

Advice to decision maker on coal seam gas project

IESC 2023-144: Atlas Stage 3 Gas Project (EPBC 2022/09410) – Expansion

Requesting agency	The Australian Government Department of Climate Change, Energy, the Environment and Water
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Advice stage	Assessment

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

The IESC was requested by the Australian Government Department of Climate Change, Energy, the Environment and Water to provide advice on the Senex Energy Pty Ltd's Atlas Stage 3 Gas Project in Queensland. This document provides the IESC's advice in response to the requesting agency's questions. These questions are directed at matters specific to the project to be considered during the requesting agency's assessment process. This advice draws upon the available assessment documentation, data and methodologies, together with the expert deliberations of the IESC, and is assessed against the IESC Information Guidelines (IESC 2018).

Summary

The Atlas Stage 3 Gas Project (the 'project') is a proposed coal seam gas (CSG) project by Senex Energy Pty Ltd in the northern Surat Basin in Queensland. The project will include the construction, decommissioning and rehabilitation of up to 151 CSG wells and supporting infrastructure (ERM 2023, p. 22). Construction of the production wells is expected to disturb approximately 100 ha of previously cleared land (ERM 2023, p. 22), with the proponent committing to a maximum disturbance limit of 530 ha for all project infrastructure (ERM 2023, p. 4).

Within the project area, several groundwater-dependent ecosystems (GDEs) occur, including riparian vegetation that provides potential habitat for Koala (*Phascolarctos cinereus*), Central Greater Glider (*Petauroides armillatus*) and Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*) which are listed

species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The riparian vegetation was identified as likely being sensitive to changes in groundwater availability and providing important landscape connectivity (KCB 2023, App. VIII, pp. 8-9).

The proponent has concluded that there is no hydraulic connection between the alluvium and the regional Upper Springbok Sandstone aquifer and predicted that groundwater drawdown in the Upper Springbok Sandstone will not impact GDEs (ERM 2023, p. 50). However, the evidence provided by the proponent to support this statement does not conclusively demonstrate a lack of hydraulic connection between the alluvium and the various underlying strata (Westbourne Formation, Gubberamunda Sandstone, Upper Springbok Sandstone and Orallo Formation) across the site and at off-site locations where potential impacts to GDEs were also identified. As such, it remains unclear whether groundwater drawdown from the project could impact the riparian vegetation, adversely affecting its ecological condition and provision of habitat for EPBC Act-listed species and dispersal corridors for terrestrial wildlife.

Key potential impacts from this project are:

- potential groundwater drawdown in the alluvium and other shallow aquifers which could reduce groundwater availability for GDEs, including riparian vegetation along Wandoan, Woleebee and other creeks and result in a decline in vegetation condition, loss of habitat for EPBC Act-listed species, and loss of the dispersal corridors needed to maintain faunal biodiversity. Given the extensive prior land clearing in the project area (ERM 2023, p. 5), the remaining riparian corridors have increased importance for movement and persistence of local wildlife;
- disturbance of riparian corridors for construction of linear infrastructure, reducing habitat and disrupting habitat connectivity which is vital to maintain the viability of local wildlife;
- additional stores of produced water and brine in the landscape which provide a potential source of contaminants through seepage from the brine ponds or overflow of the produced water stores to surface water and shallow groundwater systems, as well as the risk of accidental spills; and
- changes to overland flows and flooding from project infrastructure, the potential impacts of which are unclear based on the information provided.

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

- Collection of adequate baseline data to characterise the existing environment which will allow for improved design of monitoring, mitigation and management processes and plans.
- Evidenced-based conceptualisation of both the baseline conditions and the potential impact propagation pathways to inform the impact assessment, particularly of the possible project-specific and cumulative impacts on alluvial groundwater, potential watercourse springs and other GDEs.
- Improved assessment of the occurrence of, and potential impacts to, potential watercourse springs and other GDEs, especially riparian vegetation, to better characterise the groundwater systems and potential connectivity.
- Provision of more detail on the location of infrastructure to enable an improved assessment of potential impacts to water resources, including from changes to overland flows and flooding.
- Development of project-specific and appropriately targeted monitoring and mitigation plans.

Context

Senex Energy Pty Ltd's Atlas Stage 3 Gas Project (the 'project') is located 15-35 km southwest of Wandoan in south-central Queensland. The project is an expansion of the existing Atlas Project and lies in an area of intensive CSG production. The project will target the Walloon Coal Measures, using up to 151 CSG wells typically spaced 500-700 m apart (ERM 2023, p. 23). Water- and gas-gathering infrastructure networks will be developed, including rights-of-way up to 18 m wide and trunk lines up to 24 m wide where trenching will occur, some of which may be done via horizontal directional drilling to reduce potential environmental impacts (ERM 2023, p. 26).

Additional water and brine storages are proposed to accommodate produced water from this project, although the exact volume and location of these have not been detailed in the provided documentation. The proponent has identified that up to 600 ML of brine storage and produced water stores covering up to 30 ha may be required (ERM 2023, p. 22). Although produced water will be treated at the existing water treatment facility (WTF), a new WTF may be constructed if produced water rates are high (ERM 2023, pp. 28-29). Treated water from current CSG operations is provided to irrigators. Untreated water may be used for dust suppression.

The project will mostly be located on PL 445 and PL 209, although some infrastructure relating to this project may also be constructed on PL 1037 where currently approved CSG extraction for the Atlas Project occurs. Development of the project will occur over 5-10 years, generally progressing from north to south (ERM 2023, p. 22). No hydraulic stimulation is proposed (ERM 2023, p. 27).

The project is located within the catchments of Wandoan and Woleebee creeks in the Upper Dawson River sub-basin which is part of the Fitzroy River Basin. Watercourses in the project site are ephemeral and their biota will be sensitive to changes in the naturally variable hydrological regime. Currently, there are no plans to divert, extract from or discharge water into any surface watercourses (KCB 2023, p. 161). Riparian vegetation along the watercourses provides potential habitat for EPBC Act-listed species such as Koalas, Central Greater Gliders and Glossy Black Cockatoos and crucial dispersal corridors for terrestrial wildlife in this largely cleared area. It is likely to be sensitive to changes in groundwater availability, severely impairing its ecological values.

The main groundwater sources impacted by this project are the Walloