

Advice to decision maker on coal mining project

IESC 2021-124: Winchester South Project (EPBC 2019/8458, EPBC 2019/8459, EPBC 2019/8460) – New Development

Requesting agency	The Australian Government Department of Agriculture, Water and the Environment The Queensland Department of State Development, Infrastructure, Local Government and Planning – Office of the Coordinator-General (OCG)
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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 and the Queensland Office of the Coordinator-General to provide advice on Whitehaven Coal's Winchester South Project in Queensland. This document provides the IESC's advice in response to the requesting agencies' questions. These questions are directed at matters specific to the project to be considered during the requesting agencies' 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 Winchester South Project (the project) is a proposed greenfield mine located approximately 30 km south-east of Moranbah in the Bowen Basin of Queensland. Five open-cut pits will be developed to target coal in the Leichhardt and Vermont seams within the Rangal and Fort Cooper Coal Measures. The average extraction rate will be 15 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal, with a forecast peak extraction of 17 Mtpa. The mine life will be approximately 30 years, with 28 years of mining operations. Construction is expected to begin in 2022–23.

The project will contribute to groundwater drawdown within the alluvium, regolith, Leichhardt and Vermont coal seams. Potential terrestrial groundwater-dependent ecosystems (GDEs) in the area include the Brigalow (*Acacia harpophylla* dominant and codominant) Threatened Ecological Community (TEC) and provide habitat for listed threatened species such as the Koala (*Phascolarctos cinereus*) and Ornamental Snake (*Denisonia maculata*). The groundwater-dependency of GDEs needs to be confirmed with field measurements for the potential impacts from drawdown to be better understood. Four residual voids will remain and sit just outside the mapped floodplain of the Isaac River. The water in these residual voids will become hypersaline, leading to potential impacts on the surrounding groundwater system (e.g., the alluvium), the Isaac River and biota within and near the residual voids. Surface water will be diverted to minimise runoff to the mine, and approximately 16 stream-km of ephemeral creeks will be lost or alienated from their catchments by the project during pit construction. The potential impacts of this diversion and loss are not well explained.

Key potential impacts from this project are:

- diversion and loss of approximately 16 km of channels of several ephemeral creeks, which:
 - potentially alters downstream groundwater recharge, surface water flow regimes and extent of floodplain inundation along their lower reaches down to their confluence with the Isaac River;
 - disrupts riparian zone continuity and ecological connectivity; and
 - results in the loss of associated water-dependent ecosystems.
- groundwater drawdown within the alluvium and regolith which may impact on terrestrial and aquatic GDEs;
- hydrogeological and ecological legacy effects of four residual void lakes which will become increasingly saline after mine closure (up to 3-4 times sea-water); and
- contribution to cumulative impacts on biodiversity and ecosystem processes of water-dependent ecosystems (e.g., riparian zones, ephemeral streams, GDEs) across the region that already supports extensive mining activities.

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

- A better conceptualisation of connectivity (e.g., groundwater flow) between the different groundwater units is needed.
- The groundwater-dependency of potential terrestrial GDEs should be assessed by the proponent, (e.g., using techniques recommended in Doody et al. 2019) so that potential drawdown impacts can be evaluated more precisely and incorporated into an appropriate ecohydrological conceptual model.
- An assessment of how changes to the ephemeral creeks (diversion, loss, alienation from their catchments) will affect floodplain biota, wetlands and GDEs both within vicinity of and downstream of the project area up to the creeks' confluence with the Isaac River. This is particularly important because there are listed threatened species and TECs known in the area.
- Further information should be provided on the potential cumulative impacts of the project on groundwater and water-dependent ecosystems within and in the vicinity of the project area.

Context

The Winchester South Project (the project) is a proposed greenfield mine located approximately 30 km south-east of Moranbah in the Bowen Basin of Queensland and within the Isaac River sub-catchment of the Fitzroy River basin. Five open-cut pits will be developed to target the Leichhardt and Vermont seams within the Rangal and Fort Cooper Coal Measures. The average extraction rate will be 15 Mtpa of ROM coal, with a forecast peak extraction of 17 Mtpa. The mine life will be approximately 30 years (Whitehaven Coal 2021) with construction expected to begin in 2022/23 (DSD 2021). The project will result in a total direct disturbance area of 7,130 ha.

