

Advice to decision maker on a coal mining project

IESC 2014-050: Rolleston Coal Expansion Project (EPBC 2011/5965) – Expansion

Requesting agency	The Australian Government Department of the Environment The Queensland Department of Environment and Heritage Protection
Date of request	8 May 2014
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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 the Queensland Department of Environment and Heritage Protection to provide advice on the Rolleston Coal Joint Venture, Rolleston Coal Expansion Project (RCEP) in Queensland.

This advice draws upon aspects of information in the Draft 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 Rolleston Coal Joint Venture currently extracts up to 14 million tonnes per annum (Mtpa) from four open cut pits at the Rolleston Coal Mine (RCM), which is located 16 km west of the township of Rolleston in the Bowen Basin. The RCEP would expand the RCM, creating an additional three open cut pits and increasing run-of-mine (ROM) production by 5 Mtpa to a total of 19 Mtpa. The life of the RCM would be extended by 23 years.

Ancillary infrastructure would include upgrade of processing facilities, construction of a number of levees to protect mine pits from flood water, and the diversion of Sandy Creek, Bootes Creek, Gibbs Gully and Patons Spring Gully.

Key water related assets in the vicinity of the RCEP include: 91 landholder bores, including an irrigation area within MLA70458; the Albinia National Park; wetland areas designated as High Ecological Significance (HES) and/or High Aquatic Ecological Value under state planning instruments; one confirmed threatened ecological community, Coolibah (*Eucalyptus coolabah*) woodland on alluvial plains, assessed by the proponent to be groundwater dependent; four threatened ecological communities that are potentially groundwater dependent; confirmed or potential habitat for 27 listed threatened and/or migratory bird species whose habitat includes wetland areas and/or ecological communities considered potentially groundwater dependent; and possible new species of obligate groundwater crustaceans.

Assessment against information guidelines

The IESC, in line with its Information Guidelines¹, has considered whether the RCEP assessment has used the following:

Relevant data and information: key conclusions

Ecological surveys in areas of predicted impact beyond the RCEP's lease boundaries are needed to inform the assessment of potential impacts on ecosystems. The groundwater dependency of wetlands and terrestrial vegetation within the predicted area of groundwater drawdown should be determined.

The collection of measured stream gauge data during high flow events would address uncertainties identified during hydrologic model calibration.

Downstream users of groundwater and surface water resources should be clearly identified.

It is important that, for extensions of mining projects, data from the existing operations is analysed and presented to substantiate conclusions in the EIS's.

Application of appropriate methodologies: key conclusions

The proponent has provided a conceptual model for the region, based on a fundamental understanding of the local and regional geology.

Consideration of groundwater drawdown impacts on surface water hydrology and quality is needed to evaluate the short and long-term risks to water related assets, including human and ecological users of surface water resources.

The magnitude and extent of predicted flood impacts may not be accurate due to the use of a 1D model for the Bootes Creek catchment; restricted flood model domain boundaries; and exclusion of some mine landforms and infrastructure from the hydraulic model.

Further explanation of the proposed lateral mobility design for creek diversions is needed to confirm that the long term stability of nearby mine landforms, including waste rock dumps and flood levees, will not be affected.

Quantification of the potential impact of the proposed Meteor Downs South Coal Mine (MDSCM) on the RCEP's site water balance and interaction with the RCEP in relation to cumulative groundwater impacts is needed.

Reasonable values and parameters in calculation: key conclusions

Justification and/or further information are needed to support the proponent's approach or conclusions in relation to the recharge rates and hydraulic conductivity values used in the numerical groundwater model for the Quaternary Alluvium; proposed design parameters for watercourse diversions, which are inconsistent with guideline values (DEHP, 2011)¹; and calibration results for the flood model, which show a time shift between the modelled and measured flood peaks.

The IESC recommends that any further project assessment documentation includes information to enable a robust assessment of impacts on water resources as outlined in the Information Guidelines².

Advice

The IESC's advice, in response to the requesting agencies' specific and numerous questions, has been grouped according to theme (groundwater; groundwater dependent ecosystems; water balance; surface water; threatened ecological communities and species and matters of national environmental

significance (MNES); cumulative impact; and Draft Environmental Management Plan) and references to the relevant paragraphs are provided after each question.

Groundwater:

Question 1: Are the models, including the numerical model, adequate and the relevant data and analyses adequate to assess the potential impacts on surface water, groundwater and their interaction on listed threatened species and communities, including groundwater dependent ecosystems and matters of national environmental significance (MNES) and users of that surface water and groundwater resources? *See Paragraphs 1, 2, 7, 8, 11, 14*

- a. Is the Committee satisfied that the range of uncertainty in predictions are appropriately investigated and quantified? *See Paragraphs 1, 2, 3, 5, 7, 8, 11-14*
- b. What can be done to improve the inadequacies identified? *See Paragraphs 2, 4, 5, 7, 8, 12-14*
- c. Are there additional measures and commitments required to mitigate and manage identified impacts? *See Paragraphs 5, 12 & 13*

Question 2: Does the Committee agree with conceptual groundwater model that the proponent has developed? Does the Committee consider that the groundwater modelling has adequately addressed the identified uncertainties? *See Paragraphs 1, 2, 3, 7-14*

Question 3: Is the Committee satisfied that the EIS satisfactorily identified the key uncertainties, sensitivities and risks around outputs of the groundwater modelling in relation to impacts on water resources? Is the Committee satisfied that the model inputs and outputs were reliable and that any predictions founded on those were adequately described including incorporating the range of uncertainty about the predictions? *See Paragraphs 1, 2, 3, 7-14*

Question 4: Does the Committee agree with the conclusions set out in Chapter 10, Groundwater in particular, impacts to wetlands, residual drawdown and impacts to the Meteor Creek alluvium? *See Paragraphs 3, 4, 6, 7, 9, 11, 13, 14*

