

IESC 2016-075: Wilpinjong Extension Project (EPBC 2015/7431, SSD6764) – Expansion

Requesting agencies	The Australian Government Department of the Environment The New South Wales Department of Planning and Environment
Date of request	28 January 2016
Date request accepted	3 February 2016
Advice stage	Assessment

Context

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) was requested by the Australian Government Department of the Environment and the New South Wales Department of Planning and Environment to provide advice on Peabody's Wilpinjong Extension Project in NSW.

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

The Wilpinjong Extension Project (the proposed project) is an extension of the approved Wilpinjong Coal Mine, located 40 kilometres north-east of Mudgee in central New South Wales. The proposed project lies immediately south, and upstream, of the Goulburn River National Park. The project discharges mine water to Wilpinjong Creek, which flows into the National Park through Wollar Creek.

The extension comprises approximately 800 hectares of additional open cut mining area, continued production of up to 16 Mtpa of ROM coal from the Ulan Coal Seam and Moolarben Coal Member, and extension of the approved mine life by approximately seven years. The extension includes associated mine infrastructure such as haul roads and relocation of existing power lines and roads.

Key potential impacts

Key potential impacts to water resources resulting from the proposed project include:

- contamination of Wilpinjong Creek due to leaching of metals from reject materials
- changes to water quality and flow regime (e.g. volume, timing, frequency and duration) of Wilpinjong Creek and Wollar Creek
- contributing to cumulative impacts from mines within Wilpinjong Creek and Wollar Creek.

Assessment against information guidelines

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

Relevant data and information: key conclusions

Hydrological data from the approved Wilpinjong Coal Mine and from the neighbouring Moolarben Coal Mine were used to support the assessment of impacts to groundwater resources. However, limited surface water quality data was provided. This omission is an issue for assessment of potential metal contamination, as elevated levels of soluble metals in waste rock were identified in the Geochemistry Assessment.

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

The numerical groundwater model is appropriate to assess impacts of groundwater drawdown. Steady state and transient calibration, and peer review were undertaken. However, sensitivity analysis, uncertainty analysis and model verification were not undertaken. The neighbouring Moolarben Coal Mine was appropriately included in the numerical groundwater modelling to determine potential cumulative impacts, but the Ulan Mine was not included. This may affect cumulative impact predictions.

A sensitivity analysis was undertaken for the water balance model, but not for the salt balance.

Without justification the Geochemistry Assessment compared dissolved molybdenum and selenium concentrations to ANZECC/ARMCANZ (2000) Primary Industries (Livestock Drinking Water) guidelines instead of ecosystem protection guidelines. The Groundwater Assessment (EIS, App. C) did not make comparisons to water quality guidelines.

Groundwater dependency of terrestrial vegetation was not appropriately assessed and methods used were inconsistent between the Groundwater Assessment and the Biodiversity Assessment. Stygofauna should be assessed through a desktop analysis, followed by possible sampling.

Advice

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

Question 1: Do the groundwater and surface water assessments, including the numerical models within, provide reasonable estimations of the likely impacts to water-related resources (including water quality or water quantity). This consideration should include particular reference to Wilpinjong Creek and Wollar Creek, and any cumulative impacts associated with the Moolarben Coal Mine.

Response

1. The use of a Class 2 numerical groundwater model (as classified under Barnett et al., 2012) is appropriate for assessment of impacts to groundwater resources. However, the numerical groundwater modelling predictions would be strengthened through the application of sensitivity and uncertainty analyses, model verification, and updating of the groundwater model as new data become available.
2. Further consideration and assessment of surface water impacts is required. The conclusion that potential impacts to surface water are negligible when compared to the approved Wilpinjong Coal Mine needs to be supported by further quantifying and detailing the existing condition of the environment in the vicinity of the approved Wilpinjong Coal Mine (e.g. further geochemical studies and characterisation of surface water quality).

3. The surface water assessment, including the surface water cumulative impact assessment, would be strengthened by quantifying changes to the flow regime over the life of the proposed project. This assessment should include potential cumulative impacts from the proposed project, the approved Wilpinjong Coal Mine and the Moolarben Coal Mine.

