

Advice to decision maker on coal mining project

IESC 2020-114: Isaac Downs Coal Mine Project (EPBC 2019/8413) – New Development

Requesting agency	The Australian Government Department of Agriculture, Water and the Environment The Queensland Department of Environment and Science
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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 Agriculture, Water and the Environment and the Queensland Department of Environment and Science to provide advice on Stanmore IP South Proprietary Limited's Isaac Downs 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

Isaac Downs Mine is a proposed coal mine 10 km southeast of Moranbah, Queensland, that will target the Rangal Coal Measures within the Bowen Basin. The proponent intends to commence mining in mid-2021 and extract approximately 3.2 million tonnes per annum (Mtpa) of run-of-mine (ROM) coking coal over the first nine years, with a steady-state production profile of 3 to 4 Mtpa. Production will then decrease to approximately 1 Mtpa over the following seven years. The project includes a single open-cut mining pit, a ROM coal haul road, an access road, a ROM coal pad, a levee and a mine infrastructure area. The proposed project is close to a number of existing coal mining and coal seam gas operations including Moranbah South Mine, Bowen Gas Project, Isaac Plains Mine and Poitrel Mine. Most of these projects have been operational for several years, have altered the groundwater within the Permian coal

measures, Tertiary sediments and Tertiary basalt, and have impacted flows and the water quality of the nearby Isaac River.

Key potential impacts from this project are:

- Long-term and persistent impacts post mining to the groundwater system. The project's drawdown would contribute to existing extensive cumulative drawdown impacts. Groundwater modelling predicts drawdown in the Isaac River alluvium (up to 10 m next to the Isaac River channel where the Rangal Coal Measures subcrop beneath the alluvial sediments) and the Rangal Coal Measures from the project.
- Alienation and/or altered frequency, duration and timing of inundation of the floodplain due to the levee which could affect the condition and viability (including plant recruitment) of floodplain vegetation and other water-dependent ecosystems such as Brigalow, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as a Threatened Ecological Community (TEC).
- As a result of drawdown and some direct clearing, there will be loss of Brigalow TEC, disturbance of gilgai, and impacts to the riparian corridors and groundwater-dependent ecosystems (GDEs) which provide habitat for several EPBC Act-listed species. Species potentially impacted include the Koala (*Phascolarctos cinereus*), Squatter Pigeon (*Geophaps scripta scripta*), Greater Glider (*Petauroides volans*), Black-faced Monarch (*Monarcha melanopsis*), Satin Flycatcher (*Myiagra cyanoleuca*), Short-Beaked Echidna (*Tachyglossus aculeatus*) and Ornamental Snake (*Denisonia maculata*).
- Long-term impacts associated with the final void, including poor final void water quality and ongoing groundwater losses through evaporation from the void.

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

- Improve confidence in groundwater modelling by:
 - better characterising the geological and hydrogeological conceptual models, especially the extent and nature of heterogeneity in the alluvium;
 - quantify the effect of the spatiotemporal mismatch between modelled and observed hydraulic head in the alluvium layer (incorporating model-to-measured hydrographs for the groundwater levels shown in Figures 5.6-5.8 (AGE 2020, pp. 51-52) on the simulated predictions of drawdown within the alluvium;
 - conducting additional field testing of hydraulic conductivity to support characterisation within the groundwater model;
 - collecting detailed baseline data (water levels and quality) for at least 24 consecutive months at all bores across the project area;
 - reviewing the current monitoring bore network to establish where additional bores should be installed to improve the spatial coverage of the baseline dataset;
 - providing site-specific data from the neighbouring Isaac Plains Mine, which has been used in the groundwater modelling, so that its contribution to the model can be verified;
 - providing a time-series of maps of simulated groundwater drawdown predictions and superimposing the distribution of surface-expression GDEs in the drawdown zone to identify which GDEs may be impacted and by how much during mining and afterwards; and,

- providing further information on the influence on groundwater of thrust faults (including the Isaac Thrust Fault and the splay fault to the west of the Isaac Thrust Fault that forms the eastern wall of the pit). The proponent should review the position of the deepest base of the pit as there could be a fault in this area which could facilitate flow interactions with the void lake.
- Undertake sufficient surface water quality monitoring (including during events such as floods and heavy rainfall) to provide appropriate baseline data for all watercourses in the project area. These baseline data should include a broader suite of contaminants (e.g. metals).
- Assess how altered flow regimes and/or overbank flooding patterns might affect viability (including plant recruitment), condition and ecological integrity of water-dependent ecosystems. This should include assessment of riparian vegetation along Isaac River and the lower reaches of Billy's Gully and Southern Gully as well as gilgai and the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC. This assessment should include the repercussions of changes in these water-dependent ecosystems to their habitat values for the EPBC Act-listed and other species.

