Independent Expert Scientific Committee
on Coal Seam Gas and Large Coal Mining Development

Advice to decision maker on coal mining project

IESC 2019-103: Jellinbah Coal Mine – Central North Extension (EPBC 2018/8139) – Expansion

Requesting agency	The Australian Government Department of the Environment and Energy
Date of request	12 April 2019
Date request accepted	12 April 2019
Advice stage	Referral

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 the Environment and Energy to provide advice on the Jellinbah Group Pty Ltd's Jellinbah Coal Mine – Central North Extension in Queensland. This document provides the IESC's advice in response to the 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 Jellinbah Central North Extension (CNE) is a proposed expansion of the existing Jellinbah Central North (CN) open-cut coal mine. Three additional leases will be opened for operations. Two of these in the west will hold supporting infrastructure and spoil facilities while one in the east will be mined for pulverised coal injection (PCI) coal and minor amounts of thermal coal. The proposal will extend the operational life of the mine by 20 years and increase production by 1 Mt per annum (Mtpa) run-of-mine (ROM) coal. There will be no change to current approved operating protocols.

The project is within the Bowen Basin and the greater Fitzroy Catchment. The project and surrounding area are significantly impacted by existing agricultural and mining development and are extensively

cleared. Drawdown of regional groundwater has already occurred from previous mining. The Mackenzie River to the north, Blackwater Creek to the west and Twelve Mile Creek to the east will potentially be impacted by the project. Two areas of *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)-listed Brigalow Threatened Ecological Community (TEC) were identified at the project site. The proponent proposes to clear these areas for the project and provide a financial offset. The remaining area that will be cleared for the project consists of 788 ha of non-remnant pasture. Other EPBC Act-listed species potentially exist within the project area; however, the single field survey undertaken in February 2015 found no evidence of their presence.

Key potential impacts from this project are:

- the risks associated with increasingly saline water contained in the final void in the floodplain (noting there are 6 other voids approved for existing Jellinbah operations), and the potential for extreme events and changing climatic conditions to cause changes to the predicted void behavior;
- removal of two areas of Brigalow TEC, including one in the western tenement (ML 700012) which might be retained with project redesign;
- contributions to declines in water quality in the receiving environments of Blackwater Creek and the Mackenzie River; and
- cumulative impacts on groundwater, surface water as well as terrestrial and aquatic ecosystems from open-cut mining, releases of mine-affected water and final voids (that are predicted to become hypersaline) in the region.

The IESC has identified areas in which additional work is required to address the key potential impacts of this project. These are discussed in detail within this advice and are summarised below.

- Consider options other than leaving the void on the floodplain in order to minimise the risk of legacy impacts.
- Redesign arrangement of spoil dumps and surface infrastructure to retain and protect areas of Brigalow TEC in ML 700012.
- Provide modelling of both a more detailed water balance and floods using climate change scenarios to identify a range of plausible behaviour of the final void(s) over time.
- Establish adaptive management and monitoring plans for assessing and mitigating impacts on surface water and groundwater.
- Characterise, through field tests and measurements, the nature of hydraulic connectivity between the adjacent ephemeral creeks (Blackwater Creek and Twelve Mile Creek), the shallow alluvium and deeper groundwater.
- Adopt a collaborative approach with other operators in the region to consider options for restoration coupled with mitigation of cumulative impacts.
- Undertake further ongoing studies of receiving ecosystems downstream of the project that could potentially be impacted by releases of mine-affected water.

Context

The proposed project is an extension of the existing Jellinbah Central North (CN) Coal Mine, an open-cut coal mine in the Bowen Basin in central Queensland. The operational area of the current mine is 30 km northeast of Blackwater and 180 km west of Rockhampton. The project will involve open-cut mining to

target the Pollux Coal Seam using truck and excavator methods. Coal mined from the project will be transported in trucks for processing using existing mine infrastructure. The overall project will cover an area of approximately 803 ha. The proposed expansion is anticipated to augment the current production of the CN coal mine by an average of 1.0 Mtpa ROM coal, over the 20-year life of the project. The project will operate under the current environmental authority for the CN coal mine.

The region is extensively modified by existing open-cut mines to the east, north, west and south. Water resource development has occurred along the Mackenzie River, with significant volumes of water retained by structures including Bedford, Binegang and Tartrus Weirs. Curragh North Mine is located immediately adjacent and upstream of the Jellinbah Mine and discharges into the Mackenzie River and Blackwater Creek. Land use is typically rural with substantial areas cleared for low-intensity cattle grazing. Within the vicinity of the project area, the surface water resources are primarily used for stock watering purposes. The Quaternary Alluvium groundwater is used for stock watering. Other groundwater resources are brackish to saline and are not intensively utilised.

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 assessment documentation, particularly including baseline and modelled data, and the conclusions drawn by the proponent, are sufficient to assess the projects surface and groundwater resources (including the Mackenzie River and associated alluvium), GDEs and cumulative impacts with other proposed and existing projects?

1. The current assessment documentation, while providing information on the proposed project, does not provide sufficient information to assess potential impacts on other surface water and groundwater resources particularly the Mackenzie River and alluvium outside of the project area. The documentation does not contain sufficient baseline data or justification of the proponent's conclusions to allow the IESC to assess all potential impacts of the project on water resources. The project is an extension of an existing mine and the proponent should have site-specific baseline data that can be used to indicate potential impacts of the extension and to provide reference data against which to assess the effectiveness of mitigation strategies. The IESC has highlighted, in the response to Question 2, the additional documentation and information required to assist in the assessment of the project's potential impacts to the surface water and groundwater resources, including the Mackenzie River and associated alluvium, GDEs and cumulative impacts.

Question 2: Can the Committee identify and discuss what additional information is required to assist in the assessment of impacts on surface and groundwater resources (including the Mackenzie River and associated alluvium), GDEs and cumulative impacts with other proposed and existing projects?

<u>Groundwater</u>

2. At the existing Jellinbah CN mine, the proponent notes that no dewatering has been required to mine the Pollux seam to a depth of 125 m. Based on this experience, the proponent does not plan to install dewatering bores at the project site. This would reduce the likelihood of the project impacting groundwater levels and adding to cumulative groundwater impacts in the region. However, operational changes to mines in the surrounding area may lead to future groundwater level rebound, and so the IESC suggests that the proponent install appropriate monitoring bores to track future water level changes. The proponent considers that impacts to the alluvial aquifers are not likely to occur. This is because of a hypothesised disconnection between the alluvial and Permian aquifers. The proponent should provide further information, including hydrogeologic data, to validate the apparent lack of connectivity between the Permian strata (target coal strata), shallow alluvial aquifers and Twelve Mile Creek. If this disconnection is confirmed, then the IESC notes that additional

drawdown of deeper groundwater may not produce any additional impact in the shallow alluvium or overlying watercourses. Conversely, if the strata are saturated and connected, then additional drawdown may increase losses from the shallow alluvium resulting in potential impacts on riparian vegetation, stygofauna, and hyporheic processes (e.g. Burrows *et al.* 2017). There may also be reductions in the persistence of pools along creek beds after flow ceases, reducing habitat availability for aquatic biota.

3. The proponent has used a 2-dimensional (2D) model, SEEP/W, to predict groundwater drawdown. The proponent should justify why this model is better suited for the purpose of predicting drawdown than a 3-dimensional (3D) model.

    a. The IESC notes that drawdown impacts predicted by 2D models such as SEEP/W are likely to differ from the predictions of a 3D model and the likely nature of these differences should be established and documented. The proponent does not provide evidence to show these differences or discuss this as part of their modelling strategy nor have they provided information normally expected in a modelling report (e.g. model calibration data).

    b. If there is evidence for a hydraulic connection between the groundwater and surface water systems (particularly in Twelve Mile Creek), then a model should be developed to investigate the spatial variation and magnitude of likely impacts on surface water systems. Understanding connectivity between surface water, the alluvium and deeper strata is critical to determining whether drawdown in the Permian could impact other aquifers, potential GDEs and surface-expressed aquatic ecosystems.

