

## Advice to decision maker on coal mining project

### IESC 2022-136: Gregory Crinum Coal Mine M-Block Extension Project (EPBC 2021/9127) – Expansion

<b>Requesting agency</b>	The Australian Government Department of Climate Change, Energy, the Environment and Water
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<b>Advice stage</b>	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 Climate Change, Energy, the Environment and Water to provide advice on the Sojitz Blue Pty Ltd's Gregory Crinum Coal Mine M-Block Extension in Queensland. This document provides the IESC's advice in response to the requesting agency's questions. These questions are directed at matters specific to the project to be considered during the requesting agency's assessment process. This advice draws upon the available assessment documentation, data and methodologies, together with the expert deliberations of the IESC, and is assessed against the IESC Information Guidelines (IESC, 2018).

### Summary

Gregory Crinum Coal Mine M-Block Extension (the project) is a proposed expansion of the existing Gregory Crinum Mine (GCM) located in central Queensland. The project will include new areas of both open-cut and underground mining to the east of the currently approved mining. The project is located in an area of extensive current and historical mining activity. Environmental impacts from mining, such as groundwater drawdown, diversion of watercourses, vegetation loss and discharges of mine-affected water (MAW) have occurred and continue to occur in the region. The project will contribute to these existing

impacts, increasing cumulative impacts to water resources and biota, including Matters of National Environmental Significance (MNES).

The future coal production rate for GCM, including the project, is unclear although the mine currently produces approximately 2 million tonnes per annum of coking coal for export markets (Stantec 2022a, p. 2). The project will commence initially with open-cut mining in the northern parts of M-Block (project area) followed by underground mining progressing south and southeast, ceasing in 2049 (KCB 2022a, App. II, p. II-18). Historic and current underground mining at GCM has been longwall mining; however, the proponent intends to use the bord-and-pillar technique for this project which should considerably reduce the potential impacts from subsidence.

The project will utilise existing infrastructure at the GCM, including coal handling, storage and transport facilities, surface water management systems and monitoring infrastructure (Stantec 2022a, p. 3). Details have not been provided on how the proposed operations will be integrated with existing infrastructure such as the surface water management system which may require additional storages within M-Block and pipework to connect the project to the system.

Key potential impacts from this project are:

- groundwater drawdown from dewatering of the open-cut and underground mining areas which may impact GDEs;
- changes to groundwater quality during operations from seepage from MAW storages;
- changes to groundwater quality post-mining from seepage from voids and flooded underground workings;
- contribution to surface water impacts from GCM because water produced by the project in M-Block may be a component of the MAW discharges to Crinum Creek; and
- increased cumulative impacts to water resources in and near the project area and downstream.

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

- Clearer identification and quantification are needed of existing impacts, especially of GCM and Kestrel Mine, and the additional potential contributions from the project. This information is needed to understand the scope and scale of likely cumulative impacts and to predict the resilience of water resources and biota to the additional impacts.
- An ecohydrological conceptual model should be provided to help identify potential impact pathways and quantify the likely local and regional extents of the project's impacts on water resources and water-dependent assets.
- Clarification and further discussion of the groundwater model, parameterisation and history-matching processes are needed to improve confidence in the model impact predictions.
- Further analysis is needed of potential surface-water cumulative impacts. This includes clarifying how water generated by the project will be managed and if it will enter the existing mine water management system and hence contribute to the current impacts occurring to surface water and biota from discharges of MAW.
- Additional work (including ground-truthing the groundwater dependence of GDEs in the predicted zone of drawdown) to identify and characterise the condition and presence of potential terrestrial GDEs and stygofauna, and to improve predictions of likely impacts, particularly cumulative ones.

These data will inform the design of monitoring programs to detect responses of GDEs to altered groundwater quantity and water quality and to target suitable mitigation or remediation strategies.

- A management plan for the receiving environment needs to be developed for this project.
- A number of related management plans require further development and updating to explicitly include the project. The management plans provided lack adequate details on the design of monitoring programs and do not specify and justify site-specific mitigation and management actions, including mine closure and rehabilitation. Trigger Action Response Plans (TARPs) are also limited (where they existed) and do not provide clear linkages between monitoring, mitigation and management actions that would allow timely action to prevent or rectify impacts.