Explanation

Groundwater

4. The Ulan Mine situated on the far side of the adjacent Moolarben Coal Mine, in a separate subcatchment of the Goulburn River, was not included as part of the numerical groundwater modelling cumulative impact assessment scenario. Potential cumulative drawdown impacts from the Moolarben Coal Mine, approved Wilpinjong Coal Mine and proposed project may be exacerbated by drawdown effects from the Ulan Mine, but these potential effects have not been considered.
5. Several limitations associated with the groundwater numerical model and acknowledged in the assessment documentation (EIS, App. C, pp. 71–72) may reduce confidence in the modelling predictions. Confidence in the numerical groundwater modelling predictions would be improved by:
 - a. core sampling and testing as recommended in the assessment documentation (EIS, App. C, p. 92), to further elucidate aquifer properties (e.g. effective porosity and horizontal and vertical hydraulic conductivity)
 - b. sensitivity analyses on the numerical groundwater model
 - c. providing justification for model boundaries
 - d. sensitivity analysis on model boundaries
 - e. an uncertainty analysis on model predictions
 - f. model verification using monitoring data not used in the calibration process
 - g. updating the numerical groundwater model as more data and information from the proposed project become available.
6. The proponent states that metal concentrations are considered typical for groundwater in the area and reflect baseline conditions (EIS, App. C, p. 52), however:
 - a. Baseline conditions were not presented in the assessment documentation. Measured metal concentrations were presented in box plots for each particular metal and as a result temporal trends and spatial variations are not able to be determined (EIS, App. C, Figure 3-28).
 - b. Groundwater metal concentrations, including baseline values, have not been compared to ANZECC/ARMCANZ (2000) water quality guidelines for ecosystem protection. Local water quality guidelines could be developed using ANZECC/ARMCANZ (2000) recommended methods and validated for the area.
7. As part of the approved Wilpinjong Coal Mine groundwater monitoring network, 28 monitoring bores (PZ01–28) were installed next to Pit 1 and Pit 2 to monitor groundwater level and groundwater quality (i.e. tailings dam seepage). The proponent states there is no evidence of solute breakthrough (EIS, App. C, p. 53). However, in mid to late 2011 PZ16 indicates a sharp rise then fall in salinity and a decrease then rise in pH, which may be indicative of

short-term solute breakthrough. Concentrations of other solutes, e.g. dissolved metals, were not presented.

8. Tailings are expected to be placed within spoil emplacement areas (EIS, App. D, p. 82). The potential for leaching of contaminants from the spoil emplacement areas has not been assessed.

Surface water

9. Water quality impacts of the proposed project on Wilpinjong and Wollar Creeks are considered in the assessment documentation to be negligible: “with the implementation of management measures in the existing Wilpinjong Coal Mine Water Management Plan (Peabody, 2006a), the potential adverse effect of the [proposed] project on downstream water quality would be negligible” (EIS, p. 4-64). The Surface Water Assessment (EIS, App. D) does not provide adequate evidence to demonstrate the effectiveness of the existing strategies for managing impacts to surface water at the approved Wilpinjong Coal Mine, particularly in relation to potential metal contamination. For example:
 - a. A surface water quality monitoring programme has been ongoing across the site since 2004, but surface water quality data for parameters other than EC, sulphate, pH and turbidity have not been provided.
 - b. Measurement of metals was identified at a limited number of the surface water monitoring sites. For these sites, the frequency of monitoring was intermittent and the period of sampling was short. For example, metals were measured in two sites on Wilpinjong Creek and one site on Wollar Creek intermittently over an 18 month period from June 2004 to January 2006 and metals in Pit 2 west were monitored intermittently from January 2011 to September 2012 (EIS, App. D pp. 53–54). No data were provided.
 - c. Limited water quality monitoring data were provided for water storages and tailings disposal storages (i.e. data were provided for pH, EC, and sulphate from pre-2013 and spot samples from 2015), and no data were provided for sediment dams (EIS, App. D, pp. 71-73), despite these locations being defined in the Surface Water Management and Monitoring Plan for the approved Wilpinjong Coal Mine (Peabody, 2006b) for monthly sampling.
 - d. The surface water quality data presented indicates a number of sites regularly exceed the ANZECC/ARMCANZ (2000) guideline trigger values for the protection of aquatic ecosystems and/or Primary Industries (Livestock Drinking Water), i.e. EC, turbidity, and sulphate (EIS, App. D, pp. 55–56). Local water quality guidelines and objectives were not developed and while baseline values were reported (for pH, EC, turbidity) (EIS, App. D, section 3.6.2), contextual information was not provided to explain how these values were derived. The information presented does not allow consideration of the suitability of the baseline data set and whether these exceedences reflect the existing environment or mining-related impacts.
 - e. Data from nearby mining operations are not provided, despite the close proximity of the proposed project to Moolarben Coal Mine. These data would provide further contextual information on the upstream water quality of Wilpinjong Creek, and consideration of the potential impacts of the approved Wilpinjong Coal Mine in relation to those from nearby mines.
10. The assessment concludes that potential changes to surface water flows (i.e. from catchment excision and loss of baseflow) in Wilpinjong Creek and Wollar Creek are minor when

compared to the approved Wilpinjong Coal Mine (EIS, App. D, p. 149). These findings would be strengthened by the following:

- a. consideration of the cumulative reduction in catchment area over the operational period, including against each relevant sub-catchment and reductions associated with Moolarben Coal Mine
 - b. quantifying changes to flow regime from the proposed project (with particular regard to timing, duration and frequency) due to the combined impact of catchment excision, loss of baseflow, and regulated and uncontrolled discharges. While the assessment presents a flow frequency curve of the combined impact of estimated baseflow loss and maximum catchment excision (EIS, App. D, p. 149, Fig 8.5), further detail on the modelling (e.g. how discharges and changes to catchment area have been incorporated into the model) would enable consideration of the appropriateness of model outputs. The analysis should compare the proposed project, pre-mining condition, and effects of the approved Wilpinjong Coal Mine operations.
 - c. subsequent assessment of potential downstream ecological impacts resulting from predicted changes to flow regime
 - d. discussion of the approved Wilpinjong Coal Mine's existing stream flow triggers¹, including historical performance.
11. The proponent did not undertake new flood studies for the proposed project as the proposed extension lies outside of the Wilpinjong Creek and Cumbo Creek 1 in 1,000 annual exceedance probability design flood extent (EIS, App. D, p. 75). While this may be a plausible approach, the assessment should discuss assumptions, limitations and applicability of the previous study.
12. The water balance model for the proposed project is configured so as not to allow uncontrolled discharge of mine water from mine water storages; excess mine water is stored in mining pits instead (EIS, App. D, p. 134). However, the water balance modelling indicates that: the water management system is sensitive to climatic conditions (EIS, App. D, p. 127); discharges from sediment dams during the first 5 years of the proposed project, under wet and very wet conditions, are up to 75 ML/month and 390 ML/month respectively (EIS, App. D, p. 134); and 'significant quantities' of water will need to be stored in the pits (EIS, App. D, p. 128), which will cause disruption to operations. Sediment dams have also been used to store mine water in the past (EIS, App. D, p. 70). Considering these factors, the assessment could be improved by:
- a. quantification of impacts through solute balance modelling
 - b. further assessment of the risk of discharge of mine-affected water and sediment-affected water, including how water stored in pits will be managed during periods of high intensity rainfall.
13. While the assessment documentation includes a cumulative impact assessment for surface water, the scale of the assessment and approach of not quantifying the existing level of impact does not enable cumulative impacts to Wilpinjong and Wollar creeks to be

¹ While the stream flow triggers were not discussed in the assessment documentation, the IESC notes these are articulated in the *Wilpinjong Coal Project Surface and Ground Water Response Plan* (Peabody, 2006c) and would expect these to be discussed as part of the assessment of the proposed project.

considered. Given the level of existing and proposed development on Wilpinjong Creek a local scale quantitative assessment should be included.

Geochemistry

14. No testing of overburden, interburden and coal reject materials for elemental enrichment and solubility was conducted for the approved Wilpinjong Coal Mine (EIS, App. K, p. 44). The Geochemistry Assessment for the proposed project (EIS, App. K) indicates enrichment of arsenic and selenium and solubility of molybdenum and selenium in some of the coal reject, interburden and overburden materials (EIS, App. K, pp. 34, 39–40, 44), and that certain waste rock materials would be potentially acid forming. Given these preliminary results the assessment should include the following to improve the assessment of potential impacts:
 - a. A detailed description of the methodology of the solubility testing should be provided. The description provided (EIS, App. K, p. 23) was not adequate to provide confidence that the results predict the range of metals that may present a mobilisation risk.
 - b. Additional solubility studies (e.g. over a range of pH and kinetic tests) should be conducted to better inform understanding of the risks associated with metal contamination from waste storage, disposal, handling and treatment.
 - c. Results from solubility studies should be compared to the ANZECC/ARMCANZ (2000) water quality guidelines for ecosystem protection.

