

Advice to decision maker on coal mining project

IESC 2020-115: Fairhill Coal Project (EPBC 2019/8549) – New Development

Requesting agency	The Australian Government Department of Agriculture, Water and the Environment
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Advice stage	Assessment

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) provides independent, expert, scientific advice to the Australian and state government regulators on the potential impacts of coal seam gas and large coal mining proposals on water resources. The advice is designed to ensure that decisions by regulators on coal seam gas or large coal mining developments are informed by the best available science.

The IESC was requested by the Australian Government Department of Agriculture, Water and the Environment to provide advice on the Futura Resources Limited's Fairhill Coal Project in Queensland. This document provides the IESC's advice in response to the requesting agency's questions. These questions are directed at matters specific to the project to be considered during the requesting agency's assessment process. This advice draws upon the available assessment documentation, data and methodologies, together with the expert deliberations of the IESC, and is assessed against the IESC Information Guidelines (IESC, 2018).

Summary

The Fairhill Coal Project, proposed by Futura Resources Limited, is a new open-cut coal mine (448-ha disturbance area) to be located approximately 55 km northeast of Emerald in the upper reaches of Mackenzie River sub-catchment of the Fitzroy Basin.

Using strip mining, the project will access the thin coal seams of the Fort Cooper Coal Measures sub-Group within the Bowen Basin to produce approximately 1.7 million tonnes per annum of run-of-mine (ROM) coking coal over a seven-year period. The open-cut pit will be progressively back-filled with overburden so that no final void will remain at the end of the project.

Much of the project area has been cleared for cattle grazing and consists mostly of non-remnant vegetation. Associated infrastructure proposed for the project includes office and ablution facilities,

stormwater management structures, wastewater treatment facility, warehouse facilities, ROM stockpile area and main road access.

The IESC was hampered by the limited information provided by the proponent but it is inferred that the key potential impacts from this project are:

- changes to surface water flow due to altered catchment runoff as a result of diversions of runoff around the pit, water being caught and evaporating out of the pit and dams, and the final landform;
- poorer surface water quality due to controlled and uncontrolled releases of mine-affected water from the water management system into tributaries of Sandy Creek; and
- a decline in condition, persistence or both of groundwater-dependent vegetation along Cooroora and Sandy creeks caused by groundwater drawdown. Vegetation along the riparian corridor has been identified as potential habitat for species listed as threatened in the *Environment Protection and Biodiversity Conservation (EPBC) Act* such as Koala (*Phascolarctos cinereus*), Ornamental Snake (*Denisonia maculata*) (also favouring associated gilgai) and Greater Glider (*Petauroides volans*).

The IESC has identified areas in which additional work is required to address the key potential impacts, as detailed in this advice. These are summarised below.

- Revisit the groundwater modelling to assimilate additional field data, to account for uncertainties in the boundary conditions including groundwater recharge and spatial heterogeneity in hydraulic properties, and to simulate the time for the recovery of groundwater levels post-mining. Plots of the predicted spatial extent and magnitude and uncertainty of groundwater drawdown are required, especially in areas supporting groundwater-dependent ecosystems (GDEs), including those beyond the project boundaries where drawdown may occur. The distribution of all GDEs should be identified on these plots, together with specific assessments of their condition and vulnerability to possible impacts of predicted drawdown.
- Potential impacts on surface water flow in Cooroora and Sandy creeks as a result of the project operations need to be quantified and assessed.
- An assessment of surface water quality and potential impacts, including on water-dependent biota, is needed. This assessment should include sufficient monitoring sites sampled frequently enough to reliably establish baseline conditions. Existing information on water quality in Cooroora and Sandy creeks and potential impacts should also be presented and discussed.
- Given the potential impacts associated with the high salinity and high concentrations of metals in groundwater, further information on the sourcing of operational water and use and treatment of accumulated mine-affected water should be provided.
- Baseline data on the current condition of the riparian vegetation (including confirmation of species' groundwater-dependence) and, if present, stygofauna in the project area should be collected and provided. This will enable comparison with future monitoring data to detect any impacts of the project on these assets and assist the proponent in identifying suitable mitigation and management measures.
- Details of the final landform must be provided to allow assessment of the potential impacts on post-closure flooding, downstream flow regime and local alluvial recharge processes. Further, the suitability of its design in minimising impacts (including poorer water quality) and facilitating restoration to the desired endpoint must also be assessed.