## Context

The Gregory Crinum Coal Mine M-Block Extension Project (the project) is located in the Bowen Basin of central Queensland about 50 km northeast of Emerald (Stantec 2022a, p. 2). It spans the catchment divide of the Nogoia and Mackenzie Rivers, sub-basins of the Fitzroy River (Stantec 2022a, p. 26). The western parts of the project area drain to Crinum Creek and its tributaries as part of the Nogoia River catchment, while the eastern areas drain to Cooroora Creek, part of the Mackenzie River catchment. Current mining at GCM is within the Nogoia River catchment, and all current surface water monitoring and releases of MAW occur in this catchment. These are subject to the conditions of the Queensland Environmental Authority (EA) EPML00945013.

Open-cut mining commenced in 1979, with underground mining commencing in 1997 (KCB 2022a, p. 19). GCM adjoins the Kestrel Mine and is near Oaky Creek Mine (approximately 4 km northeast) and Ensham Mine (approximately 14 km southeast) (Stantec 2022a, p. 3), with German Creek Mine, Valeria Mine, Lake Lindsay Mine, Norwich Park Mine and Foxleigh Mine within the broader region. Other land uses in the region include cropping, grazing and some irrigated agriculture near the Nogoia River to the south of the project.

The project will clear at least 296 ha (Stantec 2022a, p. 7) which includes potentially facultative groundwater-dependent ecosystems (GDEs) and habitat for *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)-listed species. Vegetation clearing and/or groundwater drawdown may impact the threatened ecological communities (TEC) of Brigalow (*Acacia harpophylla* dominant and co-dominant) and Grassland (Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin), as well as EPBC Act-listed threatened species such as King bluegrass (*Dichanthium queenslandicum*), Squatter pigeon (*Geophaps scripta scripta*), Ornamental snake (*Denisonia maculata*), Yakka skink (*Egernia rugosa*), Dunmall's snake (*Furina dunmalli*) and Koala (*Phascolarctos cinereus*).

The IESC notes that the main text of the Draft Public Environment Report (Stantec 2022a) is often inconsistent with the report's appendices in its descriptions of, for example, project characteristics, timelines, baseline conditions, project-specific impacts and existing mining impacts. These inconsistencies should be addressed before the report progresses to public consultation. The report's lack of consistency and clarity have hindered the IESC's ability to assess potential impacts and to evaluate the suitability of the proposed monitoring, mitigation and management measures.

## Response to questions

The IESC's advice in response to the requesting agency's specific questions is provided below. The order of two questions has been changed to improve the logical flow of this advice.

Question 1: Noting the Gregory Crinum Mine's proximity to other mining projects in Central Queensland, can the Committee advise on the likely cumulative impacts of the proposed project, and whether these impacts have been appropriately identified and addressed by the proponent.

1. The project will contribute to cumulative impacts to groundwater, surface water and biota in the region. However, the magnitude and significance of these impacts cannot be assessed until the existing impacts, especially of GCM and Kestrel Mine, have been identified and quantified. This information is needed to understand the scope and scale of likely cumulative impacts and predict the resilience of water resources and biota to the additional impacts. Additionally, as discussed further in the response to Question 3, project-specific impacts are not appropriately addressed by the proponent which limits the IESC's understanding of the potential project-specific contributions to cumulative impacts.
2. The IESC has identified several limitations in the assessment of cumulative impacts as outlined in the following paragraphs.