Identification of water-related assets

15. The proponent's assessment of potential impacts to water-dependent assets would be improved by consistent classification of groundwater dependent ecosystems through the use of the following:
 - a. identification of areas of shallow groundwater (less than 20 metres below ground level) and groundwater discharge overlaid with vegetation mapping to identify areas of potential groundwater dependency
 - b. techniques from the Australian GDE Toolbox (Richardson et al., 2011), applied to confirm groundwater use by vegetation and groundwater discharge to surface water bodies
 - c. a desktop study (e.g. Eco Logical, 2015) to assess the likelihood of stygofauna presence. If stygofauna are likely to be present, a pilot study following WA EPA (2007) guidelines is recommended.

Question 2: Has the Applicant provided reasonable strategies to effectively avoid, mitigate or reduce the likelihood, extent and significance of impacts to significant water-related resources?
--

Response

16. No. The level of information describing avoidance, mitigation and reduction strategies within the assessment documentation is limited. The proponent considers that the existing strategies associated with the approved Wilpinjong Coal Mine are adequate. However, data to support the adequacy of existing strategies were not presented so the effectiveness of these strategies is not able to be assessed.
17. The existing measures are implemented through management plans which have not been included within the assessment documentation. Without these plans, it is not possible to determine how effective the measures would be at mitigating or reducing impacts from the proposed project.

Explanation

18. As identified in Paragraph 9, the information presented within the assessment documentation is not sufficient to demonstrate the effectiveness of existing strategies to avoid, mitigate and reduce potential impacts to surface water quality. This would be improved by inclusion of:
- a. background information and description of sampling methodologies. For example, groundwater metals data should include contextual information such as when the data were collected to enable assessment of whether this is representative of baseline conditions. Baseline data were not available for assessment
 - b. baseline data and data collected during the approved Wilpinjong Coal Mine operations. This would enable consideration of the effectiveness of the existing strategies to manage potentially acid forming waste rock, and the adequacy of the water management system
 - c. metals analysis for surface water on site (creeks, dams and other storages) and drainage lines including Wilpinjong Creek.
19. Mine water discharges from the Wilpinjong Coal Mine may contain untreated mine affected water mixed with permeate from the reverse osmosis plant while remaining within water quality discharge criteria (EIS, App. D, p. 82). Discharge water quality criteria only include EC, oil and grease, pH and total suspended solids (EIS, App. D, p. 74) so it is possible that other contaminants are being released from the site through this pathway without detection. Water quality data in the assessment documentation is not sufficient for this risk to be assessed.

Question 3: Would the IESC recommend any other strategies to avoid, mitigate or reduce the likelihood, extent and significance of impacts on water-related resources? And if so, why?

Response

20. Yes. To determine the need for additional strategies to avoid, mitigate or reduce potential impacts on water-related resources the IESC suggests development of a monitoring and management regime (further details in the response to Question 4). Should additional strategies be required, results from the monitoring programme should be used to inform adaptive management measures entailing ongoing waste management, water management, and mine closure strategies.

Explanation

Adaptive management/monitoring regime

21. Management trigger values should be used to inform adaptive management approaches, with Trigger Action Response Plans (TARPs) developed to apply appropriate avoidance, mitigation and reduction strategies. Adaptive management approaches should be applied (but not limited) to the following areas:
- a. Waste management: Results from regular monitoring of trace metals in surface water (e.g. creeks, dams and other storages on site) and groundwater (including back-filled areas, tailings and rejects emplacement areas) should be used to inform ongoing waste management strategies, such as the placement of potentially acid forming waste material and shape of the final landform. These data can also demonstrate the effectiveness of the mine water management system in preventing contamination of surrounding creeks (i.e. via surface water runoff, discharges, or groundwater seepage) both during and post mining.

- b. Water management system: Results from the surface water monitoring programme should be used to demonstrate the effectiveness of the mine water management system in the prevention of contamination of surrounding creeks (i.e. via surface water runoff, discharges, or groundwater seepage) both during and post operations. Management triggers and associated responses for key storages within the water management system (e.g. sediment dams) should be developed. Management responses could include increasing the pumping capacity to divert water to the mine water management system instead of being released from the site, resizing/introducing additional temporary sediment dams, and the use of flocculating agents or other treatment as necessary.
- c. Contaminant management: implement the tiered approach in the National Water Quality Management Strategy (refer to the decision tree at Figure 3.4.2 of ANZECC/ARMCANZ, 2000) for any contaminant in mine related discharges that exceeds its water quality guideline for ecosystem protection (ANZECC/ARMCANZ, 2000). This could include contaminant speciation or ecotoxicity testing.
- d. Mine closure: As more data become available during operations, surface water and groundwater modelling and predictions for the final voids should be reviewed and updated. These outputs should inform ongoing refinement of the final landform.
- e. Third party impacts: The State-owned Wollar Public School bore is expected to experience groundwater drawdown by greater than 2 metres. Triggers for remedial action should be developed and the bore should be monitored regularly for trigger exceedance.

