided on the modelling methodology. There is limited discussion of the parameterisation and calibration process. Assumptions and limitations are provided for the water balance modelling only. Sensitivity and uncertainty analyses were not undertaken. This reduces confidence in the modelling results and the suitability of the management and mitigation measures based on these predictions. To increase confidence in the water balance and flood modelling and to show that risks can be adequately addressed, consideration should be given to:
 - a. Providing details on the model construction and values of parameters used. Specifically, flood event peak flow volumes should be compared to other studies undertaken in the vicinity of the proposed project and discrepancies fully explained and justified, including why the flood volumes estimated in this study are considerably lower than those estimated in other studies on Wollombi Brook. Due to the backwater issue identified at the Warkworth gauge consideration should be given to using the upstream Bulga gauge.
 - b. Outlining calibration and validation procedures and reporting of results.
 - c. Undertaking sensitivity and uncertainty analysis.
 - d. Justifying the exclusion of any surface features from the 2D hydraulic model mesh.

Groundwater

6. The uncertainty and sensitivity analysis of parameters including recharge and hydraulic conductivity, and the cumulative impact assessment undertaken in the groundwater modelling were completed to a reasonable standard. These analyses have increased the confidence in the

groundwater modelling predictions. Improvements to the groundwater model which would further increase confidence in the model predictions are outlined below.

7. The assessment documentation is unclear whether both void lakes are expected to act as sinks (EIS, p. 80), or whether leakage may occur from the Wambo void lake (EIS, Appendix 12, p. 88). The Wambo void lake base may be above the recovered groundwater levels meaning it could become a source of groundwater recharge. Given this lake is predicted to become hyper-saline, there is potential for contamination of the Permian groundwater system which could spread to the alluvial aquifers and from there to the surface waters. This is due to the high connectivity between the groundwater systems at the site and the density effects of saline water. There is also potential for the hyper-saline water to enter the surface water system if the voids spill.
8. The approved Homestead and Main TSF (located in existing mined-out voids), and the proposed South Bates TSF (located in underground workings) have the potential to become sources of groundwater recharge. The cumulative potential for discharge from these sources needs to be examined. This should include an assessment of the risks to the surrounding groundwater systems, design of a monitoring program which is capable of early detection of any groundwater contamination, and a response plan should contamination be confirmed.
9. The project proposes to use the United Collieries underground workings as a potential mine water storage (EIS, Appendix 11, p. 38). The proponent anticipates that storing water in these workings will potentially lessen drawdown in the Permian groundwater system (EIS, Appendix 12, p. 97), however it has the potential to become a source of contaminated recharge to the groundwater system. The exact location of this proposed store is not identified and the potential for contamination of the alluvial aquifers has not been assessed. This water store should be included in the numerical groundwater model to predict its potential effects on groundwater behaviour and allow an assessment of its potential impacts.
10. A number of faults occur in the vicinity of the proposed project with some intersecting the open cut pits (EIS, Appendix 12, Figure 4-3, p. 35). No discussion or conceptualisation of the style, throw, thrust and penetration of the faults, or how they would influence groundwater flow was presented in the current documentation. Discussion of the groundwater behaviour of faults is needed and their inclusion in the numerical groundwater model should be considered.

Groundwater Dependent Ecosystems

11. The proponent has provided a limited assessment of the proposed project's potential impacts on GDEs, particularly groundwater dependent terrestrial vegetation located to the north of the project area adjacent to the Hunter River. It is also unclear if the potential impacts on GDEs due to the combined effects of both groundwater drawdown and loss of surface water flows, have been fully considered. This is particularly the case along Wollombi Brook, and for its aquatic biota that rely on baseflow during low-flow periods. Stygofauna were sampled only once; a study of temporal variation in Hunter Valley stygofauna reported new taxa were being collected after four sampling periods in over half the bores sampled (Hancock and Boulton, 2009). Further sampling of representative bores within the zone of drawdown should be considered.

Geochemistry

12. It is not possible to assess the potential impacts due to leaching from TSFs, waste rock and the final landforms because the geochemical analysis report was not provided in the assessment documentation. This report should be provided to allow an assessment of whether the risks posed by this material have been adequately addressed.

Question 2: If not, what is a reasonable assessment of the likelihood, extent and significance of impacts on these water resources and water dependent ecosystems?