### Groundwater

3. Assessment of potential cumulative impacts to groundwater partly relies on the groundwater model. The IESC has identified several issues with the groundwater model requiring further clarification or additional work, detailed below. Therefore, the IESC's confidence in the impact predictions of the groundwater model is limited.
  - a. Development of hydrogeological understanding of flow directions from field observations, rather than model results, is required to strengthen the conceptualisation by understanding the connections between groundwater and surface water, and the influences of mining on groundwater elevations. This will also serve as a reference by which to judge model outputs.
  - b. The description of the boundary conditions applied to the model are inadequate. Examples where further details and full justification are required include:
    - i. the location and representation of the limits of the model domain;
    - ii. why many of the creeks within the model domain which are ephemeral appear to be represented by MODFLOW river (.RIV) cells that are present year-round. The influence of permanent river cells on groundwater elevations should be demonstrated. River cells can act as large sources and sinks of water and will constrain fluctuations in groundwater levels; and
    - iii. why a constant head boundary condition is applied to some water storages (KCB 2022a, App. II, p. II-14). It is unusual for the water level to be maintained at a constant level within a mine-site water storage and this assumption may affect groundwater drawdown predictions.
  - c. The exclusion of Oak Creek Mine from the model requires further explanation. Oak Creek Mine was stated to be approximately 4 km from the project (Stantec 2022a, p. 3) which is well within the 8-km extent of drawdown impacts described as the basis for excluding mines from consideration for cumulative impacts (Stantec 2022a, p. 83).
  - d. The implementation of the Ti-Tree and Boundary faults in the groundwater model was briefly discussed. However, data are required to support Ti-Tree Fault being implemented as a barrier and the Boundary Fault being a low-permeability unit.
  - e. Mined areas were represented in the model using the drain package with initial conditions of free flow of water from affected cells being applied (KCB 2022a, App. II, p. II-14). It was stated that these were changed after comparison with dewatering data. More information is needed to justify the rationale for these changes as this could affect drawdown predictions.

- f. Site-specific data provided for hydraulic conductivity (Stantec 2022a, p. 58) show considerable heterogeneity. Discussion of how this heterogeneity has been addressed in the model should be provided.
- g. Additional discussion is needed of how goafs in longwall mining areas adjacent to the proposed extension have been represented in the model. If the predicted extent of cracking in the goaf areas is incorrect, then this will alter drawdown predictions that include cumulative impacts with Kestrel Mine and GCM. Currently, it is unclear to what spatial extent fracturing has been represented in the model. It is also unclear whether cracking has been modelled in the Basal Sand and Basalt layers where appropriate, given impacts in these aquifers are described which are consistent with subsidence-induced cracking from historic mining (Stantec 2022a, p. 54 and KCB 2022a, p. 75).
- h. Further justification of the recharge and evapotranspiration rates implemented in the model are needed. Consideration should be given to deriving site-specific values for recharge based on an approach such as chloride mass balance. Also, when selecting a recharge rate for the backfilled areas, the characteristics of the spoil need to be considered. The sensitivity analysis highlighted that the model was highly sensitive to recharge, and evapotranspiration rates were not analysed (KCB 2022a, App. II, p. II-59). For evapotranspiration, the distribution and modelled rates of actual evapotranspiration loss from the aquifer should be presented.
- i. The sensitivity analysis was completed on the steady state model. The sensitivity analysis was helpful but it needs to demonstrate the sensitivity of the transient model predictions to the adopted assumptions and parameterisation for interpreting cumulative impacts.
- j. The proponent has stated that groundwater flows will be towards GCM voids and underground workings in the post-mining period, and that these will act as sinks preventing legacy impacts (KCB 2022a, App. II, p. II-29). However, Figure 8.8 (KCB 2022a, p. 114) shows the underground workings of the project as potentially being a groundwater high with flows occurring in multiple directions and it is not clear that all these will be captured by other voids and underground workings (as these are not illustrated on the maps). Further clarification is needed as the water table contours may indicate that groundwater will flow towards Crinum Creek.
- k. Drawdown predictions should be provided for the watertable showing the areal extent of drawdown of 1 m superimposed on mapped terrestrial GDEs at multiple time intervals. This will allow assessment of how impacts to terrestrial GDEs will evolve over the life of the project (and beyond if maximum drawdown has not occurred before the project ceases) and may guide monitoring and management options.
- l. Clarification is needed of the timing for maximum drawdown from the project and for cumulative impacts. These may not occur simultaneously if mining in other parts of GCM or at Kestrel Mine cease well before mining for the project finishes. As a consequence localised groundwater level recovery may commence in areas where mining has ceased. It is unclear whether the provided predictions represent the maximum impact.
- m. An independent peer review, in accordance with the Australian Groundwater Modelling Guidelines (Barnett *et al.* 2012), should be provided.

#### Surface water

- 4. Historic and current mining at GCM have likely had considerable impacts on surface water through multiple diversions of several creeks (KCB 2022a, pp. 39-41), subsidence of some creek beds (Sojitz 2019, p. 12, 19, 30) and releases of MAW. As the proponent is not expecting impacts to surface

water from the project (Stantec 2022a, p. 83), they did not deem it necessary to undertake any quantitative assessment of potential impacts to surface waters. Accordingly, no consideration has been given to the potential contribution of the project to cumulative impacts on surface waters. Although the IESC agrees that bord-and-pillar mining should minimise subsidence impacts from the project, there are other pathways for the project to contribute potential cumulative impacts to surface water that were not clearly considered by the proponent.

- a. If MAW is produced by the project that cannot be internally re-used, then discharge will be required, potentially adding to existing impacts in Crinum Creek. Water balance modelling indicated that 'excess' water could result from M-Block under the wettest 10% of conditions (KCB 2022a, p. 23). The MAW may contain contaminants at concentrations greater than ANZG (2018) guideline values or relevant local water quality objectives (WQOs). Water from the project could add to existing impacts leading to cumulative impacts that may exceed the tolerance of riparian zone vegetation and/or aquatic biota to the contaminants within the MAW. The composition of MAW and the management of MAW from the project have not been sufficiently described to enable assessment of this potential cumulative impact.
- b. Given all water management infrastructure appears to be contained within the Nogoia River catchment, it seems likely (although not clear from the provided documentation) that water from M-Block (clean, runoff and MAW) will be diverted to the water management system and hence the Nogoia River Catchment, increasing flows in this catchment and decreasing them in the Mackenzie River catchment. The timing, duration and magnitude of these potential changes in flows are unknown, making it difficult to assess likely cumulative impacts on aquatic biota from altered flow regimes downstream of the discharge points. Decreased flows in the Mackenzie River catchment may have particular impacts on aquatic biota in intermittent streams whose persistence is governed by ecologically important components of flow such as duration and timing of flow or inundated aquatic habitat (e.g., Bogan *et al.* 2017).

### Voids

5. A void will be left in the project area (M-Block void) and will be one of 17 voids at GCM (Stantec 2022a, p. 62). It is proposed that the M-Block void will be partially backfilled to a height above the recovered groundwater level (Stantec 2022a, p. 61). However, little information has been provided to understand the characteristics of this void and to provide assurance that the proposed partial backfilling will keep the M-Block void dry. The proponent should assess the impacts from M-Block void further, including the potential to contribute to cumulative impacts. Seventeen voids of likely poor water quality in a relatively small area of a semi-arid landscape would appear to have a high potential for cumulative impacts and more information should be provided on how these will be monitored and managed.

### Ecological communities

6. Cumulative impacts of the proposed project to ecological communities, EPBC Act-listed species and terrestrial GDEs, have not been appropriately identified and addressed. EPBC Act-listed species recorded in the project area include King bluegrass and Squatter pigeon, and the project is likely to contribute to cumulative impacts of previous and current mining on these two species. Additional MNES (Dunmall's snake, Koala, Ornamental snake and Yakka skink) may also rely on habitat within the project site and be adversely impacted by the project and its cumulative impacts. The following paragraphs suggest ways for the proponent to improve their assessment of cumulative impacts of the proposed project to ecological communities, especially water-dependent ones.
7. Areas of Brigalow and Grassland TECs will be cleared for the project but it is less clear whether other project-related activities such as drawdown may contribute to cumulative impacts on these TECs in

the region. It is possible that some areas of the Brigalow TEC may be groundwater-dependent. The following describe some of the IESC's concerns.