Mine infrastructure will include a coal handling and preparation plant (CHPP), train load-out facility and rail-spur, water pipeline and electricity transmission line. Coal products will include metallurgical coal for the steel industry and thermal coal for energy production (Whitehaven Coal 2021).

As part of water management for the mine, up-catchment diversions will be required to divert clean water (including in several ephemeral creeks in the project area) around the mining pits (Whitehaven Coal 2021, App. B, p. 63), alienating these creeks from their catchments. Approximately 16 km of the channels of these ephemeral creeks will also be removed or diverted during construction of the pits. Four residual voids will be left at the end of the mine's life, the water in which is modelled to become hypersaline (up to 3-4 times seawater's salinity).

Response to questions

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

Question 1: Advice is sought on whether the proponent, using the information in the draft Environmental Impact Statement (EIS) (including baseline data), has adequately identified and assessed the key risks and impacts to surface and groundwater resources and water-related assets? If not, what does the Committee consider are the key risks and impacts and what additional information is required?

1. Multiple areas have been identified within the draft EIS where further information and evidence from the proponent are required to assess and identify the potential risks and impacts to groundwater and surface water resources and water-related assets. These are discussed in the responses below.

Groundwater

2. Although the groundwater drawdown model appears to be generally adequate, better conceptualisation of the groundwater system and improvements to the groundwater model are recommended to enhance the assessment of potential impacts (Paragraphs 13-15). These impacts cannot be adequately assessed without ground-truthing potential aquatic and terrestrial GDEs in the area (Paragraph 28).
3. The contribution of the project to cumulative groundwater impacts, including geochemical changes and groundwater drawdown, has not been adequately assessed and must be discussed in greater detail, particularly in relation to impacts to potential terrestrial and aquatic GDEs (Paragraphs 13-16, 51).
4. The proponent's modelling of residual voids addresses predicted equilibrated water levels and an increase in salinity for a period of 250 years post mine closure. However, the proponent has not considered how increasingly hypersaline water may affect groundwater flow within the system, especially the potential for variable-density groundwater flow (Paragraph 16).

Surface water

5. The proponent should assess how diversion and loss of approximately 16 km of several ephemeral creeks will alter ecologically important flow components (e.g., numbers of zero- and low-flow days) along their lower reaches down to their confluence with the Isaac River.
6. The IESC agrees with the peer reviewer's (Whitehaven Coal 2021, Att. 3, pp. 14-15) recommendation that baseline water quality monitoring and analysis should continue (Paragraph 39).
7. Further information is required on the potential downstream impacts of discharges from the sediment dams on the lower reaches of unnamed tributary 2, and the releases from these dams (currently determined according to Isaac River flows) should instead be determined by the flow regime in the receiving stream.
8. Moreover, the proponent has not provided any plans for monitoring residual void water quality or modelled the final geochemical characteristics of pit water (excepting salinity) for total dissolved metals, water hardness, pH, major ions and toxicants. Poor water quality in the residual voids may impact biota in the surrounding area, especially mobile fauna such as birds and aerial insects that may access the residual voids.

Water-dependent ecosystems

9. Without field assessment of groundwater-dependence (Paragraphs 28 and 29) of vegetation and ground-truthing of aquatic and terrestrial GDEs in the predicted area of drawdown, the full extent of potential impacts on water-dependent ecosystems is unknown, particularly if drawdown is greater than predicted. Some of the potentially affected terrestrial GDEs within vicinity of the project are likely to provide habitat for species such as Koalas and Greater Gliders (*Petauroides volans*) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Further assessment is needed of the risks and impacts to these species and associated biota from disruption of riparian connectivity (including along the ephemeral streams that are to be removed or diverted) and impaired condition of terrestrial GDEs and other water-dependent vegetation downstream of these ephemeral streams.
10. If GDEs are confirmed in the area, an ecohydrological model conceptualising relationships between water-dependent ecosystems and the predicted changes in surface water and groundwater regimes and water quality should be provided to enable a more accurate and integrated assessment of key risks and impacts (Paragraph 19).
11. The proponent has not provided sufficient information on how the diversion and loss of approximately 16 km of several ephemeral creeks in the project area will alter alluvial groundwater recharge, surface water flow regimes and inundation patterns of local floodplains in their lower reaches down to their confluence with the Isaac River, and the consequent impacts on the biodiversity and ecological condition of their instream, riparian and floodplain ecosystems (Paragraphs 14, 19, 25, 32-33, 48) .

Question 2: Advice is sought on whether the numerical and conceptual modelling provided is adequate for a project of this type and at this stage of development to assess the project's impacts? What refinements, if any, does the Committee recommend to improve the current modelling?

Groundwater

12. The IESC suggests the following improvements to the conceptual and numerical groundwater modelling.

13. The proponent has used multiple lines of evidence to characterise the groundwater units (Whitehaven Coal 2021, App. A, pp. 45-60), including characterising their hydraulic conductivity (Whitehaven Coal 2021, App. A, App. B, pp. 68-71). The IESC particularly commends the use of geophysical surveys at the project site and surrounding area to ground-truth the extent of the alluvium against geological mapping (Whitehaven Coal 2021, App. A, pp. 48-49). However, the vertical and horizontal groundwater flow between the units is not clear from the documentation. Improvement of the conceptual model (Whitehaven Coal 2021, App. A, pp. 106-111) would allow for a better understanding of connectivity (e.g., between the regolith and alluvium) and any potential impacts to GDEs. For example, there is some predicted incremental drawdown in the regolith adjacent to the Isaac River and its riparian vegetation (1-2 m) (Whitehaven Coal 2021, App. A, p. 116). A better understanding of how this unit interacts with the alluvium would help to characterise potential impacts on groundwater-dependent riparian and other vegetation.
14. The groundwater modelling appears to be generally adequate, and the proponent has considered the Australian Groundwater Modelling Guidelines (Barnett et al. 2012). However, some changes are recommended to improve confidence in the model predictions.
- a. The sensitivity and uncertainty analysis should be extended to encompass a plausible range of hydrogeologic parameters and to ensure that the likely range of drawdown is captured (Whitehaven Coal 2021, App. A, App. B, pp. 70-73). If drawdown in the regolith is greater than predicted (5 m), then drawdown in the alluvium may be significantly greater than the predicted 0.3 m and may impact terrestrial GDEs.
 - b. It appears that the proponent did not include all the projects in the model domain area in the modelling (e.g., Isaac Downs Mine, Poitrel Mine), and excluded some projects close to the model boundary (e.g., the Millennium Mine) (see Whitehaven Coal 2021, App. A, App. B, p. 3; Whitehaven Coal 2021, App. A, pp. 14-15). Including these projects would allow for more rigorous modelling of potential cumulative impacts.
 - c. The proponent provided a sensitivity analysis from the Olive Downs project showing the impact of the Bowen Gas project on groundwater drawdown. It was found that the cumulative impacts were sensitive to the inclusion of this project (Whitehaven Coal 2021, App. A, pp. 120, 125). Based on this, the proponent should include the Bowen Gas project in their modelling.
 - d. Major regional- and local-scale faults were included in the groundwater model, using site-specific data that were obtained by testing of boreholes and core to partially characterise faultzone hydrogeology. However, the relative importance of faults to groundwater flux remains uncertain and the model assumes no fault penetration or subcropping to alluvial groundwater (Layer 1). It is recommended that future modeling quantifies the range of plausible fault-related groundwater drawdown with mining-induced stresses, particularly for fault zones that may directly or indirectly influence alluvial aquifers, and associated implications for GDEs.
 - e. It would be useful to model how the loss or diversion of 16 km of the ephemeral creeks might influence drawdown in the alluvium due to decreased recharge from the creek flows. The proponent should assess how this potentially decreased recharge might affect saturation of the alluvium down to the confluence of the creeks with the Isaac River to increase certainty in the drawdown predictions on, for example, the High Ecological Significance (HES) wetland in the vicinity.
15. Two hundred and fifty years after mining finishes, groundwater levels in the alluvium and the regolith next to the backfilled mining pits are predicted to have recovered to pre-mining elevations. Groundwater levels in the Leichhardt and Vermont seams are predicted to be below

pre-mining elevations, and flow will move toward the mined area (Whitehaven Coal 2021, App. A, p. 127). It is not clear from the documentation if these post-mining elevations were predicted based on a cumulative or project-only scenario. Providing information from a cumulative scenario would improve understanding of the long-term impacts of the project. Further, modelling a range of recovery periods and considering potential uncertainties in the modelling (e.g., climate change) is necessary to understand long-term impacts.