Question 5: One of the most apparent potential risks in relation to groundwater relates to the proposed mining through Sandy Creek and alluvium associated with Sandy and Meteor Creeks to a point approaching Meteor Creek. Critical issues associated with predicting inflows from the Meteor Creek alluvium appear to be the understanding of recharge to the alluvium from Meteor Creek and the hydraulic conductivity of the alluvial sand and gravel between the creek and proposed pits, Meteor South A and B. Does the Committee consider that the work presented by the proponent adequately defines these parameters to allow a reasonable understanding of potential inflows from this source? *See Paragraphs 2, 11, 12, 14*

Question 6: EHP notes that predicted impacts in the alluvium appear to extend downstream and upstream of existing monitoring bores in the alluvium. Does the Committee consider that the monitoring network in the alluvium is adequate to monitor potential impacts in the alluvium? *See Paragraph 5*

Question 7: The EIS states that:

- a. Residual impacts to groundwater are anticipated in the short to medium term, concerning groundwater flow and height and are relative to the duration of dewatering.
- b. Post-closure impacts are anticipated to be limited until the steady state between void water and groundwater is reached; any impact on beneficial use or natural ecosystem values during

this time period is not considered to be significant.

Does the Committee agree with these conclusions? *See Paragraphs 6, 11, 12, 13*

Question 8: Does the Committee consider that the data uncertainty and integrity issues raised in Sections 3.1.4 and 4.6 of this RfA are suitably addressed in the EIS? *See Paragraphs 1-4, 7-14*

Section 3.1.4:

- a. A level of certainty uncertainty is noted with respect to the information provided by the proponent in relation to groundwater, including:
- i. limited information on the cumulative impacts of water flow within the catchment;
 - ii. recharge rates from Meteor creek to the alluvium adjacent proposed south pits;
 - iii. hydraulic permeability of sands and gravels in this area;
 - iv. recharge rates in the alluvium downstream of the impacted area in the alluvium. Does this downstream area rely on downvalley flow from impacted area or does it have its own source of local recharge?

Section 4.6(a-c):

- b. A level of uncertainty is noted in the EIS with respect to the information in relation to groundwater, including:
- i. recharge rates from Meteor Creek to the alluvium adjacent proposed south pits;
 - ii. hydraulic permeability of sands and gravels in this area;
 - iii. recharge rates in the alluvium downstream of the impacted area in the alluvium. Does this downstream area rely on downvalley flow from impacted area or does it have its own source of local recharge?

Response

1. The proponent has provided a conceptual model for the region, based on a fundamental understanding of the local and regional geology. However, uncertainties remain in relation to the extent of alluvium along Bootes Creek and the potential for groundwater interaction with surface water features; in particular, the wetlands located within the extent of predicted drawdown. Model construction and domain appear adequate. With the exception of parameterisation for the alluvium within the numerical groundwater model, parameters in general appear reasonable and representative of aquifer conditions.
2. Recharge and hydraulic conductivity in the Sandy Creek and Meteor Creek alluvium may not be adequately represented in the groundwater model. Higher estimates for recharge and hydraulic conductivity could be used in the model to account for the highly variable nature of alluvial sediments and provide a more robust estimate of potential mine inflows.
3. The IESC does not agree with the conclusions in Chapter 10 in relation to potential impacts to wetlands, groundwater dependent ecosystems (GDEs) and residual groundwater drawdown impacts, particularly the Tertiary Basalt and Quaternary Alluvium. These impacts need to be further investigated in the groundwater model using a sensitivity analysis. Based on the results of water quality monitoring in the deeper aquifers, the proposed 'make good' arrangements, using this groundwater, for impacted landholders may not provide landholders with water of a similar quality

and quantity as they currently access. The quality of any water supplied to landholders from the RCEP's water management system should comply with the appropriate guideline values for beneficial use.

4. It is likely that recharge of the downstream alluvium relies on a proportion of surface water flow from the impacted area. Recharge is likely to occur locally from rainfall and discharge from adjacent formations. The predicted reduction in baseflow to Meteor Creek is likely to impact downstream alluvium due to the reduced volume of surface flow available for recharge. Information on the reliance of human and ecological users on alluvial groundwater downstream of the RCEP is needed to understand the significance of this impact, if any.
5. Extension of the monitoring network in the Quaternary Alluvium beyond the predicted zone of drawdown would enable the extent of impacts to be delineated and monitored. Monitoring points upstream and in particular downstream would also provide a basis for monitoring changes to water quality outside the zone of dewatering, and detecting and monitoring potential impacts, if any, on downstream users. This approach could be adopted to monitor impacts in the Tertiary Basalt and alluvium in MLA70415.
6. The IESC agrees that short and medium term impacts are associated with dewatering during the operational phase of the mine. Long-term impacts on the Quaternary Alluvium, landholder bores, GDEs and wetlands, the hydrology of Meteor Creek, and groundwater quality, including water quality in the final void, are potentially significant. (See also Paragraph 16 on page 7).

Explanation

Conceptual and numerical groundwater models

7. Further conceptualisation and data are needed to support conclusions of limited surface water - groundwater interaction, particularly in relation to the potential for water within the Tertiary Basalt to discharge to wetlands. The results of isotope tests conducted by the proponent are a useful start to understanding groundwater-surface water dynamics, although they should be repeated on a regular basis to understand the longer term influences rainfall, runoff and seasonal climate variation on groundwater-surface water interactions.
8. The extent of alluvium along Bootes Creek should be investigated to determine whether it is laterally continuous. While the interaction between Bootes Creek and groundwater has been taken into consideration in the model, continuity of the alluvium is of significance for the assessment of the water balance in this area and its impacts on mine flows, and needs to be accurately represented in the model.

Impacts and uncertainty

9. Sensitivity testing of possible groundwater and surface water dynamics should be undertaken, especially with respect to characterising their influence on high conservation value assets. Variation in hydraulic conductivity values and rainfall conditions should be incorporated. Impacts to the Quaternary Alluvium are predominantly associated with the dewatering and part excavation of these units. There is potential for downstream impacts to groundwater flow in the alluvium as a result of its truncation and reduced flow in Meteor Creek.
10. Direct and indirect impacts are also likely along Bootes Creek and Spring Creek in the northern portion of the site due to direct removal of material in these areas and associated groundwater drawdown within the Tertiary Basalt. This may also impact connected surface water features and bores screened within this aquifer.

11. Short to medium term impacts to groundwater will depend on rainfall conditions as well as the phase, timing and duration of RCEP operations. Numerical model predictions are based on average rainfall conditions; however, drier or wetter conditions may influence the degree and extent of drawdown, particularly within the Quaternary Alluvium. Mine inflows are sensitive to recharge of the alluvium and therefore, the volume of inflows is also likely to be influenced by climatic variability.
12. There is uncertainty about the post-mining hydrology and water quality associated with the Meteor South Pit void. Water flux in this void may be dynamic during periods of above average rainfall and recharge in impacted aquifers could influence post-closure fluxes. The risk of discharge from the final void into adjacent aquifers needs to be considered and mitigation measures developed, if necessary. The timeframe for groundwater impacts to reach a state of equilibrium with the surrounding region and changes to groundwater levels, compared with pre-RCEP levels, should be clearly stated.
13. Quantification of the concentration and timeframe for stabilisation of salinity and any toxicants in water held within the final voids would enable the long-term management of this water to be evaluated. Given that the final voids are predicted to act as groundwater sinks, an explanation of the mechanism by which salinity in the W4 Pit's final void decreases is needed.

Characterisation of the Quaternary Alluvium

14. Adoption of higher hydraulic conductivity values for the basal sands and gravels would more accurately reflect field data for this unit and enable the range of potential mine inflow volumes to be predicted with more certainty. Data analysis and field work to characterise the Quaternary Alluvium indicates hydraulic conductivity of between 104 m/day and 115 m/day in the basal sands and gravels, which is not reflected in the groundwater model's parameterisation of this unit of between 41 m/day and 61 m/day. Further, in the absence of field investigations to estimate groundwater recharge, it is suggested that adoption of a higher recharge rate within the model be considered, given the highly variable nature of alluvial sediments.

Groundwater Dependent Ecosystems:

Question 9: The EIS indicates that one of the wetlands in the project area (located on MLA70416) may be dependent on groundwater. Furthermore, several watercourses and creeks on the project site, including Bootes and Meteor Creeks and some minor creeks may be groundwater dependent due to the presence of RE 11.8.11a – *Melaleuca bracteata* woodland drainage depressions. The EIS did not adequately address the long-term post mining impacts to these waterways, the impacted wetland and surrounding wetlands? Does the Committee agree that [sic] with the assessment? Are the proposed mitigation measures considered appropriate? See Paragraphs 15, 16, 18 & 19

Question 10: The EIS states that:

- a. Residual impacts to groundwater are anticipated in the short to medium term, concerning groundwater flow and height and are relative to the duration of dewatering.
- b. Post-closure impacts are anticipated to be limited until the steady state between void water and groundwater is reached; any impact on beneficial use or natural ecosystem values during this time period is not considered to be significant.

Does the Committee agree with these conclusions? See Paragraphs 15, 16, 18 & 19

Question 11: Does the Committee consider that the data uncertainty and integrity issues raised in

Section 4.6 of this RfA are suitably addressed in the EIS? See Paragraphs 17 & 20

Section 4.6(d):

The EIS identified stygofauna species in groundwater likely to be affected by the project and that localized loss of stygofauna communities is likely to occur within the project footprint. Does the Committee agree and that the EIS should fully describe any mitigation measures that may be applied and it should identify through further survey work whether the identified species have a wider distribution outside the area of influence of the project?

Response

15. The assessment documentation does not adequately address long term post mining impacts, particularly in relation to Bootes Creek, Meteor Creek, the impacted high environmental significance wetland on ML70307, or surrounding wetlands. The proposed mitigation measures are not appropriate because the impacts of groundwater drawdown have not been considered.
16. The IESC does not agree that residual impacts are relative to the duration of dewatering, as the impacts of groundwater drawdown are expected to extend beyond the duration of dewatering and to persist for up to 100 years. Further, there is no information on final groundwater levels once the state of quasi-equilibrium is reached. Long term impacts on beneficial use and natural ecosystem values are potentially significant.
17. The assessment documentation should fully describe measures to identify, mitigate and monitor impacts to stygofauna, including:
 - a. Identification to species level of the stygofauna specimens collected in the August 2011 sampling;
 - b. Further survey work within and outside the zone of modelled groundwater drawdown to clarify the distribution of stygofauna recorded in the August 2011 sampling and whether they are endemic to the RCEP lease areas; and
 - c. Development of a strategy to facilitate the persistence of any species identified as endemic to the zone of groundwater drawdown.

Explanation

18. Comprehensive identification and conceptualisation (underpinned by adequate data) of hydro-dependencies of GDEs within the area of groundwater drawdown is needed to enable a full evaluation of potential impacts and risks to natural ecosystems. Information provided in the assessment documentation suggests that wetlands, aquatic ecosystems and terrestrial vegetation could be groundwater dependent; however, no surface water bodies and only one of the ecological communities associated with alluvium and/or drainage lines, Coolibah (*Eucalyptus coolabah*) woodland on alluvial plans, have been assessed as groundwater dependent. If surface water bodies and other terrestrial vegetation are groundwater dependent, the ecological impacts of groundwater drawdown are likely to be underestimated.
19. As the equilibrium storage level in the final void will not be reached for up to 100 years after the completion of mining, actions to mitigate the impacts of groundwater drawdown on GDEs need to encompass this time period. If groundwater levels are not anticipated to recover to pre-RCEP height, the long term impact of this on GDEs should be clearly stated.
20. Measures to delineate the distribution of any new species of stygofauna identified within RCEP lease areas would determine whether the species are endemic to the RCEP/RCM lease areas and

if the development of measures to facilitate their persistence is warranted. Specimens of the obligate groundwater crustacean taxa Copepoda and Syncarida are potentially of conservation interest as they may be new species and, in the case of the syncarid, a new genus.

