Independent Expert Scientific Committee
on Coal Seam Gas and Large Coal Mining Development

Advice to decision maker on coal mining project

IESC 2017-083: Hume Coal Project (EPBC 2015/7526) – New Development

Requesting agencies	The Australian Government Department of the Environment and Energy The New South Wales Department of Planning and Environment
Date of request	23 March 2017
Date request accepted	28 March 2017
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 Hume Coal's, Hume Coal project in NSW.

This advice draws upon aspects of information in the Environmental Impact Statement (EIS), 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 Hume Coal Project is a proposed new underground coal mine, located in the Southern Highlands area of the Sydney Basin, which is within a Sydney drinking water catchment, approximately 100 km south west of Sydney. The proposed project will target the Wongawilli Seam of the Illawarra Coal measures and extract 3.5 million tonnes per annum of run of mine coal, over the 23-year life of the project (EIS, p. ES.4). The surface area infrastructure and underground footprint of the proposed project will cover approximately 50 km^2. Infrastructure associated with the proposed project includes: coal preparation plant, overland conveyors, personnel and material drift access, ventilation shafts, water management system, offices, workshop, wash-down facilities, and rail load-out facilities.

The proposed project is located in a semi-rural area with a relatively high number of individual landholders who access and use local and regional aquifers. The project area is predominantly cleared for grazing and other agricultural proposes; however, there are also significant areas of native vegetation within and adjacent to the lease boundary. This includes a number of species habitats and biota listed in the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Threatened Species Conservation Act 1995* (TSC Act).

The proponent proposes to utilise a mining system of first workings that will leave pillars of coal in place to support the overlying strata, with the aim of preventing caving-in of the overburden. This mining method, a modification of a partial extraction method, means the maximum surface settlement

across the project site is estimated to be less than 20 mm and subsidence-related impacts are predicted to be imperceptible at the surface. Underground voids left as a result of mining will be sealed by bulkheads and used to store mine rejects and possibly water used in the mining process.

The Berrima Rail Project is included within the Hume Coal Project EIS; however, it is subject to a separate development application. The IESC has not considered the potential impacts of the Berrima Rail Project in this advice, except where they contribute to potential cumulative impacts.

Key potential impacts

The proposed project has the following key potential impacts on water resources:

- Drawdown in landholders' bores, largely within the Hawkesbury Sandstone.
- Drawdown of the water table resulting in loss of baseflow and subsequent changes to the flow regime and water quality in waterways.
- Drawdown of the water table impacting groundwater dependent ecosystems (GDEs), including riverine GDEs, terrestrial vegetation and subsurface ecosystems.
- Water quality impacts to Oldbury Creek, Medway Rivulet and the Wingecarribee River, and riparian vegetation in these waterways as a result of discharge from site stormwater basins (SBs).
- Water quality impacts to aquifers and groundwater fed surface waters as a result of storing rejects in underground voids.

Assessment against information guidelines

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

Relevant data and information

The proponent has provided a significant amount of information in the EIS; however, there are areas where key conclusions cannot be verified because they are not supported by relevant data and information. These include:

- The Groundwater Dependent Ecosystem (GDE) assessment would be strengthened by the following additional information to understand the range and scale of impacts: a map of the current groundwater table overlain with surface waterways to identify gaining waterways, additional information on the groundwater dependence of key riparian and listed species, and timing and volume of contributions to creek baseflows as determined by groundwater modelling.
- A detailed surface water map to an appropriate scale with clear delineation of relevant waterways, catchments, water storages and surface water monitoring locations was not provided. This is required in order to determine the exact location of surface water monitoring sites, flow pathways and areas of potential impact.
- Data from baseline flow monitoring, undertaken by the proponent, at all flow monitoring sites are not provided. This should be presented as a daily hydrograph and analysis demonstrating baseflow separation to support the conceptualisation of surface water flow regimes in the area.

