

## Advice to decision maker on coal mining project

### IESC 2013-037: Moranbah South Project, Queensland – New Development

<b>Requesting agency</b>	Australian Government Department of the Environment; and Queensland Department of Environment and Heritage Protection
<b>Date of request</b>	19 December 2013
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<b>Advice stage</b>	Assessment

#### Advice

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the Committee) was requested by the Australian Government Department of the Environment and the Queensland Department of Environment and Heritage Protection to provide advice on the Moranbah South Project in Queensland.

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

The project is proposing a new underground mining operation within the Bowen Basin, approximately 150 kilometres south west of Mackay in Queensland. Coal will be extracted using both longwall, and bord and pillar mining methods, targeting the Goonyella Middle Seam within the Moranbah Coal Measures. The project is within the Isaac River Catchment of the Fitzroy River Basin. The project site covers an area of about 17,550 hectares and is estimated to produce coking coal for export at a rate of up to 18 million tonnes per annum of run of mine coal, with a mine life of 46 years.

There are a number of existing and proposed coal mines on and adjacent to the project site, including the Caval Ridge Project to the west; the Grosvenor Project to the north; Isaac Plains South Project to the east (with part of the tenement overlapping the project site); Eagle Downs to the south east and the Peak Downs mine to the south (Attachment B). Coal seam gas (CSG) operations are also present within the region, including the Moranbah Gas Project and the Bowen Gas Project. CSG operations are also proposed on the project site.

The Committee, in line with its *Information Guidelines*<sup>1</sup>, has considered whether the proposed project assessment has used the following:

#### Relevant data and information: key conclusions

Groundwater model: Sub-surface fracturing in or near observed areas of faulting, particularly within the longwall area of the mine, may further influence interconnectivity. Faults identified within the project site have been excluded from the groundwater model. This has the potential to impact drawdown estimates, particularly where faults may act as conduits for groundwater flow.

Impacts to Isaac River and tributaries: Subsidence and associated impacts to the Isaac River and tributaries are likely as a result of the underground longwall mine. This may result in ponding, changes in groundwater-surface water dynamics, and loss of connectivity along the river and its tributaries. An understanding of the degree of groundwater and surface water connectivity along the Isaac River and its tributaries is needed to evaluate risks associated with ponding.

#### Application of appropriate methodologies: key conclusions

Fracture zone height: Site specific calculations for predicted fracture zone height were not presented for the project. The fracture zone height may have implications for groundwater connectivity between alluvium, Tertiary Basalt and Permian groundwater systems and hydrological impacts could be exacerbated due to the presence of faults within the project site.

Cumulative impacts: The project is located within a region of significant resource development. The Committee acknowledges that the proponent has taken adjacent coal mining projects into consideration in assessing cumulative impacts. However, CSG operations are proposed on the site and these have not been taken into consideration in model scenarios. This may result in an inaccurate estimation of potential groundwater impacts.

#### Reasonable values and parameters in calculation: key conclusions

Groundwater model: Parameters used in the numerical groundwater model, particularly for hydraulic conductivity, have been compiled from limited field data. Additional site specific hydraulic conductivity measurements would improve confidence in groundwater drawdown predictions.

The Committee recommends that the proponent develop any further project assessment documentation in line with its *Information Guidelines*<sup>1</sup>. The Committee's advice, in response to the requesting agency's specific questions, is provided below.

*Question 1: What does the Committee consider are the likely impacts of the proposed action on surface and groundwater resources including, but not limited to, those raised by the State and Commonwealth (Attachment C)?*

1. The proposal will have impacts on groundwater and surface water resources. Likely impacts include: reductions in groundwater levels; changes to groundwater flow paths; potential changes to surface water-groundwater connectivity; and ponding and scouring within watercourses.
2. Groundwater levels in the alluvium and Tertiary Basalt on the project site will be impacted as a result of mine dewatering. These aquifers are estimated to take between 500 and 650 years to recover to 80 per cent of simulated pre-mining levels.
3. Site specific calculations for predicted fracture zone height, which the proponent states will extend as far as the base of the Fort Cooper Coal Measures (FCCM), were not presented. On-site data to support the assumption that the fracture zone will not extend further into the overburden and the FCCM, and potentially to the surface where the FCCM are not present, would allow the full extent of associated impacts to be taken into account.

4. Based on the ephemeral nature of the surface water systems, the proponent has concluded that groundwater is unlikely to provide any significant and sustained baseflow to surface water systems. However, groundwater discharges can be seasonal and contribute significantly to the hydrology of an ephemeral watercourse. Up to 44 metres of drawdown is predicted in the Isaac River and Grosvenor Creek alluvium over the life of the proposal. An understanding of the degree of groundwater and surface water connectivity along the Isaac River and its tributaries (including potential temporal and spatial variations) would allow the full extent of impacts to be realised and managed.
5. The Isaac River experiences periods of no flow that are likely to be influenced by the presence of mining in the region. Subsidence and associated impacts to the Isaac River and tributaries are likely as a result of the underground longwall mine. Subsidence is likely to create areas of ponding within the river and creek beds, and increase flow velocities upstream of the longwall panel subsidence zone. The increase in flow velocities can result in scouring in some sections of the river.
6. The proponent predicts that subsidence-induced depressions in the Isaac River channel will fill with sediment within one to two years of longwall mining. This is based on the assumption that the river will experience significant flow events in the years shortly following subsidence. However, the length of time that it will take to fill river bed depressions will be dependent on the actual flow regime and sediment transport experienced along the watercourses. Prolonged subsidence-induced ponding and instability in watercourse channels have the potential to exacerbate erosion and sedimentation, reduce flow duration and degrade water quality.
7. Subsidence will also create areas of ponding in terrestrial parts of the mine lease. The proponent proposes to undertake drainage works to enable water that would otherwise pool in these areas to drain freely into the nearest watercourse. Despite the implementation of sediment and erosion control measures, the proposed drainage and regrading works are likely to increase turbidity and sedimentation in receiving waterways until the newly created channels are stabilised and well vegetated.
8. Cumulative impacts within the region are expected to be significant given the number and extent of other coal mining and CSG projects in the region and the comparative scale of this proposal. In particular, the assessment does not take into account the cumulative impacts associated with CSG extraction on the project site. Cumulative impacts on water resources are discussed in detail in Question 5.

*Question 2: Have these impacts been adequately addressed within the EIS (including supplementary information)?*

9. Impacts have been partially addressed in the EIS and supplementary information. Further analysis of the following points will help to ensure that management and mitigation responses adequately address the full extent of the impacts:
  - a. Revisions to the groundwater model and additional groundwater monitoring;
  - b. Additional subsidence monitoring and improved confidence in predictions for post-subsidence channel stabilisation in the Isaac River and tributaries;
  - c. Improved testing and management of leachate from the DREA materials;
  - d. Conservative flood modelling predictions;
  - e. Appropriate storage and treatment regimes to contain/manage mine affected water; and

- f. Consideration of the project's contribution to cumulative impacts.

*Question 3: What does the Committee consider are the key uncertainties and risks of the project in relation to water resources that will need to be managed to ensure that related impacts are acceptable?*

10. The primary uncertainty for the project is its contribution to cumulative impacts, given it is located in a region of significant resource development. In this context, a number of factors have been identified that introduce uncertainty in predicting the full suite of impacts on water resources. These factors include: parameterisation of the groundwater model; subsidence associated impacts to the Isaac River and tributaries; groundwater and surface water monitoring; and the management of mine affected water.
11. The Committee identifies the following issues that introduce uncertainty in predicting groundwater impacts from project operations:
  - a. Hydraulic conductivity parameters: The proponent's sensitivity analysis of the groundwater model identified that model calibration could be affected by the parameters used in the model to represent hydraulic conductivity and recharge in the Tertiary basalt. It also identified inaccuracies in parameters used in the model for hydraulic conductivity in the coal seams that could have significant impacts on model predictions for mine inflows. The proponent states that the estimated values for these parameters used in the numerical groundwater model have been compiled using a combination of limited field data, hydrogeological expertise and knowledge of the region. Uncertainty in the values for these significant model parameters could be reduced by the use of additional site specific conductivity measurements to give confidence to groundwater drawdown predictions; and
  - b. Geological faults: Faulting may further increase groundwater connectivity and flow. The contribution of faulting is currently not included in drawdown estimates. The inclusion of on-site faults within the groundwater model would more accurately predict drawdown estimates, particularly where faults may act as conduits for groundwater flow.
12. The proponent's ongoing exploration program should include collection of hydrogeological information (e.g. such as changes in groundwater hydraulic head across fault planes). This information should be incorporated into future iterations of the groundwater model to update and deliver more accurate model predictions.
13. The proponent predicts drawdown in shallow aquifers may be within the range of natural groundwater fluctuation and that seasonal runoff and flow events would provide significant recharge to the alluvium. The proponent concludes that these natural characteristics would offset the predicted dewatering impacts. There is limited on-site monitoring of seasonal groundwater fluctuation and insufficient assessment of recharge to substantiate both these assertions. Further, mining induced drawdown will add to any natural variability. Mitigation measures should address the impact of groundwater drawdown during periods of natural low groundwater level.
14. Long-term groundwater monitoring of target formations, at an appropriate spatial scale and temporal distribution, will improve confidence in the proponent's predictions relating to the impacts of groundwater drawdown. Improved knowledge of the baseline groundwater regime and groundwater-surface water interactions, will provide understanding of:
  - a. The significance of groundwater in supporting riparian vegetation along the Isaac River and Grosvenor Creek;
  - b. The extent of groundwater use by vegetation in the Tertiary Basalt; and

- c. Whether natural recharge will be sufficient to offset groundwater drawdown.
15. Stream gauge data limitations increase the risk that flood extent, depth and velocity for these events may be underestimated. The proponent has undertaken flood frequency analysis using 43 years of recorded data from the Deverill stream gauging station. Given the short period of record, the proponent notes that it is unlikely that the flood frequency analysis will give a reliable representation of flood events greater than the 50 year ARI. It is suggested that the upper 95th percentile confidence limit flood discharge rate for the 1:1,000 year ARI rainfall event is calculated and used to protect mine landforms and infrastructure.
  16. The proponent states that the probability of controlled or uncontrolled discharge is less than once in 123 years; however, the assessment documentation refers to median climatic conditions when discussing aspects of mine-affected water dam design. It is unclear whether mine-affected water dams have been designed to accommodate wetter rainfall conditions.
  17. The Dry Reject Emplacement Area (DREA) has the potential to contribute to groundwater and surface water quality impacts from migration of contaminated leachate. The proponent considers the risk of this impact to be low given proposed management measures and the low likelihood for discharge. However, the proponent notes that discharges from the DREA catch dam may occur during extreme rainfall conditions. Given the elevated metal concentrations measured in leachate from the DREA materials, discharges of this water may impact on water quality within the Isaac River.
  18. As the quality and quantity of water in the mine water management system is likely to vary over time as mining progresses, a robust water quality monitoring program will be important to inform its management. Further modelling of mine-affected water quality within the mine water management system, under climatic scenarios necessitating discharge, is needed. The inclusion of a range of climatic scenarios in the model would support the proponent's conclusion that water discharges will meet aquatic ecosystem water quality objectives without treatment.
  19. The riparian vegetation associated with the alluvium along the Isaac River and Grosvenor Creek has been identified as a groundwater-dependent ecosystem (GDE). Groundwater at some locations within the Tertiary aquifer is shallow enough for use by terrestrial GDEs; however no information is provided regarding their presence on site. Groundwater drawdown, alterations to river flow regimes and the potential connectivity between groundwater and surface water introduces the risk of impact to GDEs. It is further noted that riparian vegetation (*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines) has been identified as high value potential breeding habitat for *Erythrorchis radiates* (Red Goshawk), listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*.