Water Balance:

Question 12: The EIS states that Naroo Dam is the existing raw water supply for the Project. Naroo Dam is the primary source of raw water storage and collection for Rolleston Coal Mine village accommodation (treated to potable standard), workshop and vehicle wash down. Additional raw water is also available from pit water and groundwater sources. These sources currently provide sufficient supply for the mine and would also accommodate the required additional demand of the Project. A detailed description of the GoldSim water balance model and the modelled outputs are provided in the technical Appendix G-1, Surface water technical report.

The proponent was recently granted a water permit under the provisions of the Queensland Water Act 2000, to take underground water for their existing operations as a result of recent drought conditions impacting on the usual water supply and without additional rainfall, the existing mine operations could not continue with its dust suppression activities to ensure compliance with dust conditions on its existing environmental authority. This appears to contradict the proponent's statement in the EIS that these sources currently provide sufficient supply for the mine and would also accommodate the required additional demand of the Project.

Also to note, Spring Creek Dam was a 6 GL overland flow storage that also provided water supply to Rolleston Coal Mine. This dam has now been mined through and the Queensland Department of Natural Resources and Mines is currently in discussions with the proponent about the relocation of this previously existing storage. This storage has not been included in the water balance model.

Is the Committee satisfied that there is sufficient information provided in the EIS and that the water balance model has been appropriately applied to support the above statement, considering that the proponent has recently required additional water for their existing mine operations?

Question 13: Does the Committee consider that the data uncertainty and integrity issues raised in Sections 3.2.4 of this RfA are suitably addressed in the EIS?

Section 3.2.4:

- a. Has the water balance model been appropriately applied to support the statement in the EIS that Naroo Dam, pit water and dewatering sources currently provide sufficient supply for the mine and would also accommodate the required additional demand of the Project?
- b. Tenements [sic] overlying the catchment area reporting to Naroo Dam is held by another mining company. What are the risks associated with the water balance model should this catchment area no longer be available to report to Naroo Dam for mine raw water supply?

Response

21. Information provided in the assessment documentation is not sufficient to support the statement that water sources identified in the site water balance would also accommodate the required additional demand of the RCEP. The same conclusion applies if an additional proposed water source, Water Storage Dam 2, is included.
22. The water balance model appears to have been appropriately applied to identify potential water deficits from reliance upon the Pit Water System, Water Storage Dam 2 and Naroo Dam. However,

it has not been applied to identify how the full suite of options (including efficiency gains and groundwater supply) would accommodate the required additional raw water demand of the RCEP.

23. There is a risk that the neighbouring proposed MDSCM may reduce surface flows to Naroo Dam. This may cause even greater water supply deficits than those already predicted for Naroo Dam. This risk is not represented in the water balance assessment.

Explanation

24. Reporting on water balance models is not sufficiently explicit to gauge the integrity of water balance assessments or provide indication of relative perturbation to hydrology. Presentation of annual inflow, outflow and deficit data, which include start and finish storage volumes, is needed to enable the predicted water deficit estimates to be reviewed for robustness and accuracy.
25. Mining and associated diversions proposed for the MDSCM development would result in loss of catchment area of both Spring Creek and Naroo Dam. The risk of reduced inflow is not represented in the Naroo Dam water balance assessment, and may be greatest in periods of low flow. The potential impact of MDSCM on the water balance for the RCEP should be quantified in the water balance so that the maximum potential raw water deficit is known and the scale of any required additional supply is fully understood.
26. It is not clear whether efficiency gains and groundwater supply, which are proposed to mitigate the predicted raw water supply deficit, will adequately meet the predicted raw water supply deficits in Water Storage Dam 2 and Naroo Dam. Information on the likely methods and scale of efficiency gains or the location and volume of additional groundwater supply is needed to improve confidence that raw water supply deficits can be met through these measures. Quantification of additional raw water needs should consider the potential loss of catchment to Naroo Dam.

Surface Water:

Question 14: Are the models, including the numerical model, adequate and the relevant data and analyses adequate to assess the potential impacts on surface water, groundwater and their interaction on listed threatened species and communities, including groundwater dependent ecosystems and matters of national environmental significance (MNES) and users of that surface water and groundwater resources? See Paragraph 27

- a. Is the Committee satisfied that the range of uncertainty in predictions are appropriately investigated and quantified? *See Paragraphs 27 & 35-38*
- b. What can be done to improve the inadequacies identified? *See Paragraphs 28 & 35-38*
- c. Are there additional measures and commitments required to mitigate and manage identified impacts? *See Paragraphs 29, 74 & 75*

Question 15: The EIS concludes that the surface water residual impacts of the Project are small and typically limited to catchment loss, water quality and afflux. Does the Committee agree with this conclusion? See Paragraphs 30-32, 33, 34 & 39-45

Response

27. The flood and hydraulic models are not adequate to assess in full the potential impacts of the RCEP, including impacts on listed threatened species and communities or users of surface water resources. There is uncertainty in the calibration of the hydraulic model, and the use of a one dimensional flood model across MLA70415 may not accurately depict the depth and extent of flooding, particularly during overbank flows.

28. Potential flood-related impacts could be evaluated more robustly by:
 - a. Using a 2D hydraulic model in the western domain of the flood model;
 - b. Presenting data on changes to the timing and duration of flood events;
 - c. Extending the model domain west, south and east, into the Albinia National Park; and
 - d. Including the realigned Springwood Road and all waste rock dumps in the revised model.
29. Additional measures and commitments are likely to be required to mitigate and manage flood-related impacts; particularly in relation to maintaining watercourse and floodplain stability.
30. The IESC does not agree that residual impacts on surface water will be limited to catchment loss, water quality and afflux. Additional residual impacts, which could be substantial, are considered to be:
 - a. Changed flow regimes within Sandy Creek and Meteor Creek due to groundwater drawdown;
 - b. Potential destabilisation of creek diversions, waste rock dumps and levees; and
 - c. Alteration of the geomorphology of Meteor Creek adjacent to, and potentially downstream of, the Meteor Creek Levee.
31. The IESC does not agree that residual impacts on surface water resources can be assessed as small as:
 - a. No methodical residual risk or impact evaluation process appears to have been conducted for surface water aspects of the assessment documentation to support this claim;
 - b. The assessment of residual risks has not considered all of the RCEP's proposed activities and potential impacts; and
 - c. Residual risks to water related assets within and downstream of the RCEP are potentially underestimated.
32. Residual impacts from catchment loss associated with the creation of mine pits, however, are unlikely to be significant in the regional context.