Context

The Fairhill Coal Project (the 'project') is a proposed greenfield open-cut coal mine located in the Mackenzie River sub-catchment of the Fitzroy Basin, 55 km northeast of Emerald, Queensland. The project will mine a maximum of 1.7 million tonnes of run-of-mine coal per year from the Bowen Basin over seven years, disturbing approximately 448 ha of mostly non-remnant vegetation. Approximately 0.64 ha of remnant vegetation will be removed by the project (SLR 2020a, p. iii). The proponent has designed the mine layout to avoid directly disturbing riparian habitat along Cooroora and Sandy creeks, including adjacent gilgai and relic channel areas.

Infrastructure constructed for the project will include offices, workshops, a water management system and out-of-pit waste rock dumps. Most waste rock will be progressively returned to the pit as no voids are planned for the final landform as per the requirements of the Queensland Department of Environment and Science (SLR 2020a, p. iii). Coal washing and processing will not be undertaken on site. Instead, product coal will be trucked to the Gregory-Crinum Mine 18 km northwest of the project area for processing and handling (SLR 2020a, p. 1) prior to rail transport to Gladstone.

The project is located in a region with several operational and planned mines. The project area has been substantially altered for grazing, including clearing of most vegetation except the riparian corridors. Pasture improvement has resulted in extensive areas of non-native vegetation and several invasive species are prevalent (SLR 2020a, p. 21).

The proponent highlights that the intent of the project is to confirm the commercial viability of mining the thin coal seams of the Fort Cooper Coal Measures sub-Group (SLR 2020a, p. i). If this is confirmed, then they expect significant additional coal resources will be unlocked for future mining across Queensland, with implications for cumulative impacts.

Response to questions

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

Question 1: Can the Committee provide comment on whether the information provided in the PER, particularly the baseline and modelled data, and the conclusions drawn by the proponent, are sufficient to assess the project's impacts to surface and ground water resources, GDEs and cumulative impacts with other proposed and existing projects?

Surface water

1. Apart from some limited information on climate, no observational data have been presented in the Public Environmental Report (PER) (SLR 2020a) that would allow adequate characterisation of the local baseline flow regime (e.g. ecologically important flow components such as timing and duration of low- and zero-flow periods) and surface water availability. The simulated streamflow and flood runoff have been generated using models that have not been calibrated, and the modelling results are presented in a manner that precludes comparison with regional information (e.g. streamflow and flood characteristics obtained from gauging of comparable catchments). In the absence of local observations and regional information, it is not possible to have confidence in the proponent's predictions of impacts to surface water resources.
2. Flood risk estimates were obtained using a rain-on-grid approach in which a two-dimensional hydrodynamic model (TUFLOW) was configured for the whole catchment area. The storage-routing flood event model (RORB) was used only to identify the duration of the rainfall event that yielded the largest floods for a given annual exceedance probability. This is a problematic approach to adopt in rural catchments which are not dominated by hydraulic controls (particularly given the coarse nature of the available topographic survey) and is not consistent with recommended practice (Ball and

Weinmann, 2019). Given the nature of the design information used and the adopted modelling approach, the IESC has little confidence in the flood risk information provided by the proponent.

3. Controlled releases of mine-affected water from the project water management system are proposed. Releases would be made into tributaries of Sandy Creek (although the exact discharge points are not shown), which flows into Cooroora Creek (ATC Williams 2019, pp. 12, 30 and 36). Releases are proposed during “sufficient” flow events in accordance with a predetermined volumetric flow ratio, or when dilutions are >1:20 for mine water dam discharges (ATC Williams 2019, Table 6, p. 30 and p. 32). Details of what constitutes “sufficient” flow and justification of the flow ratio are required so that potential impacts on water quality can be assessed. It is proposed to install a flow gauging station approximately 2 km downstream of the project (ATC Williams 2019, p. 33 and Plate 16, p. 33); however, the IESC recommends a gauging station in Sandy Creek downstream of the proposed discharge points and before its confluence with Cooroora Creek. This should be done as early as possible to provide information with which to validate the streamflow estimates.
4. The proponent considers that the only reduction in the Cooroora Creek catchment area will be the 340-ha area of the proposed pits, making up 1% of the catchment (SLR 2020a, p. 100). The surface water assessment was undertaken without knowledge of the configuration of the final landform. Assessment of potential impacts on downstream flows and the receiving environment from this reduction in catchment area and the final landform configuration should be updated when this information is available (see Paragraphs 16, 18-19).
5. Assessment of the water quality of mine-affected water and its potential impacts on the receiving environment is very limited. The proponent has identified that water quality in the proposed site water dams will potentially be elevated in salts and contain suspended solids (ATC Williams 2019, p. 49). Leachates from overburden and coal rejects were assessed (Northern Resources 2018, pp. 15-24). However, no data on the water quality in Cooroora Creek are provided. The IESC considers further information on the quality of mine-affected water must be provided to adequately predict the potential effects of these controlled releases on downstream biota and ecological processes, especially those in riparian and instream areas.

