

Advice to decision maker on coal mining project

IESC 2014-053: Angus Place Mine Extension Project (EPBC 2013/6889; SSD - 5602)

Requesting agency	The Australian Government Department of the Environment The New South Wales Department of Planning and Environment
Date of request	3 July 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 New South Wales Department of Planning and Environment to provide advice on the Centennial Angus Place Pty Ltd, Angus Place Mine Extension Project (APMEP) in New South Wales.

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 APMEP would enable the expanded operations of the existing Angus Place mine, located approximately 15 km northwest of Lithgow and 120 km west of Sydney in New South Wales. The proposal involves the extraction of approximately four million tonnes per annum of run of mine coal from the Lithgow Coal Seam, through new underground longwall mining operations. Mining of longwalls is proposed to take place under the Newnes State Forest and several Temperate Highland Peat Swamps on Sandstone (THPSS) ecological communities, listed as endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The project area lies within the Wolgan and Coxs River catchments and proposes to discharge mine water and extracted groundwater into the upper reaches of the Coxs River. The Coxs River flows south into Lake Burragorang (Warragamba Dam) which is a potable water supply for the city of Sydney.

This advice is provided in parallel with the IESC's advice on the Springvale Mine Extension Project (EPBC 2013/6881; SSD - 5594), which directly adjoins the southern boundary of APMEP, and should be considered with reference to this advice.

Key potential impacts

The key potential water related impacts of the APMEP are those expected to occur to THPSS. Key potential impacts to THPSS include: subsidence impacts such as bedrock fracturing; changes to the hydrological (surface flows from upstream tributaries and inundation) and hydrogeological (groundwater drawdown and baseflow) regimes; peat desiccation, erosion (scour) and slumping; decline of vegetation communities and swamp extent, including EPBC Act threatened species. It is highly likely that impacts to THPSS and dependent threatened species will be severe and potentially irreparable. Further, there is no scientific literature currently available to demonstrate the effectiveness of potential mitigation or remediation measures. The only known strategy to minimise impacts to THPSS is to alter the mine layout such that swamps are not undermined by longwall panels and longwalls are located such that tensile and compressive strains at these sites are below 0.5 mm/m and 2 mm/m respectively⁵. To avoid impacts to the hydrological regime of individual THPSS, this avoidance strategy would also need to be applied to any upstream tributaries that provide a significant proportion of surface flow to THPSS.

Assessment against information guidelines

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

Relevant data and information: key conclusions

The proponent has not characterised existing surface water, groundwater and ecological conditions for the majority of THPSS within the proposed project area. Seasonal surface water flow and an assessment, or estimation, of the baseflow component of the Coxs River are not provided and are needed to enable the prediction of impacts to seasonal flows within, and interactions between, surface water and groundwater systems, including those associated with THPSS. This information would also improve predictions of discharge and baseflow losses within the Coxs River and the potential for downstream impacts to occur.

Application of appropriate methodologies: key conclusions

The groundwater model has been constructed using industry best practice methods and is acceptable for predicting mine inflows. However, the scale of the groundwater model is inappropriate to predict groundwater related impacts to individual THPSS. Further, a number of swamps are not incorporated into the groundwater model. Finer scaled, site specific models, informed by a conceptualisation of the hydrology and hydrogeology, would be needed to have confidence in the predictions of groundwater impacts to individual swamps.

Water quality impact estimations for the Coxs River need to consider increased discharge volumes to Coxs River resulting from reduced demand from the Wallerawang Power Station. The assessment of mine water discharges needs to consider the resulting cumulative concentrations of a range of contaminants, in addition to salt, within Coxs River.

Reasonable values and parameters in calculation: key conclusions

Confidence in groundwater model predictions is limited by a lack of site specific hydrogeological data and lineament groundwater flow behavior. The assessment of surface water impacts, including cumulative impacts, needs to consider contaminants such as copper, zinc, nitrogen and phosphorus, which groundwater quality monitoring shows all exceed ANZECC guidelines².

Advice

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

Questions 1 to 4 relate specifically to the risks identified within the EIS documentation in relation to the Temperate Highland Peat Swamps on Sandstone Ecological Community, listed as endangered under the EPBC Act.