16. An increase in salinity due to evaporation will result in hypersaline conditions in the residual voids and thus denser void water. Modelling shows that the residual voids will generally act as a groundwater sink as the water levels of the residual void lakes are predicted to sit below pre-mining groundwater levels. (Whitehaven Coal 2021, App. B, pp. 104-105). However, a significant density differential may increase the probability for downgradient movement into the groundwater system beneath the residual void floor or allow the spread against the flow gradient via diffusion. This is likely to contaminate the surrounding groundwater system. To better understand the long-term cumulative impacts of hypersaline void water, the proponent should develop a variable-density transport model (e.g., SEAWAT- MODFLOW/MT3DMS) to simulate variable-density groundwater flow to examine the potential for saline plume migration (Langevin 2021) and consequences for GDEs and other users.
17. It has been proposed to partially backfill the residual voids; however, it is not clear whether the proposed depth of the residual voids will reduce possible saline aquifer inflows. More information (e.g., modelling of fully backfilled residual voids and their associated groundwater interactions, geochemical and groundwater flow impacts) should be provided.

Surface water

18. Overall, the standard of surface water modelling, associated water balance and flood analyses, and fluvial geomorphological investigations are well suited to this assessment.

Water-dependent ecosystems

19. An ecohydrological conceptual model is needed to illustrate how the predicted changes in surface water and groundwater regimes and water quality may impact water-dependent ecosystems within and downstream of the project area. This model should be developed following field surveys assessing groundwater-dependence of GDEs and ground-truthing them (Paragraph 19). It should also include potential pathways of ecological impacts arising from changes to surface water and groundwater regimes due to removal and diversion of approximately 16 km of the channels of ephemeral creeks within the direct disturbance area (Paragraphs 22, 25, 32-33 and 48). Particular attention should be paid to conceptually modelling the potential effects of mine-affected water releases and stream flow alterations on water-dependent ecosystems within and near the lower reaches of the unnamed tributary 2 up to its confluence with the Isaac River.

Question 3: What, if any, does the Committee consider are the consequential impacts of changes by the project to surface and groundwater resources on, and risks to, the aquatic ecosystems (surface and underground including groundwater dependent ecosystems)? Does the Committee consider that the impacts and risks to aquatic ecosystems have been adequately identified and described in the draft EIS?

20. Consequential impacts may occur due to the project. Several have not adequately been assessed in the EIS and are detailed below. Some of these potential impacts and risks are discussed more fully in Paragraphs 9 and 11, and are not repeated below. The magnitude and spatial extent of groundwater drawdown, which may be much greater than predicted by the proponent, has potentially severe consequences for surface and underground GDEs.

Groundwater

21. The proponent provides only limited details on the surface water-groundwater interactions of the tributaries to the Isaac River (Cherwell Creek, Ripstone Creek, unnamed ephemeral tributaries) within and near the project area. The proponent considers that Cherwell Creek is a losing system and that the wetlands are likely not GDEs due to the depth to groundwater (Whitehaven Coal 2021, App. A, pp. 103, 132). There seems to have been sufficient assessment of likely groundwater-dependence of the wetlands (Whitehaven Coal 2021, App. A, p. 103). However, further information is needed for the creeks intersecting the zone of predicted drawdown.
- a. Field measurements and analyses (e.g., hydraulic testing) of reach-scale and temporal patterns of groundwater recharge and discharge of Cherwell Creek, Ripstone Creek and the ephemeral creeks intersecting the zone of predicted drawdown would help justify the proponent's assessment that these creeks are losing and indicate whether potential losses due to seepage could lead to increases in numbers of zero- or low-flow days (which are ecologically important to the instream and riparian biota of these creeks, Paragraph 33).
 - b. If these creeks are found to be groundwater-dependent (even transiently), discussion of how groundwater drawdown might affect their flows would be useful because they contribute to the flow of the Isaac River and support riparian habitat for listed threatened species (see maps in Whitehaven Coal 2021, App. D, pp. 96-111).
22. The documentation does not clearly explain how diverting and removing 16 km of ephemeral creek channels may alter groundwater recharge and discharge in the project area, the creeks' lower reaches down to their confluence with the Isaac River and the adjacent alluvial sediments. This information is needed to identify how the project may impact on these processes and their likely consequences for water-dependent ecosystems such as terrestrial GDEs and the HES wetland.
23. The proposed final landform will result in four partially backfilled residual voids, located near the existing floodplain of the Isaac River (Whitehaven Coal 2021, Section 3, pp. 3-8-3-9). Residual voids are expected to act as a terminal groundwater sink. This proposed landform has a number of potential risks summarised below.
- a. Water quality will decline in the residual voids as evaporation increases contaminant concentrations. The total sulfur concentration of coal rejects is often above the median crustal abundance (potentially as reactive sulfide) and may contain comparatively high concentrations of metals/metalloids and sulfate salts (Whitehaven Coal 2021, App. M, p. 5). Results of the proponent's geochemical assessment indicate some uncertainty surrounding the acid-forming and metalliferous drainage potential of reject coal samples (Whitehaven Coal 2021, App. M, pp. 20-21).
 - b. Leachate from residual voids backfilled with waste rock may contain elevated concentrations of aluminium, arsenic, copper, selenium, and zinc (Whitehaven Coal 2021, App. A, App. A3). Further geochemical characterisation of overburden samples during various stages of the project is recommended to better represent potential leachate concentrations of contaminants across the site.
 - c. The deterioration in water quality in the residual voids represents a long-term legacy that may have impacts on mobile fauna (e.g., birds and aerial insects). These risks should be assessed by the proponent, especially the potential for aquatic-terrestrial transfer of bioaccumulated contaminants from the residual voids to predators in the foodwebs of the surrounding environment.