- a. The proponent has identified that there is limited ecological connectivity across the project area (Stantec 2022b, p. 5) This means that the loss of further patches of Brigalow TEC through clearing, groundwater drawdown or both may have a disproportionately severe impact on the connectivity and habitat value of this TEC and associated biota and EPBC Act-listed species in the project area and the wider region.
  - b. The proposed vegetation clearance and groundwater drawdown could increase fragmentation effects, and impact potential refuges for biota in an already impacted landscape, adding to cumulative impacts. The likelihood of there being an ecological tipping point (e.g., some threshold cover of vegetation needed for persistence of either the vegetation itself or its associated inhabitants) should be assessed as part of evaluating the project's cumulative ecological impacts.
  - c. Additionally, the loss of refugia and sources of colonists will likely make it difficult for some species and GDEs to re-establish after mining ceases and groundwater levels recover. The proponent should evaluate this likelihood, especially for water-dependent species with low fecundity and limited powers of dispersal.
  - d. It is unclear whether the survey efforts of 2020-2021 (151 faunal species observed, Cardno 2021, p. 21) and 2022 (23 faunal species observed, Stantec 2022b, p. 14) are directly comparable. If they are, the marked difference in biodiversity observed between these two survey periods indicate a substantial decline in faunal species abundance that may be linked with cumulative impacts of vegetation clearing and/or declines in vegetation condition across the region. The proponent should investigate this trend further and assess whether the project might contribute to further declines, either individually or cumulatively.
8. Ground-truthing of potential terrestrial GDEs, including the Brigalow TEC, is needed to enable assessment the project's likely contribution to cumulative impacts. Following ground-truthing and assessment of GDE condition (see Doody *et al.* 2019), the proponent should further assess how the project-specific impacts, in combination with impacts from other mining projects in the area, will limit these GDEs' access to groundwater and reduce persistence and condition of the communities. This assessment of cumulative and project-specific impacts should consider groundwater drawdown and potential changes to groundwater quality that may arise from seepage from MAW storages, voids, underground workings and leaching from any waste material emplacements.

Question 3: Has the proponent adequately captured local and regional impacts to groundwater resources and water-dependent assets?

9. The IESC does not consider that local and regional impacts from the project have been adequately captured to enable a detailed assessment of potential impacts to groundwater resources and water-dependent assets. These impacts should be informed by an ecohydrological conceptual model to help identify potential impact pathways and quantify the likely local and regional extents of the project's impacts on water resources and water-dependent assets. For plausible pathways, the proponent should present suitable management plans describing monitoring programs, justifying relevant parameters and outlining appropriate TARPs. Given the project's proximity to several other mines, the ecohydrological conceptual model should include pathways of potential cumulative impacts and their likely interactions.
10. Limitations of the assessment of regional impacts were detailed in the response to Question 1 in the context of cumulative impacts. Specific issues with the groundwater model were detailed in

Paragraph 3. The paragraphs below provide additional information on limitations of the local-scale impact assessment.