Application of appropriate methods and interpretation of model outputs:

The assessment generally uses appropriate methods to predict impacts to surface water and groundwater resources. Relevant sections of the assessment where methods and interpretations could be improved include:

- Estimating changes to the flow regime of all waterways predicted to be impacted as a result of baseflow reduction, including the increase of low-flow and zero-flow days, and the timing of these changes.
- The groundwater sensitivity and uncertainty analysis is limited. Sensitivity analysis of the influence of the full range of model parameters and boundary conditions on groundwater drawdown predictions is needed for assessment of the potential scale of impacts and the suitability of monitoring and management options.
- The suggested ameliorative effect on drawdown propagation of proposed reinjection does not appear to be consistent across the domain. Additional explanation of the unusual footprint extent (compartmentalisation) of drawdown predictions, and the influence of reinjection would increase confidence in model predictions.
- Additional information should be provided on all potential geological structures (fault type, throw, persistence; and intrusives) and their associated hydraulic properties. Further field evidence for the occurrence of these geological structures and their influence on drawdown propagation, would increase understanding of likely impacts to groundwater in these areas and of uncertainty in the model predictions.

Advice

The IESC's advice, in response to the requesting agency's specific questions is provided below.

Question 1: Do the groundwater and surface water assessments, including the numerical models within these assessments, provide reasonable estimates of the likely impacts to water-related resources (including water quality and water quantity impacts)? This consideration should particularly refer to the Wingecarribee River and Medway Rivulet Management Zone sub-catchments of the Hawkesbury-Nepean River Catchment.

Response

1. Partially. While the assessment generally provides a reasonable estimate of the likely impacts to the water quantity and quality of the Wingecarribee River and Medway Rivulet Management Zone sub-catchment, there are gaps in the documentation that hinder independent verification of potential impacts. In order to improve the understanding of the magnitude and scale of potential impacts, the following information would need to be provided:

Groundwater

2. The groundwater model lacks a sensitivity analysis on the full suite of hydrogeological parameters, without which it is not possible to assess the robustness of the proponent's prediction of impacts. The model has tested sensitivity of three aspects of the model: height of drainage above underground mine voids, vertical hydraulic conductivity and the mine void drain conductance. Thorough analysis of the groundwater model's sensitivity to variations in its parameterisation is needed, particularly given:

    a. The sensitivity analysis provided in the report does not discuss the effect of model sensitivities on potential drawdown propagation or groundwater impacts. For example,

changes to groundwater predictions should assess the number of additional groundwater users' potentially impacted, potential reductions in baseflow to surface waters and leakage from Medway Reservoir.

b. The groundwater model potentially underestimates/overestimates the number of private landholder bores predicted to be impacted and also baseflow losses to streams. The horizontal hydraulic conductivity (Kh) values used in the groundwater model for the Illawarra Coal Measures are lower than measured values presented in the EIS at Table 7.5. Hawkesbury Sandstone hydraulic conductivity values (particularly the deepest two model layers of the Hawkesbury Sandstone) are also lower than, or at the lowest end of, the range presented within the EIS and groundwater model report. A low Kh value in the model layers representing the Illawarra Coal Measures and base of the Hawkesbury Sandstone will reduce predictions of lateral drawdown propagation in the groundwater model and reduce the upward transfer of that propagation into the Hawkesbury Sandstone.

c. Model sensitivity to storativity values, in particular variation in drawdown predictions, is not considered.

d. Model sensitivity to boundary conditions is not considered. Sensitivity of drawdown to recharge rates and drainage from old mines in the area should be compared with available field information.

3. While several potential uncertainties in the model's construction and data sources are identified, their effects and the effects of other uncertainties on model predictions are not presented. For example, the presence of a sub-vertical flow barrier underneath the basalt is inferred because it improved model calibration. Evidence of geological structures should be provided. Additionally the proponent has identified or inferred that a number of geological structures are located within the project area. These structures have not been conceptualised (e.g. fault displacement, persistence within different strata, and fault hydraulic properties), nor have their impacts on groundwater flow and potential drawdown been assessed. The role of faults as barriers and/or conduits to flow in the groundwater model is unclear.