24. The proponent has only performed static geochemical tests (Whitehaven Coal 2021, App. M, pp. 6, 9), providing information on bulk geochemical characteristics of waste materials at a single point in time. While this provides a good indication of the physical, chemical and mineralogical composition of the potential overburden and coal reject waste material, static testing does not provide information on the reaction rates of chemical processes or the rates at which weathering products are released when exposed to the environment over long periods of time. To better understand the cumulative effects of waste rock and coal reject backfill on groundwater resources, the proponent should perform kinetic tests on overburden and coal reject samples assessing how water quality is affected when backfilled waste material interacts with water over prolonged periods of time. These kinetic tests are more appropriate than static ones for indicating potential long-term and cumulative impacts on, for example, GDEs.

Surface water

25. Details on the erosion risk and mitigation measures should be provided for the ephemeral streams' diversions and the discharge points on site to improve assessment of potential impacts on water-dependent ecosystems and their biota. This includes detail of the proposed form, alignment and treatment of the diversion channels, and what monitoring plans are in place.
26. The proponent provides few details about the construction of roads and infrastructure (including the pipeline and electricity transmission line) and what risks they may pose to water quality and water-dependent ecosystems. As a new access road will be required in the northwest of the site in addition to the pits being constructed in the path of the unnamed tributaries (compare Whitehaven Coal 2021, App. B, p. 32 to Whitehaven Coal 2021, Section 2, p. 2-2), a risk management plan should be produced for this activity that describes the monitoring and mitigation of any risks to water-dependent ecosystems downstream.
27. The proponent plans to allow the sediment dams to overflow in uncontrolled releases (Whitehaven Coal 2021, App. B, pp. 95-97). Further information is required on the water quality of these dams and whether releases might have any impacts on downstream aquatic and riparian ecosystems and their biota in the lower reaches of unnamed tributary 2 (Paragraph 22).

Water-dependent ecosystems

28. The proponent uses groundwater depth as a line of evidence to suggest a lack of groundwater-dependent ecosystems or to suggest their facultative nature (Whitehaven Coal 2021, App. D, p. 77-78; Whitehaven Coal 2021, App. F, pp. 36-37). However, the IESC considers this to be insufficient. Instead, direct field measurements of groundwater-dependence are needed (e.g., leaf water potential, soil water potential and the use of stable isotope analysis; Doody et al. 2019). These data are essential for ground-truthing predicted GDEs, assessing how much and when they might rely on groundwater, and identifying potential impacts of groundwater drawdown. Currently, the proponent infers that drawdown will be limited and will have minimal impacts on GDEs in the predicted drawdown zone (Whitehaven Coal 2021, Section 4, p. 87). However, without reliable field data on groundwater dependency of these potential GDEs, the IESC has low confidence in these inferences, especially given the concerns surrounding groundwater modelling (Paragraph 14).
29. The IESC notes a patch of Brigalow TEC (*Acacia harpophylla* dominant and co-dominant) is present within the mining lease just outside the direct disturbance area (Whitehaven Coal 2021, App. D, p. 64). As Brigalow may be groundwater-dependent, the proponent should assess whether trees in this patch are accessing groundwater and whether drawdown poses potential risks to this TEC. Furthermore, Brigalow TEC is known to provide habitat for EPBC Act-listed species. The patch of Brigalow TEC identified adjacent to the direct disturbance area is mapped in the same location where the proponent has identified potential Ornamental Snake, Koala,