11. Storage dams contribute approximately 10% of inflows to the groundwater system (KCB 2022a, App. II, p. II-46). At least some of this recharge of the groundwater system is likely to be MAW. Leakage from these dams could be introducing contaminants to shallow aquifers such as the Basal Sand and Tertiary Basalt aquifers which are potentially utilised by GDEs and accessed by bores. The scale and extent of this impact are unknown. The project will likely contribute additional MAW to the water management system which may contribute to the leakage of these dams. This potential impact pathway requires further investigation.
12. Most watercourses are ephemeral in and near the project area although persistent pools occur along Crinum Creek (Stantec 2022a, p. 82). The proponent's documentation implies that MAW from the project will be released into this creek as part of the existing water management system. Furthermore, groundwater drawdown from the project may impact Crinum Creek or its tributaries, potentially reducing persistence of these pools. The locations of these pools have not been identified, nor has their ecological condition been reported (Stantec 2022a, p. 82). It is recommended that the proponent survey the current condition of these pools to provide baseline data for future monitoring to identify potential impacts. This survey should assess each pool's hydrological aspects (e.g., volume, persistence, groundwater dependence), water quality and ecological aspects (e.g., potential importance as aquatic refuges, water supply for terrestrial fauna) and evaluate the risks of local and regional impacts from the project.
13. A summary of previous geochemical work is provided in Stantec (2022a, p. 66), which highlights potentially significant limitations with the future use of waste materials (discussed further in Paragraph 25). The full geochemical analysis should be provided so that the potential nature of the impacts from this material can be more thoroughly assessed. Currently, it is unclear whether there is sufficient benign material to rehabilitate GCM including the project.
14. Some soils at GCM have characteristics such as high salinity, high sodicity, dispersiveness and acidity (Stantec 2022a, Table 3-2, pp. 25-26). Although the proponent has identified these characteristics, there is a need to consider the risks and limitations that these characteristics pose to preventing impacts to surface water (e.g., increased erosion and sedimentation risks) and the challenges that they present to establishing and maintaining stable rehabilitated landforms.
15. Potential local and regional impacts of the project on the ecological components of water resources and water-dependent assets have not been adequately captured, primarily due to the lack of ground-truthed field data from the project area and surrounding areas that may be impacted.
16. Although the desktop assessment indicated that there were potential terrestrial GDEs mapped in the project area (Stantec 2022c), the proponent inferred that the Brigalow TEC and other terrestrial GDEs would probably not be impacted by drawdown. This desktop assessment should be verified by detailed field surveys of Brigalow TEC and other vegetation mapped as potential terrestrial GDEs and complemented by field assessments of groundwater use (e.g., applying direct techniques such as stable isotopes and leaf water potential, Doody *et al.* 2019), especially for opportunistic use during drought periods. In addition, the ecological integrity and condition of all potential terrestrial GDEs in the area of predicted drawdown, and near areas where MAW is stored or released, should be assessed to provide baseline data for subsequent monitoring of responses to groundwater drawdown and/or degradation in groundwater quality during and after mining.
17. The proponent also did a desktop review and a pilot survey for stygofauna (Stantec 2022d). Although the single field survey of ten bores (four in the project area) did not record stygofauna, the proponent acknowledges that this does not necessarily indicate they are absent and that the *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* (DSITI 2015) suggests that sampling be



done in at least two seasons at each bore (at least three months apart). The IESC agrees with the proponent that continuation of the stygofauna sampling program is required (Stantec 2022d, p. 11) and recommends sampling bores in alluvial aquifers if possible, especially down-gradient of areas where seepage from MAW storages may occur. The proponent should describe from where and how frequently stygofauna sampling will occur, and develop a stygofauna monitoring program complemented with an appropriate TARP if stygofauna are found.

18. Surface waters (ephemeral streams, farm dams) are reported in the project area (Cardno 2021, p. 26) but their water quality and biota have not been assessed because it is assumed that the project will have no impacts on them. Given the limited evidence for this assumption, and the risks that the project may contribute to cumulative impacts (for example, altered flow regimes, reduced surface water quality, high sediment loads, impaired riparian vegetation condition), the proponent should collect appropriate baseline data on surface water quality and aquatic and riparian biota and condition. Subsequent regular monitoring of these parameters for comparison with these baseline data will enable the proponent to test the assumption that the project will have no impacts on water quality, biota and ecological values of surface waters in and near the project area.

Question 2: Can the Committee comment on the adequacy of the proponent's monitoring and management plans for groundwater, surface water, subsidence, water quality, final voids, waste management (including AMD), and groundwater-dependent ecosystems.

19. The IESC was provided with brief management plans for water, subsidence, groundwater, erosion and sediment control, rehabilitation and topsoil. However, a key management plan, the Receiving Environment Monitoring Program (REMP), required under the EA, was not provided, preventing assessment of its adequacy. The provided management plans were generally high-level documents lacking detail on the design, purpose and implementation of proposed monitoring, management and mitigation, with limited or no project-specific justification for suggested programs. The following paragraphs describe some of the issues with specific plans.

#### Groundwater

20. There is currently a lack of monitoring bores to the north, east and south of the project area and offsite to track the propagation of drawdown towards potentially impacted GDEs and privately owned bores. Monitoring bores should be installed in these locations as they are key for understanding the extent and magnitude of impacts. A suitable TARP is needed that specifies appropriate and timely mitigation or remedial measures.
21. Although the EA intends to specify a range of contaminant trigger levels (see Stantec 2022a, App. B, Table W11, pp. 18-19), these are not yet defined in the EA. The proponent has proposed a very limited range of groundwater quality triggers for bores within M-Block (KCB 2022b, Table 6.1, p. 30). The IESC does not consider the proposed triggers and system suitable because the range of analytes is much more limited than the intent of the EA with no justification, and the derivation of the proposed two-trigger system is neither explained nor justified. Proposed triggers should be complemented by a comprehensive TARP that allows the timely implementation of actions to prevent and rectify impacts.