Groundwater

6. The groundwater modelling information, both for the conceptual model and the two-dimensional (i.e. vertical cross-sections) steady-state model, is presented with unsupported assumptions due to limited measurement and characterisation information, including reference to comparable sites. The information conveyed in the PER documentation provides the reader with a preliminary understanding of the likely impacts of the project on groundwater resources (predicted drawdown is depicted in SLR 2020b, Figure 30, p.65). However, the documentation lacks sufficient detail to accurately assess the impacts of the proposed project. The proponent should discuss the possible errors in the simulated drawdowns that may result from the currently used 2D steady-state representation of the groundwater flow system and how they are accounted for in the assessment (see IESC 2018). This lack of information reduces confidence in the simulated outputs.
7. The proponent undertook a linear sensitivity analysis (SLR 2020b, Figure 21, p. 45), and noted that the calibrated steady-state modelled head outputs were insensitive to the general head boundary parameters. This observation was then used to justify not further considering the uncertainty of the boundary condition parameters. However, while the steady state modelled heads are insensitive to the boundary condition parameters, the simulated predictions of flows and drawdowns can be expected to be significantly more sensitive to these parameters. Therefore, the impact of the uncertainty of these boundary condition parameters on the simulated drawdown should be assessed (see Paragraph 21).

8. The proponent has depicted the project's likely maximum drawdown through a 1-m drawdown radius with a 95% confidence interval (SLR 2020b, Figure 23, p. 48). The modelling approach employed, combined with the way in which groundwater drawdown is extrapolated and presented in three dimensions (from a 2D result), means that the drawdown predictions are likely to be unreliable. They cannot be used to understand the varying degrees of drawdown that are likely in the project area; information which is essential for assessing potential impacts on GDEs (Paragraphs 14). In addition, there are few data used to constrain the model parameters used to simulate the groundwater drawdown. Consequently, there is significant conceptual, parametric and hence model output uncertainty that is not currently captured by the modelling approach. These problems severely reduce confidence in the accuracy of predicted spatial extent and magnitude of drawdown, and in their associated confidence limits (SLR 2020b, Figure 23, p. 48).
9. As the nearest proposed project is over 11 km away, potential effects of other projects have not been included in the proponent's groundwater modelling. More information is needed to support the assumption that cumulative impacts are not material, and could be provided by assessing the superposition of potential drawdown impacts from neighbouring proposed mines.
10. The proponent started collecting baseline groundwater quality data in June 2018 but was interrupted by wet-weather conditions (SLR 2020b, p. 72). Only four samples were collected from 7 bores over a 7-month period, which is inadequate to assess baseline groundwater quality. Groundwater was highly saline and there were substantial exceedances of ANZG (2018) guidelines for aquatic ecosystem protection (95% of species) for the metals aluminium, arsenic, chromium, copper, manganese, selenium and zinc, as well as high concentrations of boron. Cadmium may also be of concern, but analytical detection limits were insufficient to allow comparison to guideline values. The proponent intends to collect additional groundwater data from 11 monitoring bores at the site monthly, over a 12-month period which is expected to begin in 2019 (SLR 2020b, p. 72), and this information will be crucial (see Paragraph 20).

Groundwater-dependent ecosystems

11. The proponent has stated that connectivity between the alluvium and Permian aquifers along both Cooroora and Sandy creeks is expected to be limited due to the presence of clay layers (SLR 2020a, p. 20). The IESC notes that the only evidence provided to justify the claims of limited connectivity is one bore log of Cooroora Creek (FHMB01). No monitoring bores have been drilled in Sandy Creek. Further information is needed to justify this assumption of limited connectivity between the alluvium and Fairhill Formation, in particular along Sandy Creek, to fully understand the potential for impacts, and their likely magnitude, to terrestrial GDEs in the project area.
12. Limited information on the baseline condition of riparian vegetation has been provided. Information is needed on the current condition of the riparian vegetation along both creeks, including at several reference sites where no impacts are predicted and outside the potential zone of groundwater drawdown, (Paragraph 26) so that the proponent can detect any impacts that may occur and can mitigate these accordingly.
13. No stygofauna sampling has been undertaken. Although one monitoring bore in the project area has a reported salinity of 44,600 $\mu\text{S}/\text{cm}$, the EC (electrical conductivity) of groundwater in other bores is generally less than half this (SLR2020b Table 2, pp. 23-24). Stygofauna have been collected from groundwater with ECs up to 54,800 $\mu\text{S}/\text{cm}$ (Schulz et al. 2013) although diversity declines with increasing EC (Glanville et al. 2016). Information on stygofauna is needed (Paragraph 25) to ascertain whether the predicted drawdown might have impacts on this obligate GDE.
14. Potential GDEs are shown on the mapping (SLR 2020c, Figures 3 and 4, pp. 35-36) derived from the desktop analysis of the occurrence of GDEs. The proponent has ground-truthed terrestrial GDEs within the project area (SLR 2020c, Figure 8) but this ground-truthing does not cover potential GDEs

within the full zone of predicted groundwater drawdown. The proponent should provide further information on whether any potential GDEs beyond the project boundaries could be impacted by groundwater drawdown arising from this project (Paragraph 25).

Question 2: Can the Committee identify and discuss what additional information could be provided to assist in the assessment of impacts on surface and ground water resources?

Surface water

15. As noted in Paragraph 1, the surface water assessment has been prepared without reference to any local observation data or other sources of regional information. To improve confidence in predictions of impacts on surface water resources, it would be necessary to provide information on:
 - a. the nature of the evidence used to inform the parameters of the streamflow simulation model (AWBM); i.e. whether the “experience with similar water balance model studies” (ATC Williams 2019, p. 40) included any calibration or validation procedures or whether they were also based on uncalibrated and unvalidated models;
 - b. how the simulated flow regimes (e.g. seasonality, cease-to-flow, runoff proportions and yield metrics) compare to regional estimates derived from gauging stations located in catchments with similar hydroclimatic characteristics (as discussed in Nathan and McMahon 2017); and
 - c. comparison of flood estimates with regional information (e.g. Rahman et al. 2019).
16. An assessment of potential impacts to flow is required as part of the Receiving Environment Monitoring Program (REMP) (SLR 2020a, p. 103) which will assist in understanding the impacts of the project on the hydrology of the downstream environment. This assessment should include quantification of potential changes to flow volumes, and discussion of what impacts these changes might have on the flow regime (including ecologically important flow components such as timing and duration of low- and zero-flow periods) in Cooroora Creek.
17. An assessment of potential impacts to water quality is needed to improve the understanding of the potential impacts of controlled releases from the water management system on the receiving environment. The assessment of water quality and collection of baseline data (reference and downstream sites) is required as part of the Surface Water Management Plan (SWMP) and the REMP. Details of what constitutes “sufficient” flow and the volumetric flow ratio for controlled releases (ATC Williams 2019, Table 6, p. 30) should be provided as part of this assessment (Paragraph 3).
18. When available, information on the source of water supplied for project operations (SLR 2020a, p. 10) should be provided. Noting that mine-affected water is modelled to accumulate over the life of the project (ATC Williams 2019, pp. 44-45), further detail on the proposed use and treatment of accumulated water (ATC Williams 2019, p. 45) should be provided. This information should be used to assess potential impacts to surface water quality and flow.
19. The design of the final landform is required as part of the Rehabilitation Management Plan (RMP) (SLR 2020a, pp. 103-104). The final landform should be included in the updated flood model required in the SWMP (SLR 2020a, p. 103) to provide more accurate conclusions on post-closure flooding and should be justified in terms of its mitigation of flood impacts on the surrounding and downstream environment. Information on drainage design and erosion controls for the final landform is required (SLR 2020a, p. 104). The design of the final landform should consider water quality of the runoff post mine-closure.