    c. It is not clear whether the proponent has calibrated the model using site-specific field data. The proponent should compare model hydraulic head predictions against historical data to assess the performance of the model.

    d. The proponent has used a recharge value of 1% of average annual rainfall, which is assumed to be constant over space and time. Given the predicted greater variability in the magnitude and sequencing of wet and dry periods, this constant recharge value should be justified and compared to results obtained from other methods for estimating recharge, such as the chloride mass balance approach or the water table fluctuation method. The impact of rainfall and recharge variability should be elucidated.

    e. The proponent has undertaken uncertainty analysis using a factor of two for each parameter. Further analysis is required where sensitive hydraulic parameters – most importantly, hydraulic conductivity, storage and recharge – are varied by factors that reflect the measured bounds of natural variability to quantify uncertainty in predictions. For hydraulic conductivity and storage parameters, this is typically an order of magnitude or more. This would be consistent with leading practice and would improve understanding of the range of potential impacts. The proponent should also provide maps showing the 1-m drawdown contours as these will improve assessment of potential impacts on GDEs associated with the shallow alluvium.

<u>Surface waters</u>

4. The proponent has not provided information on the project's potential impacts to the ephemeral surface water systems of Twelve Mile Creek, Five Mile Lagoon and Three Mile Lagoon. The IESC notes that there is a potential release point located at Five Mile Lagoon and water released here may have high concentrations of aluminium, arsenic, cobalt, copper, lead and zinc compared to 80th percentile (for highly disturbed aquatic ecosystems) ANZG (2018) guideline values. Further consideration of potential impacts should be provided, including those from sediment-bound contaminants deposited downstream or on the floodplain.

5. In response to flooding during the wet season of 2010/11, a levee was constructed to the north of the Jellinbah Plains open pit site to protect the operations from flooding in the Mackenzie River (UDP 2016, p. 14). The proponent has stated that the levee has been designed and constructed in accordance with engineering design requirements and flood modelling (AARC 2019, p. 73). Further information on the levee construction and location, along with design assumptions regarding estimated flood risk, should be provided so an assessment can be made of the levee's ability to minimise environmental impacts during flooding events from the Mackenzie River.

6. The proponent has not provided historical data on flood events for the region around the project area and no information has been provided on the methods used to define the extent of the 1:1000 Annual Exceedance Probability (AEP) (or other) design flood risks. Further information on flood extents would assist the assessment of the appropriateness of the levee's location in relation to the Central and Central North Site. The levee is aligned with the Mackenzie River meaning floodwaters from Blackwater Creek have the potential to flow into the project area from the western side of the project area. No quantitative assessment appears to have been undertaken to estimate flood behaviour in these two creeks. The IESC recommends the proponent provides models of the surface water regime and floods for both the Mackenzie River and Blackwater Creek. These models should identify:

    a. peak flows and water depths as a function of AEP;

    b. volume, duration, frequency and seasonality of inflows;

    c. wetting and drying cycles over multiple years (to span the responses to different climatic conditions); and

    d. the interaction between the pits/final voids and the flood extent of the Mackenzie River and Blackwater Creek.

7. Surface waters within the project area and nearby include the perennial Mackenzie River, ephemeral creeks including Blackwater Creek and Twelve Mile Creek, floodplain wetlands such as Three Mile Lagoon and Five Mile Lagoon, and palustrine wetlands associated with gilgai (much of which lies in the Brigalow TEC which is to be cleared). Although many of these surface waters are ephemeral, they play crucial ecological roles when inundated because they provide habitat, water and food resources for diverse biota and are the sites of ecological processes such as organic matter breakdown and nutrient cycling (Boulton *et al.* 2014). Changes to their water regimes are likely to be caused by alteration of catchment areas and topography, vegetation clearance and altered surface runoff due to open-cut mining and sediment dams. In turn, these altered water regimes will affect water depth and pool persistence in many surface waters. The proponent has not presented any information on the biota of these flowing and standing surface waters or their fringing vegetation at different stages of inundation which makes it difficult to judge likely impacts of altered water regimes (and altered water quality, see Paragraphs 20 and 24). Without such baseline data against which to assess changes after mining commences, it is impossible for the proponent to demonstrate the success of management and mitigation plans designed to minimise impacts on the flora, fauna and ecological processes in surface waters. The IESC recommends that the proponent survey water quality, riparian vegetation and aquatic biota of Blackwater Creek and Twelve Mile Creek at several times (e.g. during flow and when disconnected pools form) to obtain baseline water quality and biological data to guide predictions of potential impacts and against which to assess the effectiveness of mitigation strategies.

<u>Site water management</u>

8. Although the proponent provided a water balance, it has not accounted for the quantity of mine-affected water discharge and 'clean' water discharge in the calculations. Quantification of the amounts of water discharged by the proponent into Blackwater Creek and the Mackenzie River for

both ‘clean’ and mine-affected water is required. The water balance does not consider cyclones or high rainfall events which could produce high quantities of runoff and erosion (relevant for transport of sediment-bound contaminants, see Paragraph 4). The proponent has also not provided evidence of how the drainage, designed runoff and sediment traps will withstand extreme rainfall and weather events. The proponent should provide an updated water balance considering the above matters. The IESC suggests using the Minerals Council of Australia Water Accounting Framework (Minerals Council of Australia 2014) to do this.

9. The IESC recommends the proponent undertakes a sensitivity analysis on the water balance model to investigate and report on the uncertainties in model parameterisation and future hydro-meteorological assumptions. The current analysis is based on a “looping” of the past 100 years of climate (Paragraph 3(d)), and no consideration, even in the form of a sensitivity analysis, has been given to the likely impacts of magnitude (and hence variability) of rainfalls over the next 100 years. This could be informed through the use of the Climate Futures Framework and Tools (Whetton *et al.* 2012) (https://www.climatechangeinaustralia.gov.au/en/climate-projections/climate-futures-tool/projections/) which allows for various climate regimes to be simulated.

Mine-affected water discharge

10. The proponent has provided little information on the quality of the mine-affected water and the predicted quality of the discharge water. Additionally, it is unclear as to the duration of potential discharges because no historical data on the releases were provided by the proponent. Given the proponent noted the water quality in 2016 exceeded the Water Quality Objective values and ANZECC 2000 guidelines for a range of parameters including sulfate, aluminium, copper, arsenic, cobalt, lead, nickel, EC and pH, this information should be provided, together with an assessment of the likely impacts. Any change as a result of the proposed project in the frequency and duration of controlled or uncontrolled mine-affected water discharges should be determined (for example, after high rainfall events). Water discharge quality and timing is particularly important as turtle species within the Mackenzie River, including the critically endangered White-throated Snapping Turtle (*Elseya albagula*), are susceptible to changes in water quality, flow regime and habitat characteristics (GHD, 2015, pp. 25-26). Discharge information as well as more recent monitoring data should be used to confirm the quality of the water.

11. The proponent proposes to use multiple sediment dams to intercept runoff, and it is anticipated that there will be overflow from the sediment dams to the off-site receiving environment. It is also stated that geochemical characterisation of the overburden material indicates that runoff from spoil dumps draining to sediment dams would have concentrations of dissolved salts and metals below guideline values. However, no geochemical assessment was provided for the project area to support this conclusion, which is important if design changes for the spoil dumps and associated infrastructure can be made to preserve the Brigalow TEC in ML 700012.

12. The IESC notes that there are no water treatment systems in place, but rather the proponent states that they ‘recycle’ as much water as possible. The quality of the water once it has been ‘recycled’ and used for site activities has not been provided by the proponent. The tailings dams’ water is used at the wash plant and is pumped into water trucks at the Jellinbah Plains site. It is not clear if this water is used for dust suppression. Given that the water quality data provided by the proponent for the Tailings Dam (KW14) from 2016 show elevated levels of sulfate, arsenic and nickel, further information is needed on the exact use of this water and its potential impacts on and risks to the receiving environment.