Question 1: Does the EIS, and in particular the groundwater model and the treatment of subsidence and fracturing predictions, provide a reasonable assessment of the likelihood, extent and significance of impacts on overlying adjacent swamps?

Response

1. The EIS, including the groundwater model, does not provide a reasonable assessment of impacts to THPSS. Confidence in the groundwater model's capacity to predict site specific impacts to individual THPSS is low. In particular the model scale is not appropriate to predict impacts to THPSS, and a number of THPSS are not included within the groundwater model and therefore groundwater related impacts to these swamps cannot be predicted.
2. The incremental profile method utilised in the EIS provides reasonable predictions of subsidence likely to occur as a result of the proposed longwall design. However, there is a lower degree of confidence in subsidence predictions proximal to "type 1" and "type 2" lineaments, which are the shallow manifestations of deep, underlying faults. As a result, the EIS subsidence and flora impact assessments based on the subsidence predictions do not adequately consider the potential site specific subsidence impacts to overlying individual THPSS.

Explanation

Swamp treatment within the groundwater model

3. Within proximity of the project area, the groundwater model uses a 60 m mesh size, which has limited ability to predict fine scale interactions between surface water and groundwater in THPSS. Further, baseflow data was only available for a single swamp (Sunnyside Swamp), which was used as a calibration target. While the groundwater model's calibration shows a good level of agreement between modelled and observed baseflow values for Sunnyside Swamp, the proponent has not identified how modelled baseflows for other swamps compare with observed values. This approach does not consider the unique hydrological regimes within each THPSS.
4. To increase confidence in the groundwater model's prediction of hydrological impacts to THPSS, finer scale modelling is needed that better represents the site specific hydraulic properties, including the baseflow requirements, of each THPSS. These finer scale models should then be coupled with the larger scale groundwater model. These models should be informed by baseflow monitoring results, combined with daily climate data, for swamps and streams.
5. All swamps need to be included in a revised groundwater model before the potential impacts to these swamps can be predicted. Trail 6 Swamp, Narrow Swamp, West Wologan Swamp and East Wologan Swamp are not included within the groundwater model, and therefore groundwater related impacts to these swamps cannot be assessed. A range of other swamps that fall outside of the extent of the proposed longwalls, but are located within the lateral extent of drawdown, are also excluded from the model (for example east of Barrier Swamp).

Subsidence induced fracturing – groundwater model

6. The proponent's assertion that drawdown and fracturing related impacts are not predicted within strata above the Mt York Claystone is not supported by evidence. The EIS documentation contains limited data in relation to the hydraulic properties of the Mt York Claystone and other overlying semi-permeable layers. This data should be provided and incorporated into the groundwater model to improve confidence in the groundwater impact predictions, and to inform the assessment of impacts to overlying aquifers, swamps and surface water courses.

Geological structures

7. A series of lineaments (shallow manifestations of deep, underlying faults) have been identified within the geological strata of the project area and are, in some areas, several hundred metres wide. Four lineament types were identified, and two of these types ("type 1" and "type 2") are considered important in determining the structural stability of the underground mining areas and the overlying geological strata. These lineament zones increase the risk and severity of subsidence in their vicinity.
8. While the incremental profile method applied within the subsidence assessment generally provides reasonable predictions of subsidence parameters, there is low confidence in the approach of increasing subsidence predictions by 25 per cent in the vicinity of "type 1" and "type 2" structural lineaments. The EIS states, (Appendix D, p. 33), observed subsidence effects in the vicinity of these lineaments at the existing operations are highly variable and are, in places, up to eight times greater than predictions derived using this approach. Subsidence over previously mined longwall panels, in proximity to "type 1" and "type 2" structural lineaments, at the existing Angus Place operations contributed to severe impacts to overlying THPSS⁵.
9. At the surface, "type 1" and "type 2" lineaments are, in places, the sites of THPSS. These lineament zones are not included within the groundwater model and their effect on groundwater flow is unknown. Given the regional scale of "type 1" and "type 2" lineaments, their topographical importance in the landscape as host location of THPSS, and the severe subsidence risks in their vicinity (see paragraphs 16, 18 and 19, Question 2), these large structural lineaments should be included in updated versions of the groundwater model and their effect on groundwater flow and baseflow provision to THPSS subsequently assessed.

Swamp ecology

10. The proponent has not provided site specific data on existing conditions for the majority of THPSS that occur within the extent of predicted subsidence. An assessment of existing condition is important to determine the extent of change in THPSS condition that is caused by longwall mining impacts or is within natural fluctuation³. This assessment needs to include, groundwater levels, baseflows and surface water flows, surface standing water levels, surface elevation, swamp extent, species composition and ecological condition.
11. The impact assessment needs to be informed by an individual conceptualisation of each THPSS, with particular regard to whether swamps are reliant upon surface water, groundwater or both⁵. The conceptualisation of each swamp should identify the hydrological and hydrogeological regimes, including which aquifer/s support each swamp, as well as the surface water catchment extents and the ecosystems which are supported by these regimes. Identification of the key flora and fauna species that comprise the ecological community should also be identified.
12. The groundwater model predicts that the majority of THPSS overlying the project area will experience baseflow reductions. However, three swamps are predicted to have an increase in baseflow due to an increase in groundwater head. Bayesian belief network modelling undertaken by the Commonwealth of Australia (2014)⁴ identified THPSS ecosystems as being most sensitive

to alterations of the inundation regime. Therefore, the proponent needs to consider the potential ecological impacts of:

- a. Changes to the hydrological/hydrogeological regime caused by a reduction or increase in groundwater level, coupled with the physical reduction in surface elevation caused by subsidence, on groundwater dependent flora species within THPSS.
- b. An increase in standing surface water levels on the hydrological regime and the flora species within THPSS, given extended periods of inundation would occur where the groundwater model predicts an increase in baseflow and groundwater head level post mining.

Question 2: If not, what does the IESC consider is a reasonable assessment of the likelihood, extent and significance of impacts on overlying and adjacent swamps?

Response

13. Impacts to undermined THPSS have historically been severe, resulting in changes to the hydrological and hydrogeological regimes, vegetation composition and structure, and large reductions in THPSS extent. These changes have been significant and are considered to be beyond the ability of the ecological community to recover naturally^{3,4,5}. As yet, there is no scientific evidence or industry based results to indicate that such impacts to THPSS can be remediated successfully^{3,5}.
14. The subsidence related impacts affecting overlying and adjacent THPSS would be expected to include fracturing of underlying bedrock, a water storage capacity increase within the bedrock fracture network, a decrease in surface water flow provision from upstream tributaries and a corresponding decrease in standing surface water level. Other impacts to THPSS may include nick point erosion, peat slumping, changes to the swamp inundation regime and a decline in the biological diversity and/or species composition of swamps. Such impacts are highly likely to be severe and potentially irreparable⁴.
15. Due to the low level of confidence in the groundwater model's capacity to predict hydrological impacts to individual THPSS, the likelihood, extent and significance of groundwater impacts to swamps cannot be determined with certainty. Swamps that are directly undermined or overlie structural lineaments are more likely to be severely impacted due to the instability of underlying strata and locally increased subsidence effects. Given the temporal variability and time lags with which impacts are observed in THPSS, the significance of groundwater impacts may not be readily determined for some time.

Explanation

16. The range of potentially severe impacts caused by subsidence would be expected to include tensile cracking, movements of joint, bedding and shear planes, buckling and localised upsidence. Broadly, these impacts have been described as having the following consequences for THPSS³:
 - a. Draining of swamps, or their upstream tributaries, into subsidence formed bedrock fractures.
 - b. Drying and desiccation of peat and underlying sediments, resulting in:
 - i. Increased risk of erosion, scour and slumping of peat.
 - ii. Vulnerability to fire and invasive species.
 - c. Losses of baseflow and/or surface flow provision necessary to support swamps.

- d. Loss of standing surface water pools, or changes to the inundation regime.
- e. Decreases in water quality (for example, due to ferruginous water leaching out of fractured bedrock).
- f. Changes to, or loss of, vegetation communities and threatened species.