Groundwater

20. Baseline groundwater data should be collected for the site and used to inform the model's predictions (see Paragraph 6-10). Additional information obtained from existing, proposed and additional monitoring bores (see Paragraph 32) should be in accordance with the IESC information guidelines (IESC 2018), including for example:
 - a. geological and lithological observations during drilling, particularly the depth of alluvium, thickness and character of any clay layers between the alluvium and the Fairhill Formation;
 - b. groundwater levels and elevation data, and thus horizontal and vertical hydraulic gradients;
 - c. assessment of *in situ* hydrological properties and recharge fluxes using suitable techniques; and
 - d. groundwater quality data that could provide an independent line of evidence of the degree of connection or disconnection between alluvial aquifers and the Fairhill Formation.
21. The proponent should revisit the groundwater modelling assessment, taking account of the additional data, the uncertainty in hydraulic and boundary condition parameters (Paragraph 7), and errors related to the simplified system representation adopted (Paragraph 6), and how these propagate through to the uncertainty of the simulated drawdown across the site. The proponent should also simulate the time for the recovery of groundwater levels post-mining, noting that this will need to be simulated using a transient model, and will need to account for the uncertainty in groundwater recharge.
22. The proponent should provide the following additional information to enable better understanding of potential groundwater impacts.
 - a. Using the revised model, a groundwater contour plot depicting spatial variation in maximum predicted drawdown resulting from operations at the site would assist in understanding the extent of drawdown, including beyond the project area. Superimposed on this plot should be the distribution of ground-truthed GDEs (Paragraph 23) and alluvial aquifers so that potential impacts of drawdown on GDEs can be more readily assessed.
 - b. Further scenario analysis, which takes into account issues raised in Paragraphs 6-8, will provide greater confidence in the modelling results.
 - c. An independent peer-review of the groundwater modelling should be undertaken as recommended by Barnett et al. (2012) to ensure it is fit for predicting the potential impacts of drawdown on GDEs.

Groundwater-dependent ecosystems

23. The distribution (ground-truthed) composition and likely degree of groundwater-dependency of terrestrial GDEs within the zone of predicted groundwater drawdown should be determined (see Doody et al. 2019 for potential methods). This information would supplement the ground-truthed mapping of GDEs that is currently confined only to the mining area (Paragraph 14) and would assist the proponent in predicting, and subsequent monitoring of, potential impacts of groundwater drawdown.
24. The proponent should quantify the current condition of riparian vegetation along both creeks (including at several reference sites where no impacts are predicted and outside the potential zone of groundwater drawdown), especially where this vegetation may sometimes depend on groundwater. The proponent notes that both creeks support a Brigalow-dominated riparian community with local-scale connectivity values (SLR 2020c, p. 60). Appropriate monitoring of riparian vegetation condition

should continue during and after mining so that any impacts can be detected (e.g. by comparison with concurrently sampled reference sites) and mitigated.

25. Given that stygofauna may occur in saline groundwater (see Paragraph 13), stygofauna should be sampled from the alluvium and Permian aquifers, in accordance with the Queensland Guidelines for the Environmental Assessment of Subterranean Aquatic Fauna (DSITI 2015). This will establish whether stygofauna are present. If so, the risk of potential impacts should be assessed (see methods in Doody et al. 2019) and a suitable monitoring program undertaken during and after mining to detect impacts that may arise from drawdown and any alterations in groundwater water quality. Reference sites, where impacts are not predicted, should also be concurrently sampled to help identify changes in stygofaunal community composition unrelated to the project.

Question 3: Can the Committee provide comment on the adequacy of the proposed mitigation, management and monitoring measures, including the proposed buffer from Cooroora Creek and gilgai habitat? Does the Committee consider that any additional measures are needed to achieve projected levels of impact or reduce risks on surface and ground water resources, GDEs and cumulative impacts with other proposed and existing project?

26. The information provided by the proponent (SLR 2020a, pp. 102-4) on the proposed mitigation, management and monitoring measures lacks sufficient detail for the IESC to comment on their adequacy. Below, suggestions are made about further details that are needed in the proposed plans as well as additional measures to monitor and mitigate potential risks to surface and groundwater resources and GDEs.