Response

13. In addition to the responses provided in Question 1, the following would enable assessment of the impacts of the proposed project:
- a. The surface water modelling could be improved by:
 - i. Estimating flood hydrographs using a runoff routing model as recommended by Australian Rainfall and Runoff (Ball *et al.* 2016).
 - ii. Discussing the limitations and assumptions of the selected modelling approach and the data used in the models.
 - iii. Presenting model results against the 2D hydraulic mesh model boundary and aerial photography to facilitate interpretation.
 - b. A systematic approach to identifying GDEs and application of techniques outlined in the GDE Toolbox (Richardson *et al.* 2011) would improve the assessment of potential impacts on GDEs. Additional suggestions include:
 - i. Further surveys of GDEs which may include remote sensing to identify spatial and temporal variations in groundwater dependent vegetation (Barron *et al.* 2014), especially along the Hunter River to the north of the project. Additional stygofauna sampling should also be considered in this area.
 - ii. Discussion of how the predicted drawdown will affect the ability of GDEs to continue to access and utilise groundwater.

Question 3: Has the applicant provided reasonable strategies to avoid, mitigate or reduce the likelihood, extent and significance of impacts? And if not, why are the strategies unsatisfactory?

Response

14. The proposed strategies were not able to be assessed due to the lack of information provided on these strategies in the assessment documentation. The water management plan (WMP) is the central element of the proposed mitigation and management measures. This document has not been finalised and was not provided with the assessment documentation. Therefore the IESC is unable to determine if the proposed strategies are reasonable.

Question 4: Are there further strategies the IESC would recommend to avoid, mitigate or reduce the likelihood, extent and significance of impacts on water resources? And if so, why?

Response

15. Noting the response to Question 3, strategies that could be considered include:
- a. Use of water treatment technologies to improve the quality of discharge waters given exceedances of ANZECC guidelines have been observed in the water management system.

- b. Regular validation and review of the water balance, groundwater and surface water models including independent peer review. Uncertainty analysis of the groundwater model has highlighted that the predicted impacts could vary considerably (e.g. higher hydraulic conductivity rates would reduce surface water flows (EIS, Appendix B of Appendix 12, pp. 40-41)). Therefore improving confidence in the modelling outputs is important. It is noted that some layers of the groundwater model may not contain calibration targets. As part of the validation process, data should be obtained for these layers. Validation should occur promptly once data is available. The proponent has committed to reviewing the groundwater model every 5 years (EIS, Appendix 12, p. 116), however this could be done more frequently and should be done if validation indicates that observed drawdowns are inconsistent with predicted drawdown.
- c. Management actions based on trigger systems need to be clearly articulated and presented for all potential impacts.

Question 5: Does the EIS provide a reasonable assessment of the potential for discharges (including salt) to nearby watercourses and alluvial groundwater systems and the significance of any resulting impacts on water quality and the downstream environment? If not, what additional information would be required to provide a reasonable assessment of these matters?

Response

- 16. No. Some potential discharge sources and pathways have not been fully examined in the assessment documentation. Further consideration is required for:
 - a. Wambo void lake which could become a recharge source for the groundwater systems, as discussed in response to Question 1.
 - b. Possible spillages from the water management system.
 - c. The potential for water from tailings dewatering to be a contaminant source when it is reused.
 - d. Characterisation of metals, nutrients and organics in water discharged at the licenced discharge point on Wollombi Brook.

Explanation

- 17. There is potential for water storages to spill into Wollombi Brook and North Wambo Creek, including some that contain mine water. Due to the issues with the surface water modelling discussed in point 5 of this advice, and the recent dam failure at Wambo Coal, uncertainty exists as to whether the proposed measures to prevent discharges to surface water features will be sufficient. If any of these proposed measures was to fail, uncontrolled discharges of potentially contaminated water may occur. Further assessment of this potential discharge and contamination pathway should be made, with mitigation measures identified should spilling occur. Given the high connectivity between surface water and groundwater in parts of the proposed project area, the potential for contamination of groundwater should be considered and management options developed if needed.
- 18. The proponent proposes to reuse water from tailings dewatering (EIS, p. 235). This water has the potential to be contaminated. Reuse of this water should therefore be confined to areas where runoff can be captured and retained by the water management system to prevent possible discharges to adjacent waterways. Additionally, application rates should be carefully managed to limit the amount of contaminated water that could potentially become groundwater recharge. A water quality assessment of this water should also be undertaken to enable adequate management of these risks.

19. Exceedances of ANZECC guideline values for metals including cadmium, chromium, copper, lead, nickel and zinc have been reported in the surface water management system (EIS, Appendix 11, p. 25). As this water has been regularly discharged to Wollombi Brook it is important that its quality is understood and managed to prevent potential downstream impacts.