4. Uncertainties associated with the shape of the drawdown contours need to be discussed, particularly with regard to the effect of reinjection into final voids and the role this plays in the lateral and vertical extent of water table drawdown, including reference to potential impacts to nearby groundwater users.

5. Given the importance of the Hawkesbury Sandstone and the water table to water availability for landholders and GDEs, drawdown maps highlighting the range of possible impacts on these resources are necessary for a full assessment. This should include maps of drawdown at various stages of the project including:

    a. Maximum drawdown in all geological layers and the timeframe in which the maximum drawdown is realised.

    b. 0.2 m contour of drawdown in the water table to identify potential impacts to terrestrial GDEs and other GDEs.

    c. Predicted drawdown in all layers at multiple stages of the project including earlier in the operation, 17 years, 30 years (for consistency with water table prediction maps already presented) and additional post closure time periods to show the rate of groundwater recovery.

Surface water

6. It is unclear what the current predicted baseflow contribution to waterways is (with the exception of Medway Rivulet (EIS, App. H, p. 144 Table 7.1)) and what the predicted impact to the flow duration of the waterways as result of baseflow reduction will be (with the exception of Medway Rivulet and Oldbury Creek). A reduction of baseflow as a percentage of baseflow and the expected increase in zero and low flows days should also be identified for all waterways predicted to be impacted. This is particularly important for the Wingecarribee River as it has the most third-party users.

Water quality

7. It should be demonstrated how the targeted mean concentrations of contaminants, used in MUSIC modeling (EIS, App. E of App. E, p. 58, Table 5.8) for releases from stormwater basins (SB03 and SB04) contribute towards the achievement of the designated NSW water quality objectives over time.

8. The assessment of the short-term and long-term potential for water quality impacts to aquifers and groundwater fed surface waters as a result of coal reject emplacement in underground voids is limited. It is based on two experimental scenarios over short time frames, with conditions that may not be realistic in-situ. Uncertainty remains in the outcomes of emplacement of rejects in underground voids and quantities of lime required to ameliorate the potential release of contaminants.

9. There is also uncertainty in whether the 1% lime treatment proposed to ameliorate the potential metals released from the reject stockpile after rainfall, is sufficient to bring aluminium concentrations down to background aluminium concentrations in groundwater.

GDEs

10. The assessment of impacts to GDEs should include:

    a. A map of the maximum extent of predicted water table drawdown throughout the groundwater model simulation. This should include the range of predicted drawdown impacts as a result of uncertainty analysis, and a contour to 0.2 m of drawdown to identify potential impacts to river baseflow and terrestrial GDEs.

    b. Additional discussion on the groundwater dependence of key species, particularly EPBC Act listed species and habitat's that support EPBC Act listed species.

    c. Identification of flora outside the project area that is EPBC listed or supports EPBC Act listed species, and is potentially impacted by the project, either by baseflow reduction from drawdown or by stormwater basin discharge. Additional surveys should include waterways downstream of the project area where Koala habitat has been surveyed inside the project boundary but has not been identified immediately outside the project boundary as in Figure 4.6 of the Biodiversity Assessment (EIS, App. H, p. 85): Oldbury Creek, Medway Rivulet, and Belanglo Creek.

Question 2: Has Hume Coal developed reasonable strategies to effectively avoid and/or minimise the likelihood, extent and significance of impacts to beneficial water-related resources?

Response

11. Partially. The impacts associated with subsidence are likely to be mitigated with the use of a non-caving mining method. Mining methods that cause subsidence (i.e. longwall mining) have

impacted water users, including swamps and other highly valued GDEs, particularly in the Southern and Western Coalfields. The use of a non-caving mining method is likely to minimise subsidence-related impacts. In this case the proponent has proposed an innovative potentially low impact mining method, and significantly reduced the quantity of coal that will be extracted. However, this modification of a first workings partial extraction has not yet been used in the Sydney Basin and it therefore still needs to be proven.

12. While the proponent has proposed a strategy to minimise the impacts of subsidence, strategies proposed to minimise impacts to groundwater and surface water users need further consideration. These are discussed further in the response to Question 3.