*Question 4: What does the Committee consider are the features of a monitoring and management framework that would address the uncertainties and risks of the project identified by the Committee to ensure environmental outcomes for MNES are achieved?*

20. The proposed project is likely to have an impact on the regional water balance. Confidence in understanding the relative impacts of this mine in relation to the cumulative impacts of other operations would be improved by development of a regional water balance.
21. Groundwater monitoring network: The groundwater monitoring network described by the proponent may not provide optimal coverage of all lithologies across the project area. The groundwater monitoring network could be improved by installing additional monitoring bores at an appropriate spatial and depth distribution to allow reasonable representation across relevant formations. Future groundwater monitoring should be designed to determine a baseline and

seasonal variability of groundwater levels within the alluvium and Tertiary Basalt, and detail the potential extent of surface-groundwater interactions.

- a. The revised Environmental Management Plan (EMP) provided in the December 2013 Addendum to the EIS identifies trigger thresholds for groundwater levels and groundwater quality parameters for life of mine monitoring. The rationale and the monitoring data to support the chosen trigger values are not provided in the EIS. The given trigger thresholds should be clarified and demonstrated to be appropriate for each hydrogeological unit. Management actions arising from exceedance of the trigger thresholds should also be defined.
22. Subsidence fracturing: The height of subsidence fracturing in the strata above longwall mining may potentially result in connectivity with the Tertiary Basalt, alluvium and surface waters. Predictive modelling of the height of subsidence fracturing above longwall mining and the height of direct hydraulic connectivity with the mine workings would inform appropriate management responses. The monitoring of the subsidence fracture zone would validate model predictions in relation to inter-connectivity between formations. Monitoring should be undertaken pre- and post-mining, particularly under watercourses and in areas with shallow depth of cover relative to the target seam.
23. Isaac River and tributaries: In order to inform effective responses to potential surface water impacts, the following monitoring and management measures would be beneficial:
- a. While the proponent has considered post subsidence stabilisation of the Isaac River under median to high rainfall conditions, assessment of watercourse stabilisation timeframes under drier climatic scenarios is needed to inform mitigation and management responses. The assessment should be expanded to include Grosvenor Creek and Cherwell Creek. The effects of cumulative groundwater drawdown and likely future discharges from resource operations upstream of the proposal should also be considered;
  - b. Data presented in the assessment documentation indicates that kinetic leachate tests have not been undertaken for a sufficient period of time to define long term leachate quality from the DREA. Kinetic testing of representative reject material should be continued until robust conclusions can be drawn about the quality of post-mining leachate. The results of these tests should be used to inform post-mining monitoring and maintenance requirements; and
  - c. Modelling of mine-affected water quality within the mine water management system, under climatic scenarios necessitating discharge, is needed to confirm that water discharges will meet aquatic ecosystem water quality objectives without treatment.
24. Key features for the monitoring and management measures in the proposal's environmental management framework to reduce uncertainties surrounding the presence of GDEs and manage any potential impacts include:
- a. Investigation of the use of groundwater by vegetation in the project area using the tools in the Australian GDE Toolbox (Richardson et al. 2011)<sup>2</sup> to determine groundwater dependence and potential impacts due to groundwater drawdown;
  - b. Two monitoring bores have been established in the alluvium. Given the heterogeneous nature of river alluvium, potential impacts to the Isaac River and the scale of the project, additional monitoring locations within the alluvium are recommended;

- c. Two individuals of a harpacticoid copepod were found within the Tertiary Basalt, however the sampled bores were less than six months old and no further sampling was carried out. Additional sampling should be undertaken in the bores previously sampled and in the two bores recently drilled into the alluvium. Sampling for stygofauna should conform to WA EPA Guidance 54a (Environmental Protection Authority, 2007)<sup>3</sup>.