Explanation

Residual risk assessment

33. Confidence in the proponent's evaluation of residual risks would be improved by demonstrating that an environmental risk assessment, in accordance with published risk assessment methods, has been undertaken to evaluate the unmitigated and residual risks to surface water resources.
34. The provision of measured data from the existing RCM monitoring program would demonstrate the effectiveness of existing mitigation and management measures and improve confidence in the proponent's evaluation of residual risk.

Residual flood impacts and modelling

35. The impact of placing a waste rock dump in the active Spring Creek channel should be considered in the assessment of residual risks. Diversion of the upper reaches of Spring Creek is not proposed and the out-of-pit waste rock dump has not been included in the hydraulic model. The waste rock

dump is likely to alter flood behaviour in the Spring Creek and Bootes Creek catchments and flood events pose a risk to the integrity of the waste rock dump.

36. Use of a 2D model or a coupled one-dimensional river hydraulics model and 2D water surface model across MLA70415 would more accurately predict changes to the depth and extent of flooding, particularly during overbank flows.
37. The range of uncertainty in predictions may not be accurately quantified due to limitations in stream gauge data, and as indicated by the time-shift in peak discharge shown in model calibration curves. These uncertainties may be improved by obtaining additional high flow stream gauge data and determining catchment loss factors from a more accurately represented calibration event. Confidence in the flood models and the conclusions of the flood study would also be enhanced by:
 - a. Expanding the flood model domain to incorporate the entire diverted reach of Bootes Creek and the RCM, and downstream of the confluence of Meteor Creek and Bootes Creek, within the Albinia National Park;
 - b. Providing a comparison of pre- and post-development flood hydrographs and longitudinal profiles of peak flood surface along the Meteor Creek floodplain within and downstream of the RCEP;
 - c. Undertaking a flood-frequency analysis and plotting measured annual series stream gauge data against the adopted flood frequency distribution to demonstrate the 'goodness of fit' of the adopted probability distribution;
 - d. Undertaking and documenting a quality assurance process for model inputs, particularly in relation to the light detection and ranging (LIDAR) dataset; and
 - e. Quantifying the overall uncertainty in the model results. The sensitivity analysis should be expanded to include hydrological (initial loss, continuing loss, routing parameters, rainfall volume) and hydraulic (roughness and head loss coefficients) parameters that show the uncertainty range in the flood behaviour.
38. Any structures in the Meteor Creek floodplain associated with road construction and watercourse crossings should be incorporated in the flood model to assess the impact on flood behaviour and the potential for increased erosion in this area, which is also likely to be impacted by the Meteor Creek Levee.

Residual hydrological impacts

39. Evaluation of groundwater drawdown-induced changes to the hydrology of Meteor Creek should be incorporated in the assessment of residual surface water impacts on water related assets, including the aquatic values in the Albinia National Park. Groundwater drawdown is predicted to reduce baseflow within Meteor Creek by an average of 52 per cent and reverse the hydraulic gradient within the alluvium adjacent to the active mining area. These changes are likely to increase the duration of no flow periods within and downstream of the zone of dewatering and reduce connectivity between the upper and lower reaches of the creek. As downstream users of surface water resources have not been identified, the significance of this impact is unknown, although it is likely to impact on ecological values. Quantification of the duration of predicted impacts is needed to provide a more accurate assessment of residual impacts.
40. The proposed additional water supply dam and the placement of a waste rock dump within the active Spring Creek channel should be considered in the assessment of unmitigated and residual impacts to the hydrology of watercourses potentially affected by the RCEP.

Residual geomorphological impacts

41. Hydraulic parameters for creek diversions, realigned drainage channels, and Meteor Creek adjacent to the Meteor Creek Levee, should conform with published guidelines. The currently predicted elevation in hydraulic parameters is likely to impact on watercourse and floodplain stability, particularly on the Meteor Creek floodplain where hydraulic parameters are predicted to increase substantially. Mitigation measures, such as additional scour protection and revegetation of the floodplain, may assist in reducing erosion and consequent impacts on riparian vegetation and water quality, as well as downstream sediment deposition. Additional monitoring points, including on the floodplain, would assist with adaptive management of potential impacts.
42. The proposed lateral migration design for creek diversions elevates the risk of destabilising mining landforms, particularly in MLA70415 where watercourses will be diverted between flood protection levees and waste rock dumps. This risk would be increased during flood events. Detailed design of creek diversions should demonstrate that diversion design parameters are sufficient to maintain the long-term stability of the watercourses within and downstream of RCEP lease areas and ensure that stream migration post mine closure will not affect the integrity of waste rock dumps or levees.

Residual water quality impacts

43. Consideration of the potential unmitigated and mitigated risks to water quality from the following RCEP activities would improve the robustness of the residual impacts evaluation:
 - a. The placement of an out-of-pit waste rock dump within the active Spring Creek channel and the potential for:
 - i. Seepage of the dammed watercourse into the waste rock dump and generation of metalliferous drainage; and
 - ii. Destabilisation of the waste rock dump, potentially leading to transport and deposition of significant quantities of sediment, and potentially acid and metalliferous material into Bootes Creek and Meteor Creek;
 - b. Changes to water quality resulting from groundwater drawdown and the predicted changes to the flow regime of Sandy Creek and Meteor Creek. Change to the flow regime in Meteor Creek is likely to alter water quality as the frequency of flushing events is reduced and ponded water is subjected to extended periods of concentration and altered redox conditions;
 - c. Seepage from the mine-affected water dams ('pit-dams') located in close proximity to natural watercourses. An understanding of the quality and fate of this water is needed, particularly during low flow periods when seepage water may exert a more significant influence over water quality in any refugia ponds;
 - d. The proposed irrigation program. Details of the planned irrigation location, its proximity to surface watercourses, underlying geological formations, the quality of irrigation water, and potentially affected water related assets, are needed to evaluate risks to water resources and water related assets within and downstream of the irrigation area; and
 - e. Altered flood behaviour, construction of the Meteor Creek levee, and the mobile stream design criteria proposed for creek diversions, which are likely to increase turbidity and sedimentation in Bootes Creek and Meteor Creek despite implementation of the proposed mitigation measures.