Question 3: What strategies could be implemented to avoid and/or minimise the likelihood, extent and significance of impacts on water-related resources? And if so, what is the justification for these strategies?

Response

Groundwater

13. Methodologies for "make good" provisions, including baseline monitoring, should take uncertainty analysis into account and allow for potential variations in predictions with time. A total of 93 private groundwater bores are predicted to experience drawdown in excess of 2 m. While the proponent states that "make good" arrangements will be implemented, the methodology for baseline assessment and early identification of potential impacts to landholders' bores is reliant on current model predictions of greater than 2 m drawdown. Improved understanding of impacts is likely as mining progresses, which may result in different predictions of drawdown and these should be used to modify the "make good" provisions.

14. The groundwater model technical report and one of the peer reviewers recommended that the groundwater model be updated to include data gathered during the initial period of mining. The EIS needs to clearly identify the timing and process proposed to undertake groundwater model reviews, including the data to be utilised. The period of model verification was up to 6 months, (less for a number of verification data sources), significantly shorter than the 23-year project period.

    a. Ongoing collection of data needs to feed into progressive model updates and should be undertaken to confirm the extent and magnitude of potential impacts and support early identification of any potential further impacts to landholders, potential GDEs and river baseflows.

    b. Baseline data should be used to develop an early-warning program, using locations likely to be the most sensitive to changes in groundwater, appropriate indicators and suitable monitoring protocols that will trigger suitable mitigation strategies.

Surface Water

15. If it is determined that the reduction of baseflow in the Lower Wingecarribee River results in an increase of zero-flow days as outlined in the response to Question 1, an arrangement could be sought with water storage operators upstream of the drawdown impact zone to ensure that environmental flows and water availability in the Lower Wingecarribee River are maintained. The justification for this measure is uncertainty in the extent of baseflow reduction in waterways in the vicinity of the project.

Water Quality

16. There is uncertainty in the outcomes of emplacement of rejects in underground voids, as outlined in the response to Question 1. The proponent should conduct early and ongoing monitoring of the water quality within multiple underground coal fines emplacements. This is to confirm both the effectiveness and quantity of the limestone amendment in mitigating metals mobilisation and acid generation, and ensure that water quality parameters are within the beneficial use criteria. Site-specific water quality guidelines and mitigation/contingency measures should be developed where the limestone amendment does not work as predicted.

17. The proponent states that run-off from operational areas of the site will be directed to project storages, and run-off from high-risk coal contact areas will be transferred to the PWD for storage and reuse. However, the SB04 catchment that is proposed to be one of the two catchments that discharge into Oldbury Creek contains an area of active spoil. With the information provided it is unclear how run-off from the active spoil area is managed or not a high-risk to coal contact. It is recommended the proponent change the surface layout of the site to ensure active spoil is not contained in stormwater basin catchments. The justification for this measure is that it reduces the potential for coal to interact with run-off that will potentially be discharged off-site to Oldbury Creek.

18. The possible need for a site water treatment plant should be determined by the ongoing regular refinement of the site water balance model so that there is sufficient early warning for its construction.

19. Proposed preliminary discharge limits are based on Environment Protection Licenses for similar operations in the Illawarra and Southern Highlands. Currently it is proposed to monitor discharges to Oldbury Creek from SB03 and SB04 (after first flush) for pH, total suspended solids, total dissolved solids and oil/grease. It is recommended that additional contaminants are monitored using site specific water quality guidelines.

GDEs

20. The proponent should undertake an updated GDE drawdown risk assessment to account for the maximum of the range of drawdown outcomes from additional sensitivity/uncertainty analysis undertaken for the groundwater model. There should also be appropriate monitoring and remediation plans in place for potential impacts and strategies for impacts where remediation is not feasible. The justification for this measure is uncertainty in the identification of GDEs and uncertainty in the groundwater model parameters and therefore drawdown. The monitoring and remediation/offset plan should have particular regard for:

    a. The EPBC Act listed critically endangered ecological community (CEEC) of Southern Highland Shale Forest and Woodland.

    b. The Threatened Species Conservation (TSC) Act listed Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland endangered ecological community (EEC).

    c. Monitoring potential EPBC listed species (Koala) habitat within and downstream of the project area including Oldbury Creek, Belanglo Creek and Medway Rivulet.

    d. Monitoring groundwater levels between the project and nearby high priority GDEs, including Paddys River Swamps, to allow early identification of potential for impacts.