Context

The Stanmore IP Coal Pty Ltd Isaac Downs Coal Mine (the 'project') is a proposed open-cut coal mine to be located in the Bowen Basin, 10 km southeast of Moranbah, Queensland. The project, planned to commence in early 2021, will cover an area of approximately 1,120 ha and extract 35 million tonnes (Mt) of coal over 16 years. It will be connected by a new dedicated haul road to the adjoining Stanmore IP Coal Pty Ltd Isaac Plains Coal Mine to the north. Coal will be processed at the Isaac Plains Mine coal handling and preparation plant (CHPP) before loading at the Isaac Plains Mine rail loop and railing to the Dalrymple Bay Coal Terminal for export. A levee will be constructed during operations to protect the open-cut pit from inundation up to the 1:1,000 annual flood risk from the Isaac River. The project will comprise one new open-cut pit and will extract coking coal from the Leichhardt and Upper Vermont plies of the Rangal Coal Measures.

The project is located within the Isaac Connors Groundwater Management Area. Areas of Isaac River alluvium and floodplain adjoin the project area which is traversed by Five Mile Gully to the north and Southern Gully to the south. Billy's Gully, north of Five Mile Gully, intersects both the project area and the Isaac Plains Mine. The Isaac River is ephemeral with surface flows in the wetter months from November to April, and shallow subsurface flow from May to October. Approximately 1,118 ha of vegetation will be cleared, including 136.6 ha of remnant vegetation and 0.5 ha of Brigalow TEC. Gilgai habitat will also be disturbed. Clearing, groundwater drawdown and altered flooding regimes could result in impacts to the riparian corridors which provide habitat for several EPBC Act-listed threatened species.

Response to questions

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

Question 1: Can the IESC provide comment on the groundwater and surface water assessments presented in the EIS, especially in relation to the adequacy of the:

- identification and assessment of potential impacts and risks including their predicted duration, extent and magnitude;
- the hydrogeological characterisation and conceptualisation (including in relation to connectivity between the Isaac River and mining lease area); and,
- assumptions and calibration of models used to predict potential impacts?

Groundwater modelling

1. The groundwater model predicts drawdown for the project. The numerical groundwater model was informed by limited site-specific monitoring data. Although the history-match (calibration) results meet industry guidelines (AGE 2020, p. 90), the hydrographs show that very limited temporal data dating back to 2004 has been used for history-matching. Data is missing from 2010 to 2018, and the influence of this limited data on the model predictions should be considered. Further limitations of the data and field monitoring program are given below.
 - a. To assess impacts of drawdown on groundwater-dependent ecosystems (GDEs), it is important to have confidence in drawdown predictions in the alluvium especially spatial and temporal patterns. It is not clear from the history-matching that was presented for the whole model domain how well the model currently performs in the alluvium layer. Quantifying the mismatch between model predictions and observations of hydraulic head and drawdown in the alluvium, and assessing the impacts that this mismatch has on the predictions of drawdown within the alluvium is crucial.
 - b. Evidence from the geophysics surveys was not provided. It was not explained how the results from these surveys informed the characterisation of the geology, in particular the heterogeneous nature of the alluvium, and the thickness and lateral extent of the alluvium, particularly in areas important for GDEs. The heterogeneity of the alluvium is not described adequately (AGE 2020, Appendix C, p. 20) and it is not clear as to how this informs the groundwater model. The IESC commends the efforts that have been made using pilot points and distinguishing the bed alluvium and the flood alluvium. However the proponent needs to quantify the potential effects of the upscaling of the horizontal and vertical heterogeneity on the uncertainty of the simulated predictions.
 - c. Field investigations were only conducted by the proponent in November 2018-January 2019 and April 2019.
 - d. A substantial proportion of the monitoring bores listed in Table 5.7 (AGE 2020, Appendix C, p. 66) has only one or a small number of level observations.
 - e. Only seven monitoring bores listed in Table 5.7 located in the project area were used for hydraulic testing along with 53 other monitoring bores from neighbouring coal mine sites.
 - f. Screened stratigraphy of two of the landholder bores (RN162817 and RN162818) is unknown.
 - g. The model history-matching relies heavily on data from only 15 monitoring bores (eight in the Isaac River alluvium, six in the Rangal Coal Measures and one landholder bore (RN162817)) at the project site, and this data is only available since mid-December 2018.
 - h. Several assumptions made by the proponent about the lack of response in monitoring bores MBID07, MBID06 and MBID05 to pumping at RN162817 (Reach Environmental 2020, Chapter 8, Section 8.6.2.2) have not been adequately explained and justified. These assumptions may be contributing to a possible underestimation of west-to-east hydraulic connectivity beneath the Isaac River.
 - i. There is limited monitoring on the western side of the Isaac River (e.g. north of Conrock Gully) in the alluvium. There is also a lack of monitoring bores in the alluvium of stream tributaries in the project area, especially at the confluence of Southern Gully and Isaac River where important riparian vegetation occurs (Paragraph 9). Additional monitoring bores should be established and, if possible, sampled for stygofauna. This will provide a useful baseline for any drawdown effects, changes in groundwater quality and altered stygofauna community composition.
2. The proponent should provide additional information to increase confidence in the groundwater model predictions as suggested below.