44. The Albinia National Park, which incorporates waters declared as Aquatic Ecosystem - High Ecological Value (HEVa2124) under the Queensland *Environmental Protection (Water) Policy 2009*, is situated immediately downstream of the RCM/RCEP. As the activities of the RCEP are likely to influence the quality of water in the Albinia National Park, the residual risk assessment should consider potential impacts on the Albinia National Park and the water quality objectives for HEVa2124.
45. Water quality modelling and/or presentation of data from the existing RCM water quality monitoring program would provide evidence to support the proponent's assessment that the use of existing water management methods would result in 'small' residual impacts on water quality in receiving watercourses. Concentrations of some toxicants in groundwater and leachate from waste rock material do not meet ANZECC and ARM CANZ Guidelines (2000)³ for protection of aquatic ecosystems and/or the existing Environmental Authority's discharge criteria. As water treatment facilities are not identified in the assessment documentation, there is a degree of uncertainty about the quality of water held within the mine water management system and how that water would be managed to minimise impacts on receiving water resources and water related assets.

Impacts to Threatened Species / MNES:

Question 16: Does the Committee consider that the EIS adequately addresses the impacts to MNES and listed threatened species and communities relating to surface water and/or ground water dependent species and communities? *See Paragraphs 46, 52-55 & 59*

Question 17: Does the Committee agree with the likely impacts on surface and groundwater resources, in particular geomorphological changes that may affect surface habitat for listed threatened species and communities? *See Paragraphs 47 & 52-55*

Question 18: Are there additional measures and commitments required to mitigate and manage impacts to water-related assets including ecological and human users of water? *See Paragraphs 13, 17, 20, 27, 39, 49, 70-74*

Question 19: The EIS concludes that:

- a. The Project is not likely to impact upon conservationally-significant habitat, listed vulnerable or endangered species or on Matters of National Environmental Significance (MNES) with respect to aquatic ecology.
- b. The Great Barrier Reef World Heritage Area and the Shoalwater and Corio Bay Ramsar sites are unlikely to be impacted by the Project, as they are at least 690 km downstream of the Project Site.

Does the Committee agree with these conclusions? *See Paragraphs 50-52 & 56-59*

Response

46. The assessment documentation does not provide an adequate basis to evaluate fully the potential impacts and residual risks to groundwater dependent ecosystems, threatened species, threatened ecological communities or other MNES, particularly in relation to the RCEP's potential impacts on GDEs and riparian vegetation that may provide habitat for threatened species.
47. There is an increased risk of impacts to habitat for listed threatened species and ecological communities due to geomorphological changes caused by erosion of riparian habitat, sedimentation, and post-closure destabilisation of mining landforms and infrastructure, resulting in water quality impacts.

48. The following additional data and analysis are needed to further inform the identification of potential impacts on threatened species and ecological communities, and any necessary mitigation and management measures:
- a. Flora and fauna surveys extending across the extent of the predicted impact footprint, including potentially affected parts of the Albinia National Park, and quantification of the groundwater dependency of terrestrial vegetation within the predicted zone of groundwater drawdown; and
 - b. A comprehensive assessment of the short and long-term (post-mining) impacts on threatened species and ecological communities caused by: groundwater drawdown and potential consequential impacts on the flow regime of Meteor Creek and Sandy Creek; altered geomorphic processes; and altered flood behaviour within the proposed RCEP development area, downstream of the Meteor Creek Levee within the Albinia National Park, and upstream of the proposed waste rock dump in Spring Creek.
49. In addition to the measures proposed to mitigate and manage potential impacts on water related assets elsewhere in this Advice, it is suggested that:
- a. Monitoring programs are designed to enable early detection of potential impacts on:
 - i. threatened ecological communities which are or may be groundwater dependent; and
 - ii. riparian vegetation that may be impacted by altered flow regimes, geomorphic processes, and/or flood behaviour;
 - b. Measures to retain habitat connectivity between the Albinia National Park, the Mount Hope State Forest and the Mount Pleasant State Forest are identified; and
 - c. Detailed design of the proposed creek diversions ensures that long-term, post-mining creek and floodplain stability is achieved. Once these proposed monitoring regimes are in place, the available results can inform key management and mitigation priorities.
50. The RCEP is likely to impact on habitat of conservation significance and MNES (water resources) with respect to aquatic ecology. The RCEP will remove one wetland of HES and could potentially impact on other HES in the area, including the HES wetland in the Albinia National Park. Further, alteration of the flow regime in Meteor Creek is likely to impact on the aquatic ecology of this watercourse. The impacts to HES wetlands from changes to flood regime, including flood extent, duration and timing, have not been assessed.
51. The RCEP is unlikely to impact upon listed vulnerable or endangered aquatic species. The Great Barrier Reef Marine Park and the Shoalwater and Corio Bay Ramsar sites are unlikely to be significantly impacted by the RCEP.
52. Residual risks to threatened ecological communities and species are likely to be underestimated as they do not take into account the potential impacts identified in Paragraph 48(b), nor the potential impacts and risks to threatened species and ecological communities within the extent of groundwater drawdown and the Albinia National Park.