Question 4: What monitoring and/or management measures should be implemented to address any residual impacts on water resources?

Response

21. The IESC has identified the following as potential residual impacts:

    a. Reduced surface water flow as a result of loss of baseflow;

    b. Loss of water storage in Medway Dam as a result of increased drawdown;

    c. Impacts to water quality as a result of emplacement of reject material in voids;

    d. Impacts to GDEs; and

    e. Subsidence.

Surface Water

22. The proponent should undertake surface water flow monitoring on Wingecarribee River directly downstream of the project to monitor the potential impact of baseflow reduction on the flow regime of the river. Continuous monitoring of Medway Dam levels would enable impacts of yield loss and drawdown to be assessed.

Water Quality

23. The proponent notes a potential for an increase in aluminum and nitrate in waterways that are predicted to be impacted by a reduction of baseflow as a result of drawdown. The water quality monitoring program should include all waterways that are predicted to experience a reduction in baseflow, including outside of the project area. The program should include appropriate monitoring sites for reference. Mitigation measures should also be developed.

Groundwater

24. The EIS states that a groundwater management plan is to be developed (EIS, p. 224), including incorporation of monitoring programs and establishment of triggers and responses. Details of the monitoring and management measures have not been provided. The additional groundwater management plan should include:

    a. Identification of GDEs most at risk from the project and ensure location of appropriately sited monitoring bores to provide early warning of drawdown propagation in these areas.

    b. Details of the groundwater quality and water table level monitoring schedule, including parameters to be measured and frequency of proposed monitoring/sampling.

    c. Identification of monitoring bores and sampling points to determine groundwater quality impacts from potential contamination from the coal rejects and process water used to backfill underground voids.

GDEs

25. As discussed in the response to Question 3 there is uncertainty in the identification of GDEs. It is identified that two listed ecological communities (an area of Southern Highland Shale Forest and Woodland CEEC, an area of Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland) and a large area of Koala habitat are located in areas predicted to be subject to drawdown of greater than 10 m in places. Currently, there is uncertainty in:

a. The identification of GDEs within and adjacent to the project area (e.g. see paragraph 10)

b. Water requirements and resilience of GDEs

c. The extent of the potentially large areas predicted to be impacted

26. Monitoring of the surface water flows and water quality of Black Bobs Creek and Wingecarribee River is required to identify any potential impact to the important breeding population of Platypus.

27. There should be monitoring of the water table and GDEs (including stygofauna) at locations within the impact zone (including drawdown to 0.2 m) of uncertainty analysis undertaken in the groundwater model, as outlined in the response to Question 3. Monitoring of the water table and GDEs should also occur outside the predicted impact zone to provide reference data to discriminate potential impacts from natural variation in the groundwater table.

Subsidence

28. While the risk of subsidence impacts is considered low, the subsidence management plan should include contingency actions should anomalous subsidence events occur. Anomalous events would be most likely to occur where faults or structural features result in reduced competence (structural integrity) within the local stratigraphy. A number of inferred or identified faults occur within the proposed project area; however, their structural parameters have not been conceptualised (see paragraph 3). Identification of specific assets at risk from anomalous subsidence should also be included.

Date of advice	8 May 2017
Source documentation available to the IESC in the formulation of this advice	Hume Coal Pty Ltd 2017. *Hume Coal Project Environmental Impact Statement.* Hume Coal Pty Ltd 2015. *Hume Coal Project Referral of Proposed Action.*
References cited within the IESC's advice	IESC. 2015. *Information Guidelines for the Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals* [Online]. Available: http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-oct-2015.pdf.