Final void

13. The proposed mine plan will result in an extension of an existing approved void (the Central North void) in the project area whose water is predicted to continue to increase in salinity until saturation is

reached and salts precipitate. This void will pose multiple and ongoing risks to the environment. It will also not support fringing vegetation or aquatic biota typical of natural freshwater floodplain wetlands. Consideration should also be given to how this higher density saline water may affect groundwater flow (i.e. the void may no longer behave as a groundwater sink due to the density contrast between void water and underlying groundwater) and quality. The IESC suggests modelling of final void water quality should also be conducted with consideration of future climatic regimes as discussed in Paragraph 9.

Groundwater-dependent ecosystems

14. The proponent has used desktop searches and a single field survey to identify GDEs but only within the project area. The IESC suggests that after the proponent has provided groundwater drawdown contours at a finer scale than 5 m, as discussed in Paragraph 3e, desktop and additional field surveys for GDEs should be done in this larger area of potential drawdown to verify whether there are any GDEs at risk of losing some or all access to groundwater. Methods for conducting field surveys and risk assessments of GDEs are reviewed in Doody *et al.* (2019).

15. There is potential for terrestrial and aquatic GDEs to occur in areas of saturated alluvium along watercourses (BOM 2017), particularly in the receiving environment downstream of the project. If GDEs are present downstream of the project they could be impacted by controlled and uncontrolled releases of mine-affected water. Field studies of the flora and fauna of these potential GDEs are required to provide baseline data against which to assess potential impacts of altered water quality and/or altered groundwater access.

Cumulative impacts and final voids

16. Given the proximity and number of mining operations near the project area, cumulative impacts are highly likely. These cumulative impacts may include:

    a. pulses of potentially hypersaline water from one or more final voids that may be released to the floodplain or groundwater systems during a large flood event;

    b. additive effects of uncontrolled discharges that may alter downstream water quality and flow regimes, affecting aquatic and riparian ecosystems; and

    c. enhanced groundwater drawdown through interference of drawdown from various mines, that may affect floodplain and alluvial GDEs if connectivity between deeper groundwater and the shallow alluvium occurs.

17. The IESC notes that Twelve Mile Creek runs through additional mine sites downstream and impacts arising from those sites may limit the value of any mitigation undertaken for the Jellinbah CNE (see response to Question 3). Baseline data on water quality and biota (see Paragraph 7) should be collected to guide the prediction of these cumulative impacts and provide reference data for assessing the effectiveness of mitigation strategies.

18. Although the proponent acknowledges the likelihood of some of these cumulative effects (e.g. interference of drawdown), the likely collective impacts on aquatic and terrestrial ecosystems in the expanded areas of potential drawdown have not been assessed. Similarly, the additive effects of altered water quality caused by cumulative uncontrolled discharges (including of hypersaline water from final voids during large floods) have not been estimated nor have their possible impacts on aquatic, riparian and floodplain biota and ecological processes downstream been assessed. A risk assessment of these cumulative impacts is needed, along with reliable baseline data against which to judge the effectiveness of proposed mitigation and management plans.

Question 3: Can the Committee provide comment on whether the proposed management and mitigation measures are adequate, particularly in regards to meeting the Water Quality Objectives?

What additional measures, if any, should be taken to monitor, mitigate and manage impacts on surface and groundwater resources (including the McKenzie River and associated alluvium), GDEs and cumulative impacts with other proposed and existing projects?

Surface waters

19. According to the proponent, the Surface Water Management System will ensure the project maintains compliance with Environmental Authority conditions pertaining to release and receiving water quality, which will ensure regional Water Quality Objectives (WQOs) are achieved. However, the IESC recommends that the proponent should demonstrate how the existing water management system will ensure that these WQOs continue to be achieved. An adaptive monitoring and management framework needs to be appropriately targeted for future stages in the proposed extension, including:

    a. establishing an appropriate baseline for impact assessment, including potential downstream impacts;

    b. an ecohydrological conceptual model that illustrates potential pathways and mechanisms of the effects of altered surface flows on groundwater and alluvial recharge, in-stream water quality, and surface and groundwater ecosystems. This conceptual model would help the proponent justify strategies proposed to mitigate and manage potential impacts. The conceptual model could be informed by the use of Water Observations from Space (WOfS) (http://www.ga.gov.au/scientific-topics/earth-obs/case-studies/water-observations-from-space) to quantify where seasonal or ephemeral water bodies are present in the landscape;

    c. regular and event-based (e.g. during spates) water quality testing of the discharge water, upstream water and water immediately downstream of the licenced discharge points to determine when individual contaminants consistently exceed water quality guidelines; and,

    d. commitments for surface water and groundwater monitoring should be presented as part of the relevant water monitoring plans and should be consistent with the Water Quality Objectives for the Fitzroy River (State of Queensland 2013).

20. The IESC recommends the proponent implements a water quality monitoring program which incorporates reference and impacted sites. This is needed as water quality at the reference sites exceeds multiple water quality parameters when compared to the ANZG (2018) guidelines for aquatic ecosystem protection and the regional WQOs. Data from this program should be used to set site-specific guideline values (Huynh and Hobbs 2019)[1].

21. The IESC recommends the proponent develop a Receiving Environment Management Plan (REMP) that specifies actions to ensure that the downstream environment is not adversely affected by discharges or storage overflows from the proposed mine. Collectively, these plans should:

    a. provide a trigger-action response plan (TARP), in line with ANZG (2018) guidelines, and which uses site-specific data from reference and impact sites; and

    b. integrate with the existing Surface Water Management Plan (SWMP) so that the mitigation and management measures will adequately protect environmental values within and downstream of the project area.

[1] Expected publication on 11 June 2019

22. Using baseline data on water quality, riparian zone vegetation and aquatic biota (see Paragraph 7), the proponent should propose appropriate mitigation and management strategies to minimise potential impacts of altered flow regimes and/or water quality on aquatic biota in Blackwater Creek and Twelve Mile Creek as a result of the proposed project. A suitable monitoring strategy should be outlined that allows the proponent to demonstrate the effectiveness of these mitigation strategies in protecting the ecological integrity of the ephemeral streams and the Mackenzie River into which they flow.

Mine-affected water discharge

23. The IESC recommends that the proponent undertakes flood modelling (as outlined in the response to Question 2) and determines the risks of uncontrolled releases from water dams, sediment traps, storage ponds and other associated infrastructure during extreme weather events, such as cyclones and extended wet seasons to assist in developing monitoring and mitigation plans. Images from WOfS may add value in calibrating this modelling (e.g. Mueller *et al.* 2016). The information gathered from the flood modelling can be used to inform the SWMP as well as the REMP (e.g. risk of overtopping hypersaline final voids).

24. The IESC considers that prior to disturbance by the proposed project, site-specific water quality guideline values should be derived from 24 contiguous monthly samples as outlined in the ANZG (2018) guidelines. Site-specific guideline values are needed for all parameters where the default ANZG (2018) guideline values are not met. This includes aluminium, cobalt and arsenic in particular where elevated concentrations have been regularly observed. The proponent may need to consider treatment of water prior to discharge in order to meet the site-specific guideline values.

Groundwater-dependent ecosystems

25. The proponent has not proposed any mitigation or management measures for GDEs because it is assumed that few, if any, GDEs occur in the project area (assumed because depth to groundwater exceeds 40 m) and that no impacts on GDEs are expected from the project. However, the proponent's assessment does not consider any GDEs that potentially occur in the area where groundwater drawdown is predicted to be less than 5 m (see Paragraphs 3 and 14). It also does not include GDEs that may occur in downstream receiving environments whose groundwater quality might be affected by controlled or uncontrolled discharges or final void overflows. Further, there may be GDEs that rely on shallow perched groundwaters (e.g. gilgai in the Brigalow TEC) that are not included in the groundwater modelling. Depending on the outcome of the GDE surveys recommended in response to Question 2 (see Paragraphs 14 and 15), the proponent may need to develop specific management and mitigation plans to avoid or reduce impacts of the proposed project on GDEs in the area surrounding and/or downstream of the project area.