Greater Glider and Squatter Pigeon (*Geophaps scripta scripta*) habitat (compare Whitehaven Coal 2021, App. D, p. 64 to Whitehaven Coal 2021, App. D, pp. 97, 101, 103, 105). If this TEC is found to be groundwater-dependent, the proponent must assess the implications of predicted drawdown on its suitability as potential habitat for EPBC Act-listed and other species in the area.

30. The proponent has undertaken pilot stygofauna surveys which did not identify any stygofauna. However, only three bores within the alluvium (the most likely habitat for groundwater-dependent stygofauna in the project area) were sampled and no bores within the regolith were surveyed (compare Whitehaven Coal 2021, App. E, p. 45 to Whitehaven Coal 2021, App. A, p. 66). As this sample size is very low and facultative stygofauna have been identified at neighbouring mines (Olive Downs Project and Vulcan Complex Project) (Whitehaven Coal 2021, App. E, p. 105), the IESC recommends that the proponent undertake further sampling, especially within the alluvium and regolith. If stygofauna are found, an assessment will be required of the potential impacts of the project on this obligate GDE.
31. Any changes in groundwater quality (e.g., as a result of contamination from the residual voids as discussed in Paragraph 16) may impact on GDEs within vicinity of the project. This risk should be more fully assessed.
32. The removal and diversion of streams within the disturbance area will remove or alter existing corridors of riparian vegetation and ecological connectivity. The potential impacts of this loss and alteration of riparian connectivity should be assessed in more detail, especially for arboreal fauna because much of the surrounding landscape has been cleared and so these riparian corridors are disproportionately important. Furthermore, the potential changes that stream diversions and removal may have on flood regimes and how these may impact on gilgai and eucalypt woodland, which are likely providing habitat for EPBC Act-listed species (Ornamental Snake, Greater Glider, Koala, Squatter Pigeon), should also be considered in this assessment.
33. Removal and diversion of some 16 km of ephemeral creeks in the project area will also alter stream flow regimes, especially ecologically important flow components such as the numbers of zero- and low-flow days, along the lower reaches of these streams down to where they join the Isaac River. Changes in flow regimes in ephemeral creeks have major repercussions for the biodiversity and composition of their aquatic and riparian communities (Datry et al. 2017) but these potential impacts are not discussed by the proponent. The reduced flows in the lower reaches may also reduce recharge of local alluvial groundwater, potentially affecting the condition of groundwater-dependent vegetation in the riparian zone and nearby floodplain and detracting from habitat values for arboreal wildlife such as Koalas and Greater Gliders. Reduced alluvial recharge may also have impacts on stygofauna and other GDEs in the local area. The proponent should fully assess these potential impacts on water-dependent assets, especially those impacts that will persist after mining finishes.
34. The IESC notes that there is an area of highly erosive and dispersive soils to the northeast of the mining lease by the railway pit release point (compare Whitehaven Coal 2021, App. B, App. F, p. 36 to Whitehaven Coal 2021, App. B, p. 144). The proponent does not appear to have discussed the potential risks of impacts on aquatic ecosystems such as Cherwell Creek that may receive runoff from this area. Additional field surveys of aquatic biota are recommended in this area to identify any potential risks and serve as baseline data for future surveillance monitoring.
35. The potential ecological consequences that may arise from the increasing salinity and elevated concentrations of total dissolved metals of pit lakes (e.g., to mobile fauna such as birds and aerial insects) within the residual voids should be considered by the proponent (Paragraphs 8, 16 and 23). The proponent intends to rehabilitate the final landform back to a mixture of woodland and pasture (Whitehaven Coal 2021, Section 6, p. 6-16), which may be impacted in the long-term due

to the predicted hypersalinity of the water within the residual voids. The proponent should discuss these potential risks.