Subsidence

17. Based on the documentation provided in the EIS nine THPSS (including groups or swamp clusters) are located within the potential subsidence impact zone, and a number of these, such as Trail 6 Swamp and Tri Star Swamp, are proposed to be undermined. The EIS (p. 274) states that fracturing up to 50 mm wide is predicted to occur within the shallow bedrock of THPSS wherever they are undermined. Impacts to THPSS, such as those identified in paragraph 16, are considerably more likely to occur where swamps are directly undermined. Fracturing to further THPSS and their upstream tributaries would be expected to occur where compressive and tensile strains exceed 0.5 mm/m and 2 mm/m respectively. Strain is caused by the horizontal movement of the ground surface relative to two fixed points. Tensile strain occurs where the distance between two points increases and compressive strain occurs where the distance between two points decreases.
18. The risk and potential severity of impacts is higher for Tri Star Swamp and Trail 6 Swamp. These swamps are both proposed to be undermined with the resulting conventional subsidence predicted to be 1.9 and 0.95 m, respectively. Additionally, Tri Star Swamp is situated above a “type 2” structural lineament and longwall panels below Trail 6 Swamp are, in places, critical in width (longwall width to depth of cover ratio of 0.96).
19. Critical panel widths and structural lineaments were factors resulting in severe impacts to East Wolgan Swamp and Narrow Swamp, which were previously undermined on the Newnes Plateau. Impacts to East Wolgan Swamp and Narrow Swamp have been identified in literature⁵ and also described within the EIS (Appendix D, p. 77). Impacts included rapid decline of groundwater, peat desiccation and associated slumping, loss of natural surface flows through swamp channels and almost complete decline of THPSS flora species. Surface flows were found to be flowing into the subsidence induced bedrock fracture network and not resurfacing downstream. At East Wolgan Swamp, it was later identified that this water was pooling within bedding separation of strata approximately 60 to 70 m underneath the swamp.

Predicted groundwater impacts

20. Maximum predicted cumulative drawdown in shallow hydrogeological units (strata which provides baseflow to THPSS) is 10 m after seven years and 10 to 15 m beyond 100 years. Water table drawdown is mainly predicted to occur below the topographic ridges, with minimal predicted change in topographic valleys. There is no predicted recovery in these strata post mining, indicating that water levels are predicted to be reduced permanently in the upper aquifer. The modelled effect of drawdown on THPSS is predicted to range from an increase in groundwater head to a 0.36 m reduction in swamps across the model domain. Due to the groundwater model's mesh size, these predictions are unable to replicate the water storage capacity or flow dynamics within subsidence induced fractures overlying longwall panels. Therefore predictions of baseflow loss to THPSS may be underestimated within the groundwater model.
21. The reliability of predicted changes to baseflows within THPSS is limited by a lack of site specific hydraulic conductivity data and measured baseflows within swamps. Specifically, the model is only calibrated against baseflows estimated for a single THPSS (Sunnyside Swamp). This approach means the groundwater model may conform well to Sunnyside Swamp measurements, but is unlikely to accurately represent the unique hydrological and hydrogeological regimes of

each swamp within the model domain. The groundwater model's ability to predict the spatial and temporal severity of impacts to individual THPSS is further limited by the model's mesh size as described in paragraph 3 to 5 (Question 1).

Threatened species

22. The THPSS ecological community contains habitat for the EPBC Act listed endangered Blue Mountains water skink (*Eulamprus leuraensis*), and the vulnerable Deane's boronia (*Boronia deanei*). These species have both been identified within the adjacent Springvale Mine Extension Project area, are restricted to THPSS habitat and are described within the EIS as potentially occurring within the APMEP area. Where these threatened species occur, the loss or severe decline of THPSS within the project area would also be expected to cause severe impacts to these species⁵.

Question 3: What strategies does the IESC consider are available to avoid or reduce the likelihood, extent and significance of these impacts?

Response

23. Avoidance of undermining and locating longwalls such that tensile and compressive strains are below 0.5 mm/m and 2 mm/m respectively at THPSS sites are considered the most effective ways to manage the potential impacts to THPSS⁵. This strategy should also be applied to any upstream tributaries that provide a significant proportion of surface flow to THPSS.