Surface water

27. The proponent is required to develop a SWMP, REMP and RMP under the project's conditional Environmental Authority (EA) (SLR 2020a, pp. 102-104). The IESC notes that the proponent commits to developing these plans (SLR 2020a, p. 102), which should also include trigger-action response plans (TARPS).
28. The proponent should describe how they plan to rehabilitate the final landform and the refilled void to reduce runoff and potential movement of contaminated water whilst minimising impacts on the functioning of the floodplain.
29. The IESC considers that the project water management system is suitably designed (if it is assumed that the streamflow estimates are representative of local conditions). Modelling indicates that spillage from site water dams is unlikely, although controlled releases are planned (ATC Williams 2019, pp. 44-45). Further information should be provided by the proponent on potential water quality and flow impacts from the controlled releases to allow for adequate assessment of impacts on the receiving environment (Paragraphs 16-19).
30. The proposed event-based surface water quality monitoring will initially include a wide range of parameters (ATC Williams 2019, pp. 55-57) but at only four sites. The IESC recommends that the proponent include additional sites upstream in Cooroora and Sandy creeks, as well as an additional site at the confluence of these two creeks. It is unclear as to which surface water quality objectives (WQO) this data will be compared. The ATC Williams (2019) report suggests that a limited set of parameters from the Mackenzie River Sub-basin WQOs will be used, whereas the SLR (2020a) document suggests that the conditional EA values for a more extensive set of parameters will be used (Table 18). The IESC recommends that the monitoring data are compared to the conditional EA WQOs, as these are largely based on aquatic species protection for slightly-moderately disturbed systems (ANZG 2018). The IESC also has some concerns about the proposed reduction in the number of parameters to be monitored following initial results (ATC Williams 2019, p. 57). All

parameters should continue to be monitored during controlled discharges for the 7 years of mine operations.

Groundwater

31. The proponent is proposing to monitor groundwater quality through a monitoring network and will assess groundwater quality against natural background values. The proponent intends to tentatively establish natural background values from eight sets of monitoring data, noting that only four sets of data have been collected (SLR 2020b, p. 72). The proponent is currently using interim guideline values, derived from regional groundwater quality guidelines (DEHP 2011) or from ANZECC & ARMCANZ (now ANZG 2018) guidelines for freshwater aquatic ecosystem protection (SLR 2020b, pp. 71-73). The proponent should justify the choice of these different guidelines, particularly for cobalt, copper, uranium, and zinc.
32. The proponent is proposing the addition of six monitoring bores, increasing the project's monitoring network to 14 bores. These bores are proposed at four locations, two of which are reference and two of which will detect potential drawdown (SLR 2020b, pp. 68-71). In addition to these proposed monitoring bores, the IESC strongly recommends additional nested (paired) monitoring bores in alluvium and underlying sandstone of the Fairhill Formation (where co-incident). These additional locations should include:
 - a. a monitoring bore to the south east of the project's proposed pit at a location that can be maintained during operations to confirm the predicted drawdown in this area; and
 - b. a location within the predicted drawdown impact area near high potential GDEs.
33. There is limited information on what effects the mine is likely to have on groundwater in the area after closure. The IESC recommends that the proponent evaluate the timing and magnitude of groundwater level recovery (see Paragraph 21) after mining operations are completed and the site is restored. This information on groundwater recovery should be integrated with the planned monitoring in the RMP.

Groundwater-dependent ecosystems and gilgai

34. The proponent has proposed a 50-m buffer between project activities and the riparian corridor (including the gilgai and relic channels) (SLR 2020a, p. iv). The IESC recommends that increasing the width of this corridor (e.g. 100-200 meters, Hansen et al. 2010) would further reduce the likelihood of direct disturbance impacts to this ecologically important area. It is also possible that an increased buffer zone would provide additional environmental benefits through allowing some or all components of the project to be located outside the flood extent. This could reduce the potential for impacts arising from construction of flood mitigation structures, or from changes to flood depths and velocities such as erosion, which is important given the soils at the project site are known to be sodic (Northern Resource 2018, p. 23) and could be prone to large-scale erosion such as gullying.
35. While the proposed buffer zone around the riparian corridor will reduce potential impacts from direct disturbance, it is unlikely to be effective in mitigating impacts arising from groundwater drawdown. No mitigation or management measures have been proposed to address these potential impacts. After the proponent has undertaken the work suggested in Paragraphs 20-25 to better quantify potential impacts to GDEs from groundwater drawdown, consideration should be given to potential mitigation and management options depending on the predicted level of impact. Relevant management plans should describe these measures fully, including their proposed implementation and a monitoring regime to determine their effectiveness.
36. The proponent has proposed a monitoring program for the River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*) vegetation (SLR 2020a, p. 77), including along Cooroora