Question 4: Advice is sought on whether the proposed monitoring, mitigation and management measures are adequate? If not, what additional measures does the Committee consider are required to monitor, mitigate and manage impacts to water resources?

Groundwater

36. The proponent has committed to developing and implementing a groundwater monitoring program (sampling quarterly) that will continue throughout the life of the project and include adjacent tenure holders (e.g., Olive Downs, Eagle Downs Mine, and the Moorvale South Project). Monitoring will primarily detect changes to groundwater levels and water quality within the alluvium and Rangal Coal measures (Whitehaven Coal 2021, App. A, pp. 136-139). The proponent has committed to developing a database of the monitoring results. Suggested refinements are presented below.
- a. Monitoring of the regolith does not appear to be planned (Whitehaven Coal 2021, App. A, pp. 138-139). Water quality and groundwater levels in the regolith should be monitored to better understand potential propagation of impacts during and after the project.
 - b. Use of multi-level monitoring bores that target multiple groundwater units is strongly recommended to obtain information on vertical hydraulic gradients, allowing for a better understanding of potential impacts to groundwater flow within the system.
 - c. The groundwater monitoring plan proposed by the proponent should derive site-specific guideline values for groundwater quality and include the following analytes: total dissolved solids, major ions, water hardness, ionic balance, total alkalinity, total dissolved metals, nutrients, and organics (e.g., volatile and semi volatile organics, benzene, toluene, ethylbenzene and xylene). This plan should outline effective mitigation actions that will be performed once there is a suspected exceedance of a guideline value. Given that some dissolved metal concentrations (i.e., arsenic, aluminium, cobalt, selenium, copper, lead, nickel and zinc) exceed aquatic ecosystem protection guidelines at a 99% protection level and 80% protection level for aluminium, copper, lead and zinc (Whitehaven Coal 2021, App. A, App. A3, pp. 1-94), site-specific guideline values for groundwater quality for these metals should also be considered.
37. The proponent has committed to reviewing the validity of the groundwater model predictions using data from the monitoring network and updating the model if needed. This will be undertaken every 5 years (Whitehaven Coal 2021, Section 7, p. 7-5). More frequent reviews may be required. The length of time that these updates will continue should be specified. Updates should ideally continue following mine closure, with groundwater level data being compared to the model predictions of long-term groundwater recovery.
38. Noting that some of the monitoring bores sit in the zone of predicted drawdown (compare Whitehaven Coal 2021, App. A, p. 66 to Whitehaven Coal 2021, App. A, pp. 116-124), the groundwater monitoring program should include information about updating the monitoring network with additional bores over time.

Surface water

39. The proponent asserts that there will be negligible impacts to surface water quality due to the project (Whitehaven Coal 2021, App. B, p. 136). However, the potential combined impacts from erosion, sedimentation and releases of mine-affected water on downstream ecosystems and their biota have not been adequately considered by the proponent. The proponent should analyse and

present ongoing data from the project from monitoring of the surface waters of all potentially impacted creeks to confirm that water quality and erosion management measures are effective.

40. The locations and number of the monitoring sites (Whitehaven Coal 2021, App. B, pp. 143-144) and the suite of analytes to be monitored (Whitehaven Coal 2021, App. B, pp. 145-147) are generally adequate. Sampling during runoff events will be useful for identifying potential impacts. Although sampling of the runoff from reject material is intended (Whitehaven Coal 2021, App. B, p. 132), a detailed monitoring program, with site-specific guidelines that if exceeded, will trigger remedial action should be provided with the analytes, locations and frequency of sampling as this runoff may pose a significant risk.
41. Little information regarding the mitigation and management of erosion around the project area is provided, although the proponent has committed to develop an erosion and sediment control plan (Whitehaven Coal 2021, Section 7, p. 7-2). Details of this plan should be provided and mitigation and management for erosion should be undertaken to reduce potential impacts.