Explanation

Flora and fauna surveys and impact assessment

53. Extension of flora and fauna surveys beyond the RCEP's lease boundaries is needed to inform the assessment of potential impacts due to groundwater drawdown, and alterations to flood behaviour,

surface water hydrology and water quality. Explicit evaluation of the groundwater dependency of ecological communities within the zone of dewatering is needed.

54. An assessment of potential impacts on biota caused by geomorphological changes and/or groundwater drawdown would facilitate understanding of the full extent and magnitude of the RCEP's potential impacts on:
 - a. Threatened ecological communities, such as 'Coolibah (*Eucalyptus coolabah*) woodland on alluvial plains' and the threatened species they may support, such as *Geophaps scripta scripta* (Squatter Pigeon); and
 - b. Non-listed riparian vegetation which may support threatened species such as *Poephila cincta cincta* (Black-throated Finch).
55. Groundwater drawdown impacts on riparian vegetation would also be of significance if habitat connectivity between the Albinia National Park and the state forests to the south and west of the RCEP leases is degraded or lost.

Habitat of conservation significance and MNES

56. Two wetlands of HES are located within or adjacent to the predicted zone of dewatering. Wetlands of HES have been classified as having conservation significance due to their role in protecting the Great Barrier Reef, a listed MNES. One of these wetlands will be removed by creation of the Meteor South Pit and the other within the Albinia National Park, may be affected by groundwater drawdown.
57. Substantial changes to the hydrology, geomorphology and water quality in Meteor Creek would likely impact on the aquatic ecosystems within this creek. Water resources, including the organisms and ecosystems that contribute to the physical state and environmental value of water resources, are considered MNES under the EPBC Act in the context of large coal mining developments. Therefore, the RCEP may impact on MNES with respect to aquatic ecosystems.
58. Due its scale and distance from coastal areas, the RCEP is unlikely to measurably contribute to deterioration of water quality in the Great Barrier Reef Marine Park or Ramsar sites when it is considered in isolation. The RCEP would have a negligible contribution to cumulative impacts on the reef in relation to sediment loading.

Residual risks to threatened species and ecological communities

59. Re-evaluation of the residual risk assessment for threatened species and ecological communities is warranted, particularly in relation to the proponent's predicted 'magnitude of change' with respect to the potential impacts from groundwater drawdown, and residual impacts from altered flood behaviour and geomorphological changes. The risk assessment does not take into account potential impacts from groundwater drawdown, which would adversely impact on terrestrial vegetation with a groundwater dependency. The magnitude of potential and residual geomorphological and flood-related impacts is likely to be underestimated.

Cumulative Impacts:

Question 20: Advice from the Commonwealth Minister for the Environment on 17 October 2013 indicated that, as the Project may have an impact on the hydrology and quality of water in the area, Water Resources (under ss. 24D and 24E of EPBC Act) is a controlling provision for the Project. The EIS states in:

- a. Chapter 9, Surface water, Table 9-17, Other proposals located near the project site outlines

the proximity of other proposals in relation to the Project Area. The EIS states that other proposals located near the Project Site are not situated within the catchment of Bootes, Spring or Sandy Creek or are situated distant and downstream of the proposed Project and that dilution and the ability of downstream waters to assimilate indicate that significant, cumulative impacts are unlikely.

- b. Chapter 10, Groundwater, Table 10-5, Other proposals located near the project site outlines the proximity of other proposals in relation to the Project area. Limited information has been provided of the other proposals close to the Project Site. However, the proponent does not consider drawdown of these projects to overlap or occur within common aquifers.

Does the Committee agree with the EIS conclusions? Does the Committee consider that the information provided in the EIS is suitable to address the cumulative impacts of the Project? If not, what information should be provided in the EIS to adequately address the potential cumulative impacts of the Project?

Response

60. The IESC does not agree with the conclusions in the assessment documentation regarding cumulative impacts and does not consider that the information provided is suitable to address the cumulative impacts of the RCEP. It is recommended that the cumulative impact assessment be undertaken in accordance with the IESC's Information Guidelines².
61. The proposed MDSCM and groundwater extraction from the two irrigation bores located on the 'Springwood' property are likely to intersect the same aquifers as the RCEP and should be included in the groundwater model to enable a more accurate assessment of cumulative drawdown impacts. These activities are likely to extend and increase groundwater drawdown and may have impacts on water related assets including wetlands and other surface water features identified in the RCEP region.
62. The RCEP is likely to impact cumulatively on the surface waters of the Comet River. Further, if the MDSCM development proceeds, it is likely to have a direct cumulative impact with the RCM / RCEP on the surface water resources of Spring Creek and Meteor Creek.

Explanation

63. The full extraction entitlement of the two irrigation bores located upstream of the RCEP on Meteor Creek should be included in the groundwater model. These bores are screened within the basal sands and gravels of the alluvial aquifer and their inclusion would help balance the inflows and outflows of the steady state water balance.
64. In addition to the assessment of cumulative impacts on surface water resources from discharges of mine-affected water, it is recommended that the assessment of cumulative impacts evaluates risks to water resources, and ecological and human users of surface water resources, from sediment dam discharges, altered flow regimes, changes to flood behaviour, increased turbidity, salinity and sedimentation from erosion due to land clearing, and geomorphological impacts in watercourses and floodplains.
65. The proposed MDSCM may reduce the contributing catchment to Naroo Dam and discharge mine-affected water into this catchment. Therefore, if the MDSCM is approved, it is likely to contribute to cumulative impacts on Meteor Creek locally and the Comet River regionally; particularly in relation to water quality and flow regime.

66. Identification of other users of groundwater within the Quaternary Alluvium downstream of the RCEP is needed to enable risks to water resource users outside the RCEP lease area to be evaluated more comprehensively.