26. The proponent should provide a map of the estimated saturated zones/depth to the water table (in metres below ground level) and overlay this with a map of potential GDEs. This map would indicate which GDEs may be at risk of drawdown and therefore deserve particular mitigation or management (Doody *et al.* 2019).

Cumulative impacts and final voids

27. The cumulative impact assessment undertaken by the proponent does not consider all adjacent mines and other existing tenements. While the current project may make only a small contribution towards cumulative impacts, the overall cumulative impact of these operations should be considered. Monitoring and mitigation plans to address cumulative impacts should be developed in collaboration with the operators of the Curragh and Yarrabee mines.

28. The remnant Brigalow TEC in ML 700012 should be retained, which could be achieved by redesigning the project to avoid clearing the TEC for spoil deposition and infrastructure. This refugial

patch is a potential source for subsequent colonization of rehabilitated vegetation after cessation of mining.

29. The IESC notes that while the proposed project will result in the modification of a single approved void in the Jellinbah Central mine, the other mines in the broader Jellinbah operation will result in a further six final voids. All seven of these voids will have a lasting cumulative impact. The final voids pose long-term risks to biota from deteriorating water quality, especially increasing salinity. The proponent should work collaboratively with other operators to provide a mitigation plan for minimising impacts on wildlife, and outline how these strategies will be monitored to assess their success.

30. The IESC recommends that various options for backfilling voids should be investigated. If final voids are not to be backfilled, justification should be provided for why complete backfilling is not achievable and/or results in adverse environmental outcomes. The design of the final landform should consider the impacts to water resources. Appropriate mitigation, monitoring and management measures should ensure that these impacts are minimised.

31. Both the Mackenzie North and Plains voids were modelled, with the results showing that final void water will be below the base of the alluvium (AARC 2018, p. 8). The modelling, however, does not examine the effects of extreme events nor the changes in contributing catchment areas arising from mining activities. It may be possible for water levels in both the Mackenzie North and Jellinbah Plains voids to rise above the base of the alluvium providing a connection between the void and the surrounding environment. The saline void water could then discharge into aquifers or the surrounding surface environment via the alluvium. Given the proponent has stated the final voids will be a contaminated saline water sink, this has the potential to impact on the receiving environments and downstream ecosystems. The proponent should examine the effects of successive high-rainfall years on void water levels to ensure that discharge from final voids to the environment cannot occur through the alluvium.

Date of advice	XX May 2019
Source documentation provided to the IESC for the formulation of this advice	CNE – MNES Assessment (AARC 2017b; Appendix A2). Preliminary Documentation - Jellinbah CNE Area (AARC, 2018). Conceptual and Numerical Groundwater Modelling – Jellinbah CNE Area (JBT 2019; Appendix D4). Environmental Offsets Strategy (AARC 2015; Appendix A2). Groundwater Assessment – Jellinbah CNE Area (JBT 2016; Appendix A2). Jellinbah Coal Mine – Chemical and Fuel Management Plan (AARC 2018a; Appendix C4). Jellinbah Coal Mine – CNE – Terrestrial Flora and Fauna Assessment (AARC 2017a; Appendix A2). Jellinbah Coal Mine – Erosion and Sediment Control Plan (AARC 2019; Appendix C5); Jellinbah Coal Mine – Rehabilitation and Void Investigation Report (AARC 2018b; Appendix C2). Jellinbah Coal Mine – Topsoil Management Plan (AARC 2018c; Appendix C1). Jellinbah Coal Mine – Weed and Pest Management Plan (AARC 2018d; Appendix C3). Jellinbah Mine Site – Site Water Management Plan Including Central North (UDP 2016; Appendix A2). Local Surface Water Quality (AARC 2019; Appendix D3) Microbat Call Identification Report (Balance Environmental 2015; Appendix D1).

	Public Document Register (AARC 2019; Appendix A) Summary of Surface Water Quality Data for Mackenzie River (AARC 2019; Appendix D2)

References cited within the IESC's advice

AARC 2018. *Jellinbah Coal Mine – Rehabilitation and Void Investigation Report.* Preliminary Documentation Appendix C2. Report prepared for Jellinbah Group Pty Ltd November 2018.