25. Monitoring of aquatic ecological values, particularly macroinvertebrate and fish community richness, is needed to improve understanding of the spatial and temporal variability of baseline data. This information is needed to substantiate the proponent's conclusion that impacts on aquatic ecosystems will not occur.

*Question 5: Have the cumulative impacts of coal and gas projects already operating in the location been sufficiently addressed?*

26. Significant CSG operations are proposed or currently exist in the region. Existing groundwater drawdown from historical and ongoing production at the Moranbah Gas Project has been considered in the groundwater model. However, the CSG extraction proposed on the project site has not been taken into consideration in modelling scenarios and as such model predictions of impacts have the potential to be underestimated. The large Bowen Gas Project is also noted to be present in the region.

27. An assessment of cumulative impacts on the hydrology and water quality of the Isaac Rivers and its tributaries has not been undertaken. This assessment should consider groundwater drawdown, subsidence effects and water discharges within the Isaac River catchment to assist in identifying the full extent of potential impacts.

28. The proponent has incorporated the Isaac Plains South Project's Overburden Emplacement Area, flood protection levy and Conrock Gully diversion into the flood model. Scenarios for other existing and proposed developments which may influence flood behaviour, either through landform changes or discharges of mine affected water during flood events, would be beneficial to determine the full range of impacts in a regional context.

29. The proponent states that no significant cumulative aquatic ecology impacts are anticipated. However, given the number and extent of other projects in the region and potential impacts as a result of subsidence, altered flow regimes and potential connectivity with groundwater, ongoing monitoring will be needed to substantiate this prediction.

30. The Committee notes the reference to the Isaac River Cumulative Impact Assessment of Mine Development (CIA) report funded by Anglo American Metallurgical Coal and BHP Billiton Mitsubishi Alliance (Lucas *et al.*, 2008). The proponent states that subsidence of the Isaac River predicted as part of this proposal is similar to that assessed in the CIA report and as such, the findings of the CIA are directly applicable. However, a copy of this report was not provided as part of the assessment documentation and does not appear to be available publicly. Therefore, the conclusions relating to the nature, magnitude and duration of subsidence effects on the Isaac River could not be verified.

*Question 6: Are there additional measures and commitments required to mitigate and manage impacts to MNES?*

31. In addition to measures discussed in response to Question 4, the Committee considers that the management proposals to address potential impacts from subsidence and mine affected water could include:

- a. Variable levels of salinity and elevated concentrations of metals are anticipated in groundwater and in mine-affected water storage dams. Appropriate on-site containment and possible treatment may need to be considered to minimise risks to downstream ecological systems or shallow groundwater, particularly during periods of heavy rainfall; and
  - b. The proponent intends to undertake a survey of potential tension cracking areas within six months of subsidence to locate cracks. Surface tension cracks of up to 0.3 metres wide and 10 metres deep are predicted where the depth to mining is shallow. Where cracks are located in watercourses, they should be remediated prior to the onset of the wet season.
32. 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. Results should be compared to local water quality objectives for aquatic ecosystems, where these are available, or the ANZECC Guidelines (2000) where local water quality objectives are not available.

<b>Date of advice</b>	7 February 2014
<b>Source documentation available to the Committee in the formulation of this advice</b>	Moranbah South Project, Environmental Impact Statement (July 2013) Moranbah South Project Environmental Impact Statement Addendum (December 2013)
<b>References cited within the Committee's advice</b>	<p><sup>1</sup> Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources, available at: <a href="http://www.environment.gov.au/coal-seam-gas-mining/project-advice/pubs/iesc-information-guidelines.pdf">http://www.environment.gov.au/coal-seam-gas-mining/project-advice/pubs/iesc-information-guidelines.pdf</a>.</p> <p><sup>2</sup> Richardson, E., Irvine, E., Froend, R., Boon, P., Barber, S. and Bonneville, B. (2011). Australian groundwater dependent ecosystems toolbox part 2: assessment tools, Canberra: National Water Commission.</p> <p><sup>3</sup> Environmental Protection Authority (2007). Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986) Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia. No. 54a. Technical Appendix.</p>