Water-dependent ecosystems

42. Discussion of mitigation, management and monitoring plans for water-dependent ecosystems is limited which hampers assessment of the adequacy of the suggested measures.
43. The proponent does not intend to monitor GDEs (Whitehaven Coal 2021, App. F, p. 44). If the recommended additional sampling of stygofauna (Paragraph 30) and the assessment of groundwater use by potential terrestrial GDEs (Paragraph 28 and 29) indicate that GDEs are actually more prevalent than predicted, suitable mitigation, management and monitoring plans will be needed. These should include appropriate monitoring (using approaches suggested in Doody et al. 2019) to obtain adequate baseline data and assess the efficiency of mitigation and management strategies. Measures to feasibly mitigate impacts (e.g., drawdown) on GDEs should be described as part of a suitable trigger action response plan (TARP).
44. Monitoring plans for water-related assets, including riparian zone condition and GDEs, should be able to detect relevant changes in water quality of groundwater and surface water during and after the project and identify how these changes might impact water-dependent ecosystems. Risk mitigation measures should include thresholds for assessing declining water quality which may compromise GDEs and other water-dependent ecosystems, and incorporate these thresholds into appropriate TARPs.
45. If trees in the Brigalow TEC (Paragraph 29) are shown to be accessing groundwater, the proponent should consider how potential impacts of groundwater drawdown on this TEC will be monitored and mitigated. This TEC has not been included in the proponent's environmental offset strategy. If it is found to be groundwater-dependent and mitigation of drawdown impacts is not feasible, the proponent may need to include it in their offset strategy.
46. Monitoring, management and mitigation plans may be required to address potential risks of releases from the railway pit and runoff from the highly dispersive/erosive soils (Paragraph 34) situated nearby. While the IESC commends the intention to implement an erosion and sediment control plan, the details of this plan are insufficient (Paragraph 41) and further aquatic ecology surveys are suggested to elucidate the potential risks from sedimentation and other stressors. Depending on the survey results, the proponent may need to implement appropriate monitoring, management and mitigation measures, including suitable water quality triggers.

Question 5: Advice is sought on whether the draft EIS gives adequate consideration to the project's contribution to cumulative impacts associated with other mining activities and coal seam gas production in the area?

47. The draft EIS does not give adequate consideration to the project's contribution to cumulative impacts associated with other extraction projects in the area. Cumulative impacts are considered in some technical assessments (e.g., the groundwater model) but are not discussed in relation to potential impacts on water-dependent assets.

Groundwater

48. The proponent has modelled cumulative drawdown, although it is noted that some of the projects (e.g., Poitrel Mine, Isaac Downs Mine) surrounding the project have not been included in the modelling. A brief discussion of the modelled cumulative impacts is provided (Whitehaven Coal 2021, App. A, pp. 119-120), but this does not discuss potential impacts. More details about how the project will contribute to the impacts of cumulative drawdown are required, especially in areas where recharge from ephemeral streams may be altered because of the loss or diversion of their channels and alienation from their catchments by the project.
49. The proponent has not considered the potential cumulative impacts of the void water on the surrounding groundwater system. These impacts should be considered with reference to the concerns raised in Paragraphs 19-22 and 30.

Water-dependent ecosystems

50. Assessing the project's contribution to cumulative impacts on aquatic habitats and terrestrial GDEs is important given that the landscape is already heavily modified and habitats such as ephemeral streams, riparian corridors and patches of remnant vegetation in the area are likely to be particularly important. Furthermore, there are many mines along the Isaac River and their collective impacts on floodplain wetlands, ephemeral streams, riparian vegetation and other habitats must be considered at landscape and catchment scales, especially for listed threatened species (e.g., Koala, Ornamental Snake) and other species (e.g., fish, turtles) in and near the project area.
51. Discussion of the cumulative impacts of the project by the proponent is limited, and largely focuses on impacts from land clearing. The proponent should assess the collective hydrogeological and hydrological impacts on ephemeral streams and floodplain habitats and their biota, especially flanking the lower reaches of the tributaries whose upper reaches are to be lost or diverted. The cumulative impacts of lost riparian connectivity across the project area should also be assessed. If GDEs are more prevalent than predicted within the zone of cumulative predicted drawdown (including beyond the boundaries of the project area), these impacts should also be assessed collectively. Finally, the potential cumulative impacts of the residual voids and their long-term legacy of declining water quality should be assessed.

Date of advice 5 September 2021

Source documentation provided to, and used by, the IESC for the Whitehaven Coal 2021. Winchester South Project – Environmental Impact Statement.

**formulation of
this advice**

**Other
references cited
within the
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