- a. Collection of detailed baseline data over at least 24 months at all current bores across the project area. Continuous monitoring needs to be undertaken at selected locations to determine the dynamics of recharge and implications for hydrological connectivity in the system. The collection of data also needs to occur during events such as heavy rainfall to gather information to understand dynamic responses to rainfall events and/or aquifer pumping.
- b. Review of the current monitoring bore network to establish where additional bores should be installed to improve the baseline dataset. This review should consider the spatial and depth coverage of the network and justify how the proposed network will provide adequate data for parameterisation and calibration of the groundwater model.
- c. Provision of the site-specific data from the neighbouring Isaac Plains Mine which has been used in the groundwater modelling presented. This data was not provided by the proponent for this assessment but is needed so that the contribution to the model can be verified.
- d. Provision of further information on the influence of thrust faults (including the Isaac Thrust Fault) on groundwater dynamics in the project area. The proponent expects these faults will limit depressurisation but this has not been adequately discussed and justified. This discussion should address the potential for the faults to provide a pathway for leakage to deeper aquifers and/or seepage from the final void. Additional uncertainty scenarios could be used to explore the effects on predictions of a range of credible fault conceptualisations within the project area.
- e. Although the proponent describes the Isaac River as a losing system with occasional periods of baseflow to the river from the underlying alluvium occurring after prolonged rainfall events or following flooding events, this has not been supported with site-specific data. The proponent has not clearly defined the hydraulic interaction between the Isaac River alluvium and the groundwater in the underlying Permian and Tertiary sediments along the river channel floodplain. The proponent should also explain why seasonal variations were not considered in the model (Reach Environmental 2020, Chapter 8, p. 85).

Groundwater quality

3. Potential impacts to groundwater quality have not been fully assessed. Further work should be undertaken as suggested below.
 - a. Water quality was only sampled twice: November 2018-January 2019 and April 2019. The proponent only sampled groundwater quality at five regional landholder bores and 15 monitoring bores (seven in the alluvium and eight in the Rangal Coal Measures). This data is insufficient to characterise temporal variability in baseline groundwater quality at the project site. Further data should be collected over a sufficient period to encompass seasonal and interannual variability.
 - b. The proponent has compared groundwater quality for the alluvium and coal measures against 20th and 80th percentile local Water Quality Objectives (WQOs). Exceedances in the alluvium occur for calcium, manganese, magnesium, chloride, sulfate, iron, copper, fluoride, silica and zinc. Similarly, in groundwater in the coal measures, exceedances occur for calcium, manganese, magnesium, sodium, chloride, sulfate, fluoride and lead. The proponent should collect further baseline data to establish whether the observed exceedances are typical of groundwater in the project area. Possible causes and potential impacts of these exceedances should be reviewed and addressed.
 - c. For the alluvium, the proponent has also derived preliminary site-specific guidelines from only two sampling events, based on the DSITI (2017) guidance, with some modifications. It is not clear why guidelines were based on 95th percentiles, rather than the more conservative 80th percentiles of reference bores. Once an adequate baseline dataset has been established

(preferably from monthly sampling of reference bores over a 2-year period), the proponent should revise the site-specific guidelines according to DSITI (2017) and ANZG (2018).