Draft Environmental Management Plan:

Question 21: Is the Committee satisfied that the EIS, including the water management plan, provides sufficient detail to address the ongoing monitoring and management of surface and groundwater related impacts? *See Paragraph 67*

- a) Are there additional measures and commitments required to mitigate and manage impacts to water related assets? *See Paragraphs 68 & 70-77*
- b) Are the provided management options adequate to manage local and regional flooding? What modifications or additions would address any significant shortcomings? *See Paragraphs 67, 69, 74 & 75*

Response

67. The detail provided to address the ongoing monitoring and management of impacts to water resources is limited and could be further improved, particularly in relation to monitoring within the Quaternary Alluvium and the management and monitoring of flood impacts.
68. To detect and further minimise potential impacts on water resources and water related assets, additional measures are needed, most notably for the proposed monitoring plans, rehabilitation activities, and measures to inform the assessment and management of long-term (post-mining) impacts.
69. There remain residual impacts relating to flooding and the proposed watercourse stability monitoring locations may not be sufficient. Further, additional detail on design of flood management infrastructure including diversions and levees is required to confirm the long-term stability of these structures.

Explanation

Monitoring and management plans

70. The following modifications or additions to the water and biodiversity management plans are suggested:
- a. Relocation of Upstream Monitoring Stations to upstream of all known mechanisms of potential impact, including groundwater drawdown and potential seepage from mine dams and landforms, to measure upstream water quality conditions more accurately;
 - b. Downstream users of groundwater and surface water resources and any potential mechanisms of potential impacts on these users should be identified. Monitoring plans should incorporate sites to detect and manage impacts on users of water resources;
 - c. Incorporation of toxicant monitoring in receiving waters immediately prior to and during discharges of mine affected water to enable a direct comparison with discharge water quality as specified in the Draft Environmental Management Plan;
 - d. Inclusion of water quality monitoring sites within the appropriate shallow aquifer/s and downstream of irrigation areas, if these areas are owned/operated by the proponent. Any water supplied to third parties for beneficial use should comply with the appropriate water quality guidelines for that beneficial use;

- e. Establishment of background aquatic ecosystem values prior to commencement of dewatering or ground disturbance works for the RCEP to avoid the influence of the RCEP's activities on background values; and
 - f. Inclusion of monitoring locations within the alluvium upstream and downstream to delineate and monitor drawdown and water quality impacts. Additional monitoring locations within MLA70415 would be beneficial for monitoring drawdown impacts along Bootes Creek.
71. Details of the proposed Receiving Environment Management Plan have not been provided in the assessment documentation and therefore, its suitability to detect and measure impacts that are not associated with discharges of mine-affected water cannot be assessed. It is suggested that the REMP be designed to:
- a. Measure seasonal and interannual variations in hydrology and water quality within Bootes Creek, Sandy Creek and Meteor Creek;
 - b. Measure seasonal and interannual variation in the health of aquatic and groundwater dependent ecosystems; and
 - c. Enable early detection and/or measurement of potential impacts from the RCEP, particularly:
 - i. Groundwater drawdown and associated impacts on hydrology, water quality and aquatic ecosystems;
 - ii. Altered geomorphology and erosion of mine landforms;
 - iii. Water discharges from sediment and pit water dams; and
 - iv. Seepage from mine-affected water dams and waste rock dumps.

Rehabilitation

72. Minimising the period that disturbed areas are exposed to erosive forces would reduce the potential for increased turbidity and sedimentation of downstream watercourses. Risks to water quality would be further reduced by completing stabilisation and rehabilitation activities before the onset of the wet season.
73. Kinetic leach testing of materials identified as potentially acid forming and/or forming metalliferous leachate would enable the long-term risks to water resources and water related assets to be evaluated more accurately.

Flood and creek diversion mitigation and management

74. The following measures would minimise potential impacts due to flooding and to the construction of flood protection levees and creek diversions, and inform the design of appropriate mitigation and management measures:
- a. Use of velocity, stream power and shear stress results for the 100 and 1,000 year average recurrence interval event to identify stresses on flood protection levees and potential impacts on watercourse geomorphology. Sufficient detail about proposed mitigation measures should be provided to demonstrate that the stability of natural watercourses, mine landforms and infrastructure will be maintained, particularly in the post mining phase, when regular maintenance may not be feasible;
 - b. Adoption of hydraulic parameters within creek diversion guideline values to minimise risks to the stability of watercourses, water quality and water related assets within and downstream of

the RCEP. Further consideration of the impact of land use practices and stock access on natural watercourses in the context of creek diversion design objectives is warranted; and

- c. A geotechnical assessment of the proposed Sandy Creek diversion would assist in the design of mitigation measures to stabilise the channel banks and reduce risks to the stability of the Meteor Creek Levee. There is a risk that groundwater flow down gradient at this location will result in groundwater seepage through the diversion banks. As soils in the area are susceptible to erosion, this could destabilise the diversion and the Meteor Creek Levee.

75. In addition to the strategic watercourse stability monitoring points proposed in the assessment documentation, monitoring in the following areas would provide for more effective adaptive management:

- a. Sandy Creek, upstream of the RCEP, to monitor any changes in flood regime and to validate model predictions;
- b. Within the Sandy Creek diversion and other drainage realignments;
- c. Downstream of the RCEP to monitor any changes in the flood regime and validate model predictions, in particular: downstream of the Meteor Creek levee; in Bootes Creek downstream of the proposed diversion (within the existing diversion); and also in Bootes Creek, downstream of the existing mine;
- d. Downstream of the RCEP at and beyond the confluence of Bootes Creek and Meteor Creek; and
- e. Upstream of the RCEP, where Spring Creek intersects with the out-of-pit waste rock dump.

76. 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.

Date of advice	12 June 2014
Source documentation available to the IESC in the formulation of this advice	Rolleston Coal Expansion Project Environmental Impact Statement (December 2013)
References cited within the IESC's advice	<p>¹Department of Environment and Heritage Protection (DEHP) (2011) <i>Watercourse Diversions – Central Queensland Mining Industry V5.0</i>, Department of Environment and Resource Management, Queensland</p> <p>²Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals available at: http://iesc.environment.gov.au/pubs/iesc-information-guidelines.pdf</p> <p>³ANZECC and ARMCANZ (2000) <i>Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Volume 1)</i>, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council for Australia and New Zealand, Canberra</p>