#### Surface water and water quality

22. The Water Management Plan provided (Sojitz 2020a) lacks detail on the monitoring program for surface water. It does not clearly identify the location, frequency and analyte suite and does not include a TARP. It is unclear that monitoring of the receiving environment is occurring at suitable impact locations (for example, at least one site at the discharge location and another within 500 m downstream) and suitable unimpacted upstream locations. It is also unclear that monitoring of the

receiving environment includes an appropriate range of analytes, including toxicants, or that sediment monitoring is occurring.

- a. The project must be explicitly included in the monitoring and management plans. This may necessitate the addition of further monitoring locations in the catchment of Cooroora Creek and its tributaries.
- b. The proponent should monitor the same analytes in the receiving environment as those specified in Table W3 in the EA (see Stantec 2022a, App. B, Table W3, p. 6) for the release waters. Local water quality objectives (WQOs) or default ANZG (2018) guideline values for 95% species protection (slightly to moderately disturbed system) should be used. From the data provided, sufficiently regular sampling has not occurred since 2010 to enable derivation of site-specific WQOs.

### Subsidence

23. The Subsidence Management Plan provided (Sojitz 2019) is focused entirely on subsidence from the currently approved mining. It contains limited detail on proposed monitoring and does not include monitoring for the project. Although subsidence associated with bord-and-pillar mining for the proposed project is expected to be relatively minor, surveys to confirm that no subsidence has occurred should be considered particularly if mining will occur beneath surface water features.

### Final voids

24. No monitoring or management plan was provided for final voids, although they are mentioned in the rehabilitation plan. A detailed monitoring program design (e.g., analytes, sampling frequency, monitoring site locations) is needed once water is stored within voids to identify potential leaching or seepage and to enable timely implementation of a TARP to prevent further impacts from occurring and to rectify any existing impacts.

### Waste management

25. No waste management plan was provided or discussed for addressing the geochemical characteristics of the waste rock and tailings at the GCM. These characteristics include potentially acid-forming material, toxic material, material with extremely poor physical characteristics, and material that would be difficult to incorporate into a rehabilitated landscape (Stantec 2022a, p. 66). Approximately 37% of waste material was categorised as 'hostile/potentially toxic', 'extremely hostile' or 'hostile/difficult'. Although this material was not generated by the project, it is likely that waste material from M-Block will have a similar composition. It is unclear whether any of this material will be used to backfill the voids. Regardless, this material requires a detailed plan for storage, handling and disposal to avoid serious impacts to surface water, groundwater and water-dependent biota during and after mining.

26. Clarification is required of the monitoring measures expected to be implemented during the project (e.g., scheduled environmental inspections of erosion and sediment controls (Sojitz 2020b, p. 7)). The sediment and erosion control plan provided limited details on the frequency, location and nature of monitoring and management actions and does not clearly include the project. It is also uncertain if monitoring and management measures will extend into mine closure and rehabilitation plans. Monitoring is required post-operations for potential impacts from waste material and erosion until it can be clearly shown that the landscape is safe, stable and non-polluting.

### GDEs

27. Under the assumption by the proponent that there are no terrestrial or aquatic GDEs or stygofauna in the project area, no specific management and monitoring plans have been provided. Following the

assessment of GDEs using ground-truthed data (Paragraph 8) and additional stygofauna monitoring (Paragraph 17), the proponent may need to develop specific monitoring plans and management measures appropriate to the scale of impact.

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<b>Date of advice</b>	9 October 2022
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<b>Source documentation provided to the IESC for the formulation of this advice</b>	Stantec 2022a. <i>Public Environment Report. Gregory Crinum Mine M-Block extension. 304500119</i> . Prepared for Sojitz Blue Pty Ltd. 22 August 2022. Version D.
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