Explanation

Mine design

24. The proponent has designed the longwall mine layout to avoid some THPSS (Twin Gully Swamp and several unnamed swamps), and to minimise subsidence through narrowing of several longwalls and increasing chain pillar widths. However, a number of THPSS remain overlying or within the potential subsidence impact zone of the proposed longwalls. Fracturing in the bedrock below these swamps is expected to occur where tensile and compressive strains caused by conventional subsidence exceed 0.5 mm/m and 2 mm/m respectively⁵. Fracturing within the bedrock of tributaries upstream of THPSS is also predicted to occur. The risk of bedrock fracturing is reduced by minimising the exposure of bedrock to strain. Ensuring that tensile and compressive strains are below 0.5 mm/m and 2 mm/m respectively at THPSS sites is the only measure known to prevent impacts to THPSS⁵. To avoid impacts to the surface water hydrological regime of THPSS, this avoidance strategy would also need to be applied to upstream tributaries that provide a significant proportion of surface water flows to downstream THPSS.
25. The time delay between evidence of impacts to a THPSS and longwall mining means that, once damage caused by a progressing longwall is evident, the longwall extraction may already be too advanced to prevent further impacts. There is a high risk that impacts to THPSS would be irreversible.

Other mitigation measures

26. Other measures used to mitigate impacts caused by longwall mining have historically involved isolation of ground movements through, for example stress relief slots; and remediation or maintenance responses⁵. The efficacy of strategies for remediating the ecological function and hydrological/hydrogeological regimes of impacted THPSS, has not been demonstrated in Australia.

27. Ground isolation measures include stress relief slots. These measures have previously been trialled to mitigate impacts to surface water courses, though have not been trialled as measures to mitigate impacts to upland THPSS (such as those located within the project area)⁵. These measures require the drilling of deep “slots” into bedrock to reduce the strains associated with subsidence. As a result the installation of stress relief slots is highly invasive and may impact the functions of the swamp that they were designed to protect. These measures are rarely used and have not been fully investigated for their efficacy. Results from the southern coalfields suggest that the use of these measures may limit some subsidence impacts, though does not appear sufficient to prevent the full extent of subsidence impacts to THPSS^{3,5}.
28. Preservation responses include the sealing of surface fractures through grouting, cementing, gel injection, grading or other soft engineering measures. There is limited evidence of remedial preservation techniques being trialled on THPSS, and no literature is available that details the successful remediation of THPSS to pre-impact condition using these techniques⁵. In addition, many of the identified measures are highly invasive and may cause impacts to the swamp in their own right. For example, to access fracturing in bedrock below a THPSS would require the removal of the peat layer, which would destroy the swamp in that location and may have long lasting effects on the hydrological regime and the ecological community. Options for horizontal drilling and grout injection are not known to have been trialled for THPSS⁵.
29. The proponent has stated that cracks are predicted to form within the sandstone substrate underlying many swamps within the project area. The proponent states that these cracks will naturally fill with soil and peat (self-ameliorate), and therefore impacts related to these bedrock fractures are “considered unlikely”. However, THPSS are exceptionally slow to self-heal or self-ameliorate. Examples of lowland swamps from the Southern Coalfields of New South Wales show that without attempted rehabilitation, self-amelioration is not evident within two lowland swamps over a 25 to 30 year period⁵. Based on a lack of supporting evidence and available literature, self-amelioration is not considered to be a reliable or effective remediation method.

Proposed monitoring and TARPs

30. The EIS states that the existing Angus Place operations are covered by monitoring programmes and management plans that incorporate subsidence monitoring and management commitments. The suitability of the outlined monitoring and management plans, in regards to their ability to predict or mitigate impacts to THPSS, cannot be determined as they have not been included within the assessment documentation. The provision of these plans is needed to enable an assessment of the adequacy of the proposed monitoring programme, and would provide data on the suite of identified impacts within the existing mining area.
31. The monitoring plan includes a TARP (Trigger Action Response Plan). The time lag between mining and observation of impacts, particularly ecological impacts, greatly reduces the potential effectiveness of TARPs. As a result, industry experience shows that mitigation or management actions implemented as a component of a TARP, have been unsuccessful in preventing impacts to, or restoring the ecological function of, any THPSS^{4,5}.

Question 4: Which, if any, of these strategies does the IESC recommend, and why?

Response

32. The only known strategy to reduce the risk of impact to THPSS ecological communities within the project area would be to alter the mine layout such that swamps are not undermined by longwall panels and longwalls are sufficiently removed from THPSS such that tensile and compressive strains at THPSS sites are below 0.5 mm/m and 2 mm/m respectively⁵. This avoidance strategy should also be applied to any upstream tributaries that provide a significant proportion of surface

flow to THPSS. This approach is the most likely to prevent impacts to THPSS given the potential severity of impacts, difficulties in the accurate and confident prediction of impacts, and the ineffectiveness of other mitigation and management measures. Further, there is no currently available scientific evidence to demonstrate that remediation activities are able to successfully restore the ecological and hydraulic functions of these threatened ecological communities to pre-impact condition^{4,5}.

Questions 5 to 9 are specifically addressed in relation to the groundwater modelling included within the EIS documentation and its assessment of the impacts of potential groundwater discharge to surface waters.

Question 5: Is the groundwater model suitably robust, and are the resulting quantitative predictions accurately and reasonably described?

Response

33. The groundwater model is a regional scale model that provides generally robust predictions of mine groundwater inflows. These are reasonably described. However, due to the scale of the groundwater model, it is limited in its capability to predict groundwater related impacts to surface water systems including those affecting THPSS and proximal reaches of the Coxs River. This results in a low level of confidence in the predictions of impacts to Cox's River and THPSS baseflows described within the EIS.

Explanation

34. Many of the groundwater model's limitations, with respect to predicting impacts to water levels and swamp and stream baseflows, are identified within the EIS (Appendix E, CSIRO groundwater model). The following inclusions would reduce uncertainty in the groundwater model's quantitative predictions of groundwater related impacts:

- a. Undertake hydrogeological testing and improve the groundwater monitoring network above, below and within the Mt York Claystone. This should be undertaken to improve parameterisation of the groundwater model and to improve the understanding of surface water and groundwater interconnectivity. The effect of subsidence on hydraulic and storage properties of the hydrogeological units above and within the Mt York Claystone should also be assessed.
- b. Development of a finer scale model representative of local scale topography and geology, coupled to an updated regional scale model to enable more reliable representation of shallow groundwater system dynamics. The fine scale model should use site specific climatic (daily time-steps), swamp and stream flow, and water level data.
- c. Development of finer scale modelling of the Coxs River to allow predictions of surface water and groundwater interactions, including:
 - i. Representation of Coxs River as a river within the groundwater model.
 - ii. Undertaking hydraulic characterisation of river and aquifer connectivity including characterisation of connectivity between Coxs River, Coxs River alluvium and mine impacted hydrogeological units.
 - iii. Identification of the baseflow proportions of flows within swamps that are located in tributaries of Coxs River and are upstream of discharge points. The effect of reduced baseflow provision to upper reaches of Coxs River should then be assessed against observed flow data to determine potential impacts to the Coxs River flow regime.

Question 6: Are the cumulative water quality impacts of discharges to the Coxs River accurately and reasonably described?

Response

35. The cumulative water quality impacts of Angus Place and Springvale mine water discharges to the Coxs River, an important contributing source to Sydney's drinking water supply, were not modelled for all relevant contaminants, did not consider all likely discharge conditions, and are therefore not accurately and reasonably described.
36. Salinity was the only water quality variable modelled for cumulative impacts. The cumulative impact of other contaminants was not provided, even though the EIS states (Appendix C within Appendix F) that levels of copper, zinc, nitrogen and phosphorus have been elevated above ANZECC² 95th percentile protection level for slightly to moderately disturbed ecosystems. The contributing water quality impacts to Coxs River from other mines in the area are not quantified.
37. Water quality impact estimations for the Coxs River for both Angus Place and Springvale were conducted for scenarios that included the transfer of large volumes of water through the Springvale Delta Water Transfer Scheme (SDWTS) to the Wallerawang Power Station. This may no longer be a viable option because the Wallerawang Power Station has been placed into care and maintenance. Increased discharge volumes resulting from reduced demand from the Wallerawang Power Station would affect the outcome of the cumulative water quality impact assessment and should be considered as a potential discharge scenario.

Explanation

Cumulative water quality impact assessment

38. The regional water balance provides estimates of cumulative water extraction and mine water discharge volumes for groundwater and surface water management units resulting from mines in the Western Coalfields. However, these analyses were conducted to determine whether water licensing for Centennial operations in the corresponding water management areas would be sufficient, and does not focus on the Coxs River catchment.
39. The potential cumulative impacts of copper, zinc, nitrogen and phosphorus on the Coxs River were not considered in the EIS. The proponent should describe the contribution of mine water discharges to potential cumulative impacts of relevant water quality variables in line with the ANZECC² Guidelines.
40. The proponent's conclusions from the regional water balance are that there are no expected sustained increases to pollution loads from the current operations. This statement is not substantiated by appropriate analyses. In order to accurately and reasonably describe cumulative water quality impacts to all reaches of the Coxs River, a regional water balance and cumulative water quality impact model that encompasses all relevant extractions and discharges (including any groundwater extractions that may reduce baseflows in the Coxs River) would be required.

Closure of Wallerawang power station

41. Water quality impact estimations for the Coxs River include the transfer of mine water to the Wallerawang Power Station through the SDWTS at either the current 30 ML/d capacity, or the proposed upgraded 50 ML/d capacity. Water discharge volumes based on transfers to the SDWTS may no longer be appropriate as the Wallerawang Power Station has been placed into care and maintenance. The proponent should assess the impacts of the potential closure of Wallerawang Power Station on Coxs River water quality. This should include an expanded water quality impact assessment and salt balance modelling that considers the cumulative impacts

under the scenario where maximum mine water discharge occurs under low flow conditions in Coxs River.

Question 7: Is the information provided sufficient to predict any changes to either water quality or water quantity in the Coxs River at Kelpie Point which would arise as a result of the mining operation? (Kelpie Point – station number 563000 – is located on the Coxs River close to its entry location into Warragamba Dam. The Sydney Catchment Authority has undertaken flow and quality monitoring at this location for extended periods.)

Response

42. No. The proponent's estimation of downstream impacts was limited to site water balance and cumulative salt mass balance modelling that did not model impacts beyond the upper Coxs River catchment (i.e. not downstream of Lake Lyell). In addition, the existing condition of the Coxs River was not adequately described and the downstream impact modelling that was undertaken included transfer of large volumes of water through the SDWTS to the Wallerawang Power Station, which may no longer be a viable option.

Explanation

43. The Coxs River enters Warragamba Dam (a drinking water supply for Sydney) approximately 110 km downstream of the Springvale Colliery. The Coxs River is the second largest tributary in the Warragamba catchment and contributed approximately 30 per cent of the total inflow volume to Warragamba Dam during 2012–13⁶. Monitoring data collected at Kelpie Point (close to where the Coxs River enters Warragamba Dam) provides information on parameters including flow volume, nutrient and metal concentrations, pH, dissolved oxygen and turbidity.

44. Analysis of hydrological impacts of mine water discharges on the Coxs River was not presented in the EIS. Discharge volumes and velocities in Coxs River tributaries downstream of the APMEP licensed discharge point 001 (LDP001), and Springvale Mine Extension Project LDP009 were analysed for erosion potential, but similar analysis was not presented for the Coxs River. Median flow in the Coxs River is 12.2 ML/d downstream of the above discharge points. However, sustained discharges of up to 43.8 ML/d may eventuate as a result of the two proposals, which would have hydrological and geomorphological impacts on the Coxs River. The proponent needs to consider the impact of all mine water discharges, from both the APMEP and Springvale Mine Extension Project, on the hydrology of the Coxs River.

45. The downstream extent of the proponent's surface water quality impact modelling was limited to the Coxs River above Lake Lyell. In order to quantify changes to water quantity in the Coxs River at Kelpie Point that would arise as a result of the mining operations, modelling and/or analysis of the hydrological impact of all mine water discharges is needed. This water quality assessment should consider the volume, frequency and timing of discharges in relation to current flows at Kelpie Point and should consider discharges from both the APMEP and the Springvale Mine Extension Project. The model should consider the extractions and discharges of any downstream water users, and should also consider a scenario where the Wallerawang Power Station is not operational.

46. The proponent considers that the hydrological consequence of increased mine water discharges on the Coxs River is not significant because there is excess demand for this water in the catchment. This conclusion is based on Wallerawang Power Station requiring 30ML/d and Mount Piper Power Station requiring 38.9 ML/d. However, this conclusion may no longer be valid as the Wallerawang Power Station has been placed on care and maintenance. In order to predict any changes to water quantity in the Coxs River at Kelpie Point the proponent should model the

hydrological impact of mine water discharges assuming no water transfers to the Wallerawang Power Station.

Question 8: If so, what are the predicted changes to water quality water quantity in the Coxs River at Kelpie Point and what are the consequences for stored water within Warragamba Dam?

Response

47. Water quantity and quality changes in the Coxs River at Kelpie Point cannot be reliably estimated based on the information presented in the EIS documentation, as detailed in the response to Question 7. For similar reasons, the consequences for stored waters in Warragamba Dam also cannot be reliably estimated from information in the EIS.

Explanation

48. The proponent has not modelled water quality or quantity impacts downstream of Lake Lyell. To predict changes to water quality and quantity at Kelpie Point, all inputs and outputs to the Coxs River catchment, both in terms of water volume and concentration of contaminants would need to be considered.

49. Comparison of Kelpie Point median water quality values to mine water discharge quality indicates that water quality at Kelpie Point has been similar or better quality than water immediately downstream of the APMEP mine discharge points on the Coxs River over the same time period. However, it is not possible to determine the contribution of the APMEP mine water discharges to the water quality at Kelpie Point, nor predict changes resulting from the proposed mine extensions, without detailed modelling of the Coxs River catchment.

Question 9: What water treatment options does the IESC recommend and/or consider feasible to reduce the salt and contaminant levels of mine water discharged to the Coxs River.

Response

50. Protection of the long-term ecosystem health of Coxs River should include consideration of the ANZECC and ARMCANZ (2000)² Guidelines, through an agreed set of approval trigger discharge values and management protocols. Where salinity or other contaminants of concern are likely to exceed trigger values, management and treatment options may include, but are not limited to, reverse osmosis and ion exchange technologies.

Explanation

51. Development of surface water quality trigger values and contingency options (including treatment where necessary) based on agreed water quality outcomes will assist design and operation of potential treatment facilities and ongoing water quality monitoring programmes.

52. The Hawkesbury-Nepean subregion has been identified for Bioregional Assessment. Data and relevant information from the proposed project should be made accessible to this Bioregional Assessment and to relevant research programmes, to assist the knowledge base for regional scale assessments.

Date of advice	25 August 2014
Source documentation available to the IESC in the formulation of this advice	Golder Associates, 2014. Angus Place Colliery, Angus Place Mine Extension Project, State Significant Development 5602, Environmental Impact Statement. Volume 1: Report. Prepared for Centennial Angus Place Pty Limited. 7 April 2014.
References cited within the IESC's advice	<p>¹ Information 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>² ANZECC and ARMCANZ, 2000. Australian Guidelines for Water Quality Monitoring and Reporting. National Water Quality Management Strategy (NWQMS). Document 4 and 7. Australian and new Zealand Environmental and Conservation Council & Agriculture and Resource Management Council for Australia and New Zealand, Canberra.</p> <p>³ Commonwealth of Australia, 2014a. <i>Temperate Highland Peat Swamps on Sandstone: longwall mining engineering design—subsidence prediction, buffer distances and mine design options, Knowledge report</i>. Prepared by Coffey Geotechnics, for the Department of the Environment.</p> <p>⁴ Commonwealth of Australia, 2014b. <i>Temperate Highland Peat Swamps on Sandstone: ecological characteristics, sensitivities to change, and monitoring and reporting techniques, Knowledge report</i>. Prepared by Jacobs SKM, for the Department of the Environment.</p> <p>⁵ Commonwealth of Australia, 2014c. <i>Temperate Highland Peat Swamps on Sandstone: evaluation of mitigation and remediation techniques, Knowledge report</i>. Prepared by the Water Research Laboratory, University of New South Wales, for the Department of the Environment.</p> <p>⁶ Sydney Catchment Authority, 2013. Annual Water Quality Monitoring Report 2012-13</p>