AARC 2019. *Central North Extension – Preliminary Documentation.* Prepared for Jellinbah Group Pty Ltd March 2019.

ANZG 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available [online]: www.waterquality.gov.au/anz-guidelines accessed May 2019

BOM 2017. *Groundwater Dependent Ecosystems Atlas.* Available [online]: http://www.bom.gov.au/water/groundwater/gde/ accessed May 2019

BOM 2019. *Fitzroy: Climate and Water*. Bureau of Meteorology. Available [online]: http://www.bom.gov.au/water/nwa/2017/fitzroy/climateandwater/climateandwater.shtml accessed May 2019

Boulton AJ, Brock MA, Robson BJ, Ryder DS, Chambers JM and Davis JA 2014. *Australian Freshwater Ecology: Processes and Management*. 2nd edition, Wiley, Chichester.

Burrows R, Rutlidge H, Bond N, Eberhard SM, Auhl A, Andersen MS, Valdez DG, Kennard M 2017. High rates of organic carbon processing in the hyporheic zone of intermittent streams. *Scientific Reports 7*, 13198 (DOI:10.1038/s41598-017-12957-5).

Doody TM, Hancock PJ, Pritchard JL 2019. *Information Guidelines explanatory note: Assessing groundwater-dependent ecosystems*. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia. Available [online]: http://www.iesc.environment.gov.au/publications/information-guidelines-explanatory-note-assessing-groundwater-dependent-ecosystems accessed May 2019

GHD 2015. *Appendix M Fitzroy River Turtle (Rheodytes leukops) species management program*. Lower Fitzroy Infrastructure Project. Report for Gladstone Area Water Board and Sunwater. Available [online]: http://eisdocs.dsdip.qld.gov.au/Lower%20Fitzroy%20River%20Infrastructure/EIS/Volume%203/V3%20Appendix%20M%20Fitzroy%20River%20turtle%20(Rheodytes%20leukops)%20species%20management%20program/vol3-app-m-fitzroy-river-turtle-species-management-program-jun15.pdf accessed May 2019

Huynh T and Hobbs D 2019. *Deriving site-specific guideline values for physico-chemical parameters and toxicants.* Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2019.

IESC 2018. *Information Guidelines for proponents preparing coal seam gas and large coal mining development proposals.* Available [online]: http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-may-2018.pdf. accessed May 2019

Minerals Council of Australia 2014. *Water accounting framework for the minerals industry User guide*. Available [online]: http://www.minerals.org.au/leading_practice/water_accounting_framework_for_the_australian_minerals_industry accessed April 2018.

Mueller N, Lewis A, Roberts D, Ring S, Melrose R, Sixsmith J, Lymburner L, McIntyre A, Tan P, Curnow S, and Ip A 2016. Water observations from space: Mapping surface water from 25 years of Landsat imagery across Australia. *Remote Sensing of Environment* 174, 341-352. Available [online]: https://www.sciencedirect.com/science/article/pii/S0034425715301929 accessed May 2019

State of Queensland 2013. *Water Quality Objectives (2011) Environmental Protection (Water) Policy 2009 Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin September 2011*. Environmental Policy and Planning, Department of Environment and Heritage Protection. Available [online]: https://environment.des.qld.gov.au/water/policy/pdf/plans/fitzroy_mackenzie_river_wqo_290911.pdf accessed May 2019

UDP 2016. Jellinbah Mine Site - *Site water management plan including proposed Central North*. Report No. JEL007/R01. Rev. E. Date 5September 2016. Available [online]: http://epbcnotices.environment.gov.au/_entity/annotation/c812bdb3-6e2d-e811-ad33-005056ba00a7/a71d58ad-4cba-48b6-8dab-f3091fc31cd5?t=1552603281253 accessed May 2019

Whetton P, Hennessy K, Clarke J, McInnes K, Kent D 2012 *Use of Representative Climate Futures in impact and adaptation assessment.* Climatic Change 115, 433-442. 10.1007/s10584-012-0471-z.

390