Other suggestions

- 22. If additional water-related assets are identified as a result of further surveys (as recommended in Paragraph 15), predicted impacts should be reassessed in light of the additional data collected, and appropriate avoidance and mitigation strategies proposed.

Question 4: Would the IESC recommend any additional monitoring or management measures to address any residual impacts on water-related resources?

Response

- 23. Yes. Recommended additional monitoring and management (see response to Question 3, above) measures include:
 - a. determination of appropriate local water quality guidelines and objectives
 - b. spatial and temporal expansion of the surface water and groundwater monitoring networks, including event-based monitoring of surface water quality
 - c. ongoing refinement of the proposed final landform based on information collected during operations
 - d. continued aquatic ecology surveys.

Explanation

Water quality guidelines and objectives

- 24. The IESC considers surface water and groundwater monitoring presented as part of the Water Management Plan (Peabody, 2006a) should be consistent with the National Water Quality Management Strategy (ANZECC/ARMCANZ, 2000), and could include determination of appropriate local water quality guidelines and objectives (for physical and chemicals

stressors, and relevant toxicants). The assessment documentation compares surface water quality data for EC, turbidity and pH to baseline values (EIS, App. D, section 3.6.2), but details surrounding the baseline data sets for both surface water and groundwater were lacking. Additional relevant parameters such as metals should also be included.

25. The Water Management Plan (Peabody, 2006a) should be updated to reflect the proposed project, and potential local water quality guidelines and objectives. Further, the plan should define the adaptive management approach, including management triggers and appropriate management responses in the event that management triggers and/or water quality objectives are exceeded. This could include ecotoxicity testing or further aquatic ecology surveys to determine impact. This should build upon the approach described in the *Wilpinjong Coal Project Surface and Ground Water Response Plan* (Peabody, 2006c).

Groundwater and surface water monitoring regime

26. The proponent states that the existing groundwater monitoring network is considered adequate to assess groundwater levels and quality, and for groundwater model calibration and verification (EIS, p. 4-53). While monitoring sites show reasonable spatial distribution and represent the main stratigraphic units, monitoring could be improved by the following:
 - a. Additional bores should be installed outside the pit expansion areas to the southwest, south, and southeast of the proposed project site because most of the bores in these areas are located in the pit expansion areas and will need to be removed once mining commences.
 - b. Two bores were installed in spoil emplacement areas: GWf1 in Pit 1 and GWf2 in Pit 5. Continued monitoring of these bores is recommended. Such data are useful in providing information on the recharge rates through spoil, spoil permeabilities, and to validate modelling assumptions and predictions. In the future, it would be useful to install and monitor an additional bore in the spoil/final landform north of the proposed Pit 8 final void (assuming that GWc31 will be removed by mining).
 - c. The proponent states that the tailings storage facility for the approved Wilpinjong Coal Mine located in Pit 2 is no longer active (EIS, App. C, p. 88), but indicates that water and tailings for the proposed project will be treated within Pit 2 using a tailings filter press (EIS, App. D, p. 82). Monitoring of PZ20 and PZ21 (located north of Pit 2) could be reinstated, as recommended in the assessment documentation (EIS, p 4-53), to monitor any potential seepage impacts. The reinstatement of some of the other piezometers (PZ01-28) already installed upstream and downstream of the expected tailings treatment area should also be considered.
 - d. Groundwater monitoring stations could be established in the backfilled pits to monitor water quality as the groundwater level reaches equilibrium, provide an early indication of potential water quality impacts to groundwater and associated surface waters, and demonstrate performance of existing waste management practices.
 - e. Molybdenum could be added to the groundwater monitoring programme, as recommended in the assessment documentation (EIS, p. 91), as there is a risk that molybdenum may be mobilised from waste rock under near neutral conditions (EIS, App. C, p. 88).
27. The existing surface water monitoring programme, included in the Surface Water Management and Monitoring Plan (SWMMP) (Peabody, 2006b), is proposed to be retained and revised for the proposed project. This plan is not described explicitly in the assessment documentation (e.g. parameters and frequency). The SWMMP accessed by the IESC from

the proponent's website is dated March 2006. When updating the SWMMP to incorporate the proposed project, the IESC suggests the following improvements:

- a. Metals monitoring on a monthly and event-based basis should be included for the existing surface water monitoring sites, and storages, tailings disposal storages, and sediment dams. This should cover arsenic, molybdenum and total alkalinity/acidity, as noted in the assessment documentation (EIS, p. 4-68), and any metals that pose a risk of mobilisation, as identified in existing solubility studies (and any additional studies as recommended in Paragraph 14).
- b. The most upstream site on Wilpinjong River (WIL-U2) is very close to the Project Boundary, and the proposed extension extends to this area. Monitoring stations further upstream would assist in characterising upstream water quality, the ongoing influence of the proposed project, and impacts of nearby operations. Additional downstream monitoring points on Wollar Creek would also assist in identifying impacts to waters within the downstream Goulburn River National Park. Data sharing with nearby operations may help to address this deficiency.

Final landform

- 28. In relation to the proposed final voids and final landform, the following should continue to be assessed and revised as data is collected during operations:
 - a. assessment of legacy issues and risks to water resources as a result of the final landform, including potential risks to regional hydrogeological units and surface watercourses caused by potential leakage, loss of baseflow, or connectivity (e.g. flood ingress and overflow) as a result of the final voids. This should include quantification of the inflow/outflow of the backfilled pits and the final void predicted to act as a flow-through system, including the volume, travel times and salt loads of seepage and risk of overflow.
 - b. design of a post-mining groundwater and surface water monitoring network to provide a indication of groundwater and surface water quality.

Aquatic ecology surveys

- 29. Stream health and aquatic macroinvertebrate surveys were conducted annually between 2011 and 2014 (EIS, App. F, p.14). It is not stated in the assessment documentation whether aquatic ecology monitoring will continue on the site. Monitoring should continue on an annual basis to identify potential cumulative impacts in the Wilpinjong and Wollar Creek catchments, especially focussing on how extended low-flow periods might affect biota (e.g. atyid shrimps) and other ecological aspects.
- 30. The Northern Sydney Basin Bioregion, which includes the Hunter subregion, has been identified as a Bioregional Assessment priority region. Data and relevant information from the proposed project should be made accessible to this Bioregional Assessment and related research projects.

Date of advice	14 March 2016
-----------------------	---------------

Source documentation available to the IESC in the	McVicar, T. R., Pinetown, K. L., Hodgkinson, J. H., Barron, O. V., Rachakonda, P. K., Zhang, Y. Q., Dawes, W. R., Macfarlane, C., Holland, K. L., Marvanek, S. P., Wilkes, P. G., Li, L.T. & Van Niel, T. G., 2015. <i>Context statement for the Hunter subregion</i> . Product 1.1 for the Hunter subregion from the Northern Sydney Basin
--	---

**formulation of
this advice**

Bioregional Assessment. Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia.

Peabody Energy, 2016. *Wilpinjong Extension Project Environmental Impact Statement*.

**References
cited within the
IESC's advice**

ANZECC/ARMCANZ, 2000. Australian Guidelines for Water Quality Monitoring and Reporting. National Water Quality Management Strategy (NWQMS). Canberra: Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Barnett, B., Townley, L. R., Post, V., Evans, R. E., Hunt, R. J., Peeters, L., Richardson, S., Werner, A. D., Knapton, A. & Boronkay, A., 2012. Australian groundwater modelling guidelines, Waterlines report, National Water Commission, Canberra.

Eco Logical, 2015. Bylong Coal project Environmental Impact Statement - Stygofauna Impact Assessment. Prepared for Hansen Bailey.

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>.

Peabody, 2006a. Wilpinjong Coal Project: Site Water Management Plan.

Peabody, 2006b. Wilpinjong Coal Project: Surface Water Management and Monitoring Plan.

Peabody, 2006c. Wilpinjong Coal Project: Surface and Groundwater Response Plan.

Richardson, S., Irvine, E., Freund, R., Boon, P., Barber, S. & Bonneville, B., 2011. Australian groundwater dependent ecosystems toolbox part 2: assessment tools, National Water Commission.

Western Australia Environmental Protection Authority (WA EPA), 2007. *Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986)*, Draft Guidance statement No. 54A, Western Australia.