Surface water management and monitoring

4. It is commendable that the proponent has undertaken a climate sensitivity analysis for the mine water balance and surface water assessment tasks for 'best case' and 'worst case' climate warming scenarios (Reach Environmental 2020, Chapter 7, p. 46). The analyses indicate that there is sufficient water allocation to meet site water demands under all except the most extreme climate conditions, and that there are no undue concerns with controlled or uncontrolled releases of mine water and sediment dam waters. These projections are based on a low-medium emission (RCP4.5) scenario. Given the uncertainty of these projections and the realistic possibility that there will be little curbing of global emissions, it would be prudent to consider the impacts of a high-emission (RCP8.5) scenario on external water demand requirements and uncontrolled releases.
5. The proponent has stated that water management will be integrated with that of the Isaac Plains Mine (Reach Environmental 2020, Chapter 7, pp. 23-26). The IESC cannot comment on the adequacy of the proposed integrated system at Isaac Plains Mine because the water management plan for Isaac Plains Mine and its associated modelling were not provided by the proponent.
6. The proponent has stated that controlled releases of mine-affected water from the mine water dam into Five Mile Gully will occur only if the release rate does not exceed 4% of the Isaac River discharge measured at the Goonyella gauge (Reach Environmental 2020, Chapter 7, p. 27). The proponent has also stated that the two sediment dams will be dewatered after rainfall events via pumping into the mine water dam or Isaac River in accordance with the erosion and sediment control plan (Reach Environmental 2020, Chapter 7, p. 25). The IESC notes that the proponent has not discussed monitoring or managing uncontrolled water released, as their modelling does not show uncontrolled discharges. The proponent has provided a draft Environmental Authority (DES 2020) which outlines the requirements for monitoring of mine-affected water discharges. Water quality in the sediment dams is to be monitored quarterly for pH, EC, sulfate, fluoride, aluminium, arsenic, cadmium, cobalt, copper, lead, nickel and zinc (Reach Environmental 2020, Chapter 7, p. 67). Given that selenium exceedances were also reported in the leaching studies in the geochemical assessment for both the spoil and coal rejects, selenium should also be monitored in these water storages.
7. Baseline surface water quality sampling was undertaken in March-April 2019 (Reach Environmental 2020, Chapter 7, p. 17) with the majority of the water samples taken from standing water as there was no flow. Due to the limited data collected at the monitoring sites, the proponent has stated that they will base their WQOs on regional water quality data collected from gauging stations, including Burton Gorge, Deverill, Goonyella, Red Hill Mine Lower Isaac, Red Hill Mine Upper Isaac and Isaac Plains Mine (Reach Environmental 2020, Chapter 7, p. 18). The following parameters for the majority of the regional water quality data collected at the above gauging stations did not meet the 20th and 80th percentile values for the local WQOs for stock: aluminium (total and dissolved); for aquatic ecosystem protection guidelines: reactive phosphorus, total nitrogen, turbidity, total suspended solids (TSS), sodium, aluminium (dissolved), copper, iron (dissolved), nickel, vanadium and zinc (dissolved); and for irrigation: iron (total). The IESC recommends that such WQOs should only be used in the interim until relevant site-specific data becomes available with which to refine the WQOs. The proponent should do site-specific monitoring and event-based sampling for all contaminants, including metals. The metalloids arsenic and selenium should be monitored (not just EC, pH, TSS and sulfate), and all analytes compared to agreed WQOs (Paragraph 18c).

Question 2:

Can the IESC provide comment on the adequacy of the assessment of all water-dependent ecological assets, including but not limited to stygofauna, GDE assessment areas 1 and 2, riparian and floodplain

ecosystems and associated threatened species habitats and movement corridors, and whether sufficient information is provided to support conclusions made in the EIS?

8. As the proponent provided only limited site-specific baseline data for groundwater, the IESC has concerns about the predictive capability of the groundwater model (see Paragraph 1a). Therefore, confidence in the model's predictions of drawdown is low, in turn affecting the reliability of the proponent's predictions of impacts to GDEs. The modelling predicted 2-5 m of drawdown near the Isaac River channel for GDEs in Area 1. The GDEs in Area 1 are trees which are inferred to be permanently interacting with shallow groundwater in the alluvial aquifer (3D Environmental 2020, p. 34). Greater drawdown of up to 10 m is predicted next to the Isaac River channel where the Rangal Coal Measures subcrop beneath the alluvial sediments. There is the potential in these zones for GDEs to be impacted if the alluvium is desaturated or if drawdown lowers the watertable beyond the reach of groundwater-dependent vegetation at critical times (e.g. during drought). Long-term drawdown post mining is also predicted in the alluvial system of the Isaac River. Further discussion and assessment of these impacts should be provided once the proponent has collected adequate baseline data and updated the groundwater model.
9. During November 2018, the proponent measured stable isotopes and leaf water potential of trees at eight sites to assess their likely groundwater use during the dry season (as recommended by Doody et al. 2019), and is to be commended for this assessment. From this work, it was concluded that most trees in GDE Area 1 are interacting with shallow groundwater whereas in GDE Area 2, trees nearer the river interacted more with groundwater than those higher up the bank. Other vegetation in Area 2 appeared to have no or limited interactions with groundwater (Reach Environmental 2020, Chapter 10, p22). The IESC provisionally agrees with this conclusion but notes the limited spatial extent of the sampling which was only done once. This region has been affected by prolonged drought leading to decreased availability of surface water and groundwater, and these impacts are likely to be worsened by mining-related drawdown. Drawdown impacts include loss of canopy vigour and foliage cover (3D Environmental 2020, p. 45) which, in turn, are likely to impact species (e.g. EPBC Act-listed species such as Greater Glider and Koala) using the riparian vegetation along the Isaac River for habitat and foraging and as a movement corridor. As the Isaac River is mapped as a state-wide riparian ecological corridor while the section of Southern Gully in the project area is mapped as a regional riparian ecological corridor (Ecology Survey and Management 2020, Figure 9 and p. 16), further discussion of these potential impacts should be provided to guide mitigation strategies (see response to Question 4).
10. Although there has been commendable assessment of likely groundwater dependence of trees at eight sites that has informed derivative conceptual models (Figures 17-20, 3D Environmental 2020), the proponent acknowledges that the sampling is a spatially limited 'snapshot' and proposes supplementary monitoring of vegetation condition, especially at sites known to represent GDEs as well as at sites within and outside the predicted zone of drawdown (3D Environmental 2020, pp 46-47). The IESC supports this proposed additional sampling and vegetation monitoring because it will enable the proponent to differentiate impacts associated with drawdown from background changes (e.g. seasonal, drought-related) in the health of riparian vegetation. As well as monitoring riparian vegetation condition at multiple locations along Isaac River and in the lower reaches of Billy's Gully, Five Mile Gully and Southern Gully, additional investigations should include:
 - a. monitoring aquatic biota from the Isaac River when it is flowing, preferably after multiple weeks of flow when its aquatic biota is expected to be most diverse. The proponent has presented limited survey data from a single sampling time following an extended period of low rainfall, and the results likely underestimate aquatic biodiversity. Where possible, surveys should be undertaken during both high- and low-flow periods to compare how aquatic fauna in the project area responds to a typical wet season and to cyclones and associated flooding (to which the region is prone, Reach Environmental 2020, Chapter 6, p. 50). These surveys should include

sites upstream and downstream of the predicted zone of drawdown below the Isaac River so that the proponent can identify whether there are reach-scale differences in aquatic biodiversity and composition that may be associated with flow regimes potentially altered by this drawdown;

- b. surveys of biota in Regional Ecosystems (REs) in the project area that could provide aquatic habitat after periods of rainfall (Reach Environmental 2020, Chapter 10, p. 28). This baseline data would allow the proponent to identify any flora or fauna at risk in these REs and guide suitable plans to avoid or mitigate impacts of the development on them (see response to Question 4);
- c. further stygofauna sampling. Given the limited stygofauna sampling undertaken (ten bores sampled once), the IESC considers that the results may under-represent the stygofauna biodiversity in the project area. This is supported by results of previous studies which indicate multiple species occur in the region (FRC Environmental 2019b, p. 14; Hose et al. 2015, p. 14). At least one further round of sampling, especially in any alluvial bores with electrical conductivity values below 10,000 $\mu\text{S}/\text{cm}$ and concentrations of total dissolved solids below 1000 mg/L, would confirm whether stygofauna in the project area are sparse and species-poor. Any new bores installed to monitor groundwater (Paragraph 2b) could also be sampled for stygofauna;
- d. assessment of whether the levee has alienated sections of the floodplain and/or altered patterns of inundation, and therefore changed sediment deposition and/or recharge of alluvial sediments which may impact the condition and viability of water-dependent ecosystems such as the EPBC Act-listed Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC and gilgai; and,
- e. development of an ecohydrological conceptual model of the project area, incorporating the conceptual models of riparian GDEs already presented (3D Environmental 2020,p). This model should identify all potential impact pathways associated with groundwater depressurisation, altered sediment and flow regimes, and changes in surface runoff, overbank flooding and alluvial recharge. Key ecological components of the model include groundwater-dependent vegetation in the riparian zone, relevant fauna, TECs and REs, especially those likely to be affected by drawdown and/or altered flooding regimes due to the proposed levee bank. Direct and indirect effects should be considered, including those associated with altered water quality. This model is needed for a comprehensive assessment of risks to all water-dependent ecosystems and to help guide appropriate monitoring and management measures to address such risks.

Question 3:

Can the IESC provide comment on the proposed levee and out-of-pit waste dump, particularly whether the levee and dump may impact the hydraulics, hydrology and water quality of the Isaac River and whether proposed mitigation measures are adequate, during and post-mining, to successfully limit impacts?

- 11. The flood modelling has been undertaken to a high standard that is consistent with the most recent edition of the national flood guidelines. The proposed levee causes minimal impacts to flood levels and velocities for more common floods that may occur under operational conditions. For the rarer floods that cause overbank inundation, there are localised areas that are likely to scour heavily, particularly during the most extreme floods considered. Given the extreme rarity of these floods (with annual likelihoods of 1 in 1000 or rarer), it is unclear whether the incremental impacts of the levee are of material concern to the downstream environment, but it must be expected that works will be required to maintain the integrity of the levee during mining operations following the occurrence of extreme floods. The geomorphic impacts of the revised flood behaviour under post mining conditions are generally minimal compared to current conditions (WRM Water & Environment 2020, Appendix B, pp. 285 and 312). The IESC endorses the proponent's intention to

establish natural vegetation cover as part of final landform to minimise risk of scour in vulnerable areas.

12. Designs for the levee and a flood model for the Isaac River, Billy's Gully Crossing and Five Mile Gully Crossing are provided but the proponent has not assessed whether altered inundation potentially caused by the levee and out-of-pit waste dump might affect viability of water-dependent ecosystems, including riparian vegetation, gilgai and the Brigalow TEC. If monitoring indicates that riparian or floodplain vegetation condition and recruitment are being affected by altered flow regimes and flooding, mitigation measures will be needed to limit these impacts. The proponent should outline what these measures will be and justify their likely effectiveness.
13. The proponent has stated that the overburden and interburden will be disposed of in an out-of-pit spoil emplacement area on the north-western side of the pit for the first two years of operations before being placed as low-wall spoil within the mined-out area behind the active mining face (Terrenus Earth Sciences 2019, p. 28). Results from the geochemical assessment indicate that all potential spoil materials are strongly sodic. Specifically, weathered materials were generally sodic while unweathered siltstone may be prone to dispersion (Terrenus Earth Sciences 2019, p. 24). It is also noted that seepage from the overburden is of low to moderate salinity. The impacts of seepage from the pit on water quality in the Isaac River have not been considered by the proponent, but should be picked up through the downstream Isaac River water quality monitoring. Sodic spoil will need to be managed in a way that minimises potential erosion, which could include maintaining shallow slopes and progressive rehabilitation of soil (Terrenus Earth Sciences 2019, p. 24).
14. As noted in Paragraph 9, the Isaac River is mapped as a state-wide riparian ecological corridor and the lower section of Southern Gully in the project area is mapped as a regional riparian ecological corridor. A 50-200 m buffer is proposed to separate the levee construction area and high bank of the Isaac River (Reach Environmental 2020, Chapter 4, p. 60). This buffer may not be sufficient to ensure that recruitment of all native vegetation is not impacted or that connectivity is maintained along the riparian vegetation (e.g. the buffer may be too narrow for animals to safely use the riparian zone as a corridor for movement). The proponent should justify the buffer width along the length of the levee, especially its adequacy for plant recruitment and fauna use. It may be necessary to increase the width of the buffer to maintain the effectiveness of the Isaac River riparian ecological corridor.

Question 4:

Can the IESC provide comment on the adequacy of the proposed mitigation, management and monitoring to be implemented by the project? Does the IESC suggest that any additional measures are needed to achieve projected levels of impact or to reduce risks?

15. The IESC notes several limitations with the proposed mitigation, management and monitoring for this project. Some of these limitations have been discussed in the responses to Questions 2 and 3, and others are outlined below. Additional measures to reduce risks are also suggested.

Groundwater

16. Additional information should be provided on the existing and proposed groundwater monitoring network. This should include the following:
 - a. to assist with assessment of spatial and depth coverage of the monitoring network, a map should be provided that shows all bores, their specific target aquifer and their lithological logs; and,
 - b. as discussed in Paragraph 3a, the proponent has only undertaken two rounds of groundwater monitoring (November 2018-January 2019 and April 2019) that included a broad suite of analytes. This monitoring identified many exceedances of the WQOs so it is important that

sufficient bores are monitored to identify trends in groundwater quality and potential impacts from the project. This further monitoring will also allow the proponent to assess whether the water quality exceedances are either natural site-specific features or are attributable to the project.

17. The proponent's groundwater modelling predicts a final drawdown post mining of up to 10 m in the alluvial sediments of the Isaac River and that the groundwater will not fully recover to pre-mining levels (AGE 2020, Figure 6.20, p.117). This permanently lowered water table could severely impact groundwater-dependent vegetation and potentially disrupt the continuity of the riparian zone along the Isaac River which is mapped as a state-wide riparian ecological corridor (Paragraph 9). The proponent should discuss possible mitigation and management strategies to address the ecological impacts of this persistent drawdown.

Surface Water

18. According to the proponent, the Surface Water Management System will ensure that the project maintains compliance with Environmental Authority conditions and that regional WQOs are achieved. The proponent has also suggested that a Receiving Environment Monitoring Program (REMP) will be developed to monitor local waterways potentially affected by water releases from the project at upstream (IR1) and downstream (IR5) monitoring points (Reach Environmental 2020, Chapter 7, p. 68). The IESC agrees that a REMP should be developed and should include the following:
 - a. Establishing an appropriate baseline dataset for impact assessment, including potential downstream impacts. Further monitoring sites upstream of the confluence of Isaac River and Five Mile Gully would strengthen the assessment of the impact of the project on the Isaac River downstream.
 - b. Regular and event-based (e.g. during first-flush and spates) water quality monitoring of the discharge water, upstream water and water immediately downstream of the licenced discharge points to determine whether and when analytes exceed water quality guidelines.
 - c. For a and b, a full suite of analytes, including metals and the metalloids arsenic and selenium, should be monitored, not just the proposed EC, pH, TSS and sulfate, and concentrations of all analytes should be compared to agreed WQOs.
 - d. Implementation of a water quality monitoring program which incorporates reference and impacted sites. Data from this program should be used to set site-specific guideline values as outlined in Huynh and Hobbs (2019).
 - e. Specific actions to ensure that the downstream environment is not adversely affected by discharges or overflows and spills from the sediment dams. These could be implemented through:
 - i. developing a trigger-action response plan (TARP) that uses the regional WQOs and site-specific data from reference sites;
 - ii. including direct toxicity assessment using toxicity tests with locally relevant species if there are regular exceedances of WQOs. This would provide another line of evidence to support chemical analyses and biological monitoring to ensure that mixtures of contaminants are not likely to cause adverse effects; and,
 - iii. integrating the results with the existing Surface Water Management Plan for the Isaac Plains Mine so that the mitigation and management measures will adequately protect environmental values within and downstream of the project area.

19. Using baseline data on water quality and the community composition and condition of riparian zone vegetation and aquatic biota, the proponent should propose appropriate mitigation and management strategies to minimise potential impacts of altered flow regimes and/or water quality on riparian vegetation and aquatic biota in the Isaac River, Five Mile Gully, Billy's Gully and Southern Gully. A suitable monitoring strategy, including sampling appropriate reference sites, 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 Isaac River into which they flow. This monitoring strategy would include assessment of the effectiveness of the buffer strip of riparian vegetation along the proposed levee bank (Paragraph 14).

Groundwater-Dependent Ecosystems

20. The proponent states that as groundwater drawdown is predicted to have a minor impact on groundwater vegetation, the mitigation approaches focus on monitoring (3D Environmental 2020, pp. 45-47). Although the proposed monitoring measures are commendable, there are no proposed mitigation measures should the monitoring reveal impacts due to groundwater drawdown. Therefore, specific management and mitigation plans are needed that describe how the proponent will avoid or reduce impacts of the proposed project on GDEs in the area surrounding and/or downstream of the project area. In particular, these plans should justify the measures to be used to mitigate the likely impacts of drawdown on groundwater-dependent riparian vegetation and other REs. Such mitigation plans will be guided by a suitable ecohydrological conceptual model and appropriate monitoring (Paragraph 10e). If mitigation of drawdown impacts on terrestrial GDEs (e.g. groundwater-dependent trees in GDE Area 1) is not feasible, it may be necessary to negotiate appropriate offsets.
21. The proponent should also provide further characterisation of ephemeral alluvial systems associated with the watercourses traversing the proposed project area and their role in maintaining riparian ecosystem functioning, especially in the lower reaches where these alluvial systems intersect the Isaac River. If these roles are likely to be compromised by altered groundwater levels, mitigation measures should be proposed and implemented. This is particularly relevant given that the riparian zone of Isaac River and the lower section of Southern Gully in the project area are mapped as important riparian ecological corridors (Paragraph 9).
22. The 2019 – 2020 bushfires affected part of the Isaac River catchment but not the project area. Consequently, the Isaac River riparian corridor and other habitat within and around the development area is likely to be providing crucial refugial areas for many species, including EPBC Act-listed species, that either escaped the fire or are potential colonists of burnt areas after they recover. Therefore, maintenance of this habitat and its connectivity to adjacent riparian and floodplain vegetation is particularly important while surrounding burnt bushland recovers, and should be a priority in the mitigation and management strategies of the development.

Final void and landform

23. The proponent indicates that the final void will gradually accumulate water and remain a perpetual groundwater sink (Reach Environmental 2020, Chapter 7, p. 51). This void will pose multiple and ongoing risks to the environment. Water within the void is predicted to become hypersaline. Consideration should 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. A climate change sensitivity analysis should be undertaken to determine potential impacts on the water quality of the final void.
24. Final voids usually have long-term impacts on local groundwater levels and quality. The IESC notes that while the proposed project will result in a single void at the Isaac Downs Mine, there will be five further voids associated with the Isaac Plains Mine. All of these voids will have a long-term

cumulative impact. The final void poses long-term risks to biota from deteriorating water quality, especially increasing salinity, as well as leachate seepage from overburden emplacement to groundwater systems. The proponent needs to provide mitigation plans to deal with these risks. These mitigation plans should be informed by water quality monitoring and solute transport modelling (Salmon et al. 2017 and Hamann et al. 2015).

25. The IESC recommends that various options for further backfilling of the final void should be investigated. Alternatives for partial backfilling of the void should be considered if aquifer discharge to the base of the final void is a significant source of salt. 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.
26. As part of the final landform preparation, the proponent plans to maintain the vegetation cover of the floodplain to minimise the risk of scour (Reach Environmental 2020a, Chapter 9, p. 45). The IESC supports this approach as long as the vegetation is native to the area and is not affected by groundwater drawdown or sodic spoil.

Cumulative impacts

27. Given the proximity and number of mining operations near the project area (18 existing and 8 proposed resource developments within 5-70 km upstream and downstream), cumulative impacts are highly likely. For example, after recovery post-mining, the final predicted drawdown is up to 10 m in the alluvial sediments of the Isaac River, and it is possible that impacts on riparian zone vegetation may be exacerbated by cumulative impacts from drawdown associated with nearby past, current and planned mining operations. As groundwater levels are predicted to only partially recover post-mining (Paragraph 17), appropriate strategies should be described by the proponent to mitigate and manage the cumulative ecological impacts of this persistent drawdown. 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.
28. The Isaac River runs parallel to other mines upstream and downstream of the project area, and impacts arising from those sites may limit the value of any mitigation actions undertaken at Isaac Downs Mine. Baseline data on water quality and biota (Paragraphs 8 and 10) should be collected to help predict cumulative impacts and provide reference data for assessing the effectiveness of mitigation strategies.

Date of advice	12 May 2020
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Source documentation provided to the IESC for the formulation of this advice	<p>3D Environmental (2020). Isaac Downs Project Groundwater Dependent Ecosystem Assessment. Prepared by 3D Environmental on behalf of Stanmore IP South Pty Ltd. Project No. 2018_205a.</p> <p>AGE (2020). Isaac Downs Groundwater Impact Assessment. Prepared by Australasian Groundwater and Environmental Consultants Pty Ltd on behalf of Stanmore IP South Pty Ltd. Project No. G1803D.</p> <p>DES (2020). Draft Environmental Authority - EPML. Queensland Department of Environment and Science.</p> <p>ECOSM (2019). Biodiversity Offsets Strategy Assessment Isaac Downs Project. Prepared by Ecological Survey and Management on behalf of Stanmore IP South Pty Ltd. Document version: 18043_Rpt02d.</p>
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