Question 6: In addition to the proposed monitoring and management regime recommendations in the EIS, does the IESC recommend additional monitoring and management measures to minimise the risks of the project to water resources and water dependent ecosystems? If yes, what are they?

Response

20. Yes. The IESC suggests the following further monitoring and management actions be considered, in addition to those highlighted in the response to previous questions:
- a. Design and implementation of monitoring programs (including installation of additional monitoring bores) capable of early detection of groundwater and surface water contamination from the Wambo void lake, the TSFs and the final landforms.
 - b. Additional groundwater monitoring bores to the north and northwest of the proposed project site both in the Hunter River alluvium and between the mine and the alluvium, and to the southwest of the proposed project, near Wollemi National Park. These bores would allow potential impacts to be better monitored near these sensitive locations and would provide further data for model validation.
 - c. Further monitoring of surface water and groundwater levels, and ecosystem health at the location identified as GDE 1. These measures would improve the understanding of this ecosystem, and allow a management plan to be formulated to monitor and manage drawdown and prevent complete dewatering of the alluvial aquifer at this location. These actions could be done in co-operation with Hunter Valley Operations South.
 - d. Monitoring of metals in the surface water management system (currently only undertaken by United Collieries annually) should be increased in frequency (e.g. monthly). The proposal to only sample for metals when a pH trigger is initiated would require in-depth knowledge of potentially leachable metals and their solubility characteristics under a range of conditions, which has not been demonstrated in the assessment documentation. Additionally, exceedances of the ANZECC guidelines for metals have been observed in the water storages (EIS, Appendix 11, p. 25), highlighting the need to monitor for metals as this water may be discharged to adjacent waterways, potentially impacting water quality and possibly GDEs. Metals and organics (as toxicants and stressors) monitoring should also be undertaken in receiving waterways as proposed in the EIS (EIS, Appendix 11, p. 89).
 - e. Refinement of the proposed trigger schemes for surface water and groundwater quality and groundwater levels to improve the ability of these schemes to promptly detect change. This includes:
 - i. Discussion of the derivation of the surface water quality triggers and confirmation that these are consistent with the ANZECC methodology.
 - ii. Groundwater quality data should be compared with trigger values when data becomes available rather than annually as currently proposed (EIS, Appendix 12, p. 116) and the temporal scale of sampling increased to three-monthly. The proposed use by the proponent of a control chart approach to developing triggers would require considerable baseline data and a high sampling frequency. It may also lead to issues with gradual

changes not being detected if a moving baseline is used. Derivation of triggers based on the ANZECC methodology (i.e. 80th percentile from reference conditions for physicochemical parameters) could be more appropriate. Proposed control charting may be a useful tool during the investigative phase following trigger initiation.

- iii. The trigger for groundwater drawdown outside the predicted zone of impact needs to consider that using a moving 24-month average as currently proposed (EIS, Appendix 12, p. 116) may allow a gradual decline in water levels to go undetected. Management measures would then not be implemented.
 - f. Measurable triggers, based on robust statistical analyses, should be developed in advanced for identifying significant deviations in groundwater levels from baseline or model predictions. These should be used in addition to the judgement of an expert independent hydrogeologist.
 - g. Automated loggers should be downloaded more frequently, currently proposed to be six-monthly, to reduce the potential for data loss and to improve the capability of the proposed trigger system. Three-monthly sampling of groundwater quality would improve the ability to detect and address changes in water quality.
 - h. Selection of appropriate groups of upstream and downstream sampling locations to be used for identifying the potential impacts of discharge on downstream environments. These should be located within the same reach where possible and the downstream location should not be affected by discharge from other mining operations. Contextual information about the proposed monitoring sites and justification of the selection should be provided.
21. Commitments for surface and groundwater monitoring should be presented as part of a water monitoring plan and should be consistent with the National Water Quality Management Strategy.
22. The Northern Sydney Basin, which includes the Hunter Subregion, has been identified as a Bioregional Assessment priority region. Data and relevant information from the proposed project should be made accessible to this Bioregional Assessment and related research projects.

Date of advice	14 October 2016
Source documentation available to the IESC in the formulation of this advice	ANZECC/ARMCANZ 2000. <i>Australian Guidelines for Water Quality Monitoring and Reporting. National Water Quality Management Strategy (NWQMS)</i> . Canberra: Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. United Collieries Pty Ltd 2016. <i>United Wambo Open Cut Coal Mine Project, Environmental Impact Statement. August 2016</i> . United Collieries Pty Ltd.
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