and Sandy creeks. However, the plan's limited detail constrains the IESC's assessment of its adequacy. For example, it is unclear what baseline data have been collected or will be collected prior to the project commencing, so it cannot be judged how useful this data will be for measuring potential impacts arising from the project. The proponent mentions using reference sites as part of the monitoring program (SLR 2020a, p. 77) but gives no information on the location or characteristics of these reference sites. Further detailed information on the proposed riparian vegetation monitoring program duration and, if necessary, after the project, should be provided in the relevant management plans. This information should include the spatial and temporal scales of monitoring and its frequency, the parameters to be measured, and detailed justification for site (including reference sites) and parameter selection. How this information feeds into management and mitigation plans to assess their effectiveness should also be provided.

37. Although the proponent acknowledges the importance of the gilgai (e.g. for Ornamental Snake) and has designed the mine layout to avoid direct impacts on this habitat, there are no plans presented in the PER that describe monitoring of this habitat to demonstrate that the avoidance strategy has been successful. Given the importance of this habitat and the uncertainty surrounding the effects of altered runoff and/or groundwater drawdown from the proposed project on adjacent gilgai, the IESC recommends that a suitable monitoring program of gilgai condition is developed for suitably replicated reference sites (where no impacts are predicted) and potential impact sites within the project area. Baseline data should be collected before mining commences, and then the sites should be monitored during and after mining until the proponent can be sure there are no residual impacts on the habitat (including from the final landform after the void is filled).
38. The proponent needs to specify how the information from monitoring of GDEs (Paragraph 36) and gilgai (Paragraph 37) will be used to guide suitable management and mitigation strategies, especially if any adverse changes are detected. Management plans should explain how any impacts will be mitigated and, if necessary, what restoration options are feasible. Mitigation and restoration options should be fully justified, preferably with examples and data from comparable case studies.
39. The proponent states that the project is intended to confirm the commercial viability of mining thin coal seams of the Fort Cooper Coal Measures sub-Group in the Bowen Basin, with a view to unlocking significant additional thin seam coal reserves for the State (SLR 2020a, p. i). Should the mine prove viable, it is likely that there will be future cumulative impacts. A crucial component of commercial viability includes the feasibility and resource requirements of monitoring, management, impact mitigation and post-mining restoration, and the IESC expects that the proponent should assess the adequacy of all monitoring and mitigation activities, including:
 - a. the monitoring of water table fluctuations (including post-mining groundwater recovery), runoff and streamflows (e.g. ecologically important components) in Sandy and Cooroora creeks, surface and groundwater water quality and habitat condition (e.g. riparian vegetation, gilgai) before, during and after mining;
 - b. the 50-m buffer (including considering wider buffer widths to enhance their benefits in protecting riparian habitat and facilitating faunal movement along the stream-side corridor);
 - c. the suitability of the refilled void and final landform (e.g. stability, infiltration characteristics, soil fertility and structure, erosion potential) given the desired restoration endpoint; and
 - d. other activities that may improve the post-mining environment (e.g. excluding grazing from riparian zones).

Date of advice	27 July 2020
Source documentation provided to the IESC for the formulation of this advice	<p>ATC Williams 2019. <i>Water Management Assessment. Fairhill Coal Project</i>. 4 July 2019. Report No. 112108-04R001-rev0</p> <p>Northern Resource 2018. <i>Overburden and Potential Coal Reject Characterisation Report. Fairhill Coal Project</i>. 20 November 2018. Version 6.</p> <p>SLR 2020a. <i>Public Environmental Report. Fairhill Coal Project</i>. 29 May 2020. Version No:1.0. Ref: 0620.30029-R01.</p> <p>SLR 2020b. <i>Underground Water Impact Report. Fairhill Coal Project</i>. 24 May 2019. Version No:1.0. Ref: 623.17171-R01.</p> <p>SLR 2020c. <i>Terrestrial Flora and Fauna Technical Report. Fairhill Coal Project</i>. 19 May 2020. Version No:3.0. Ref: 623.17171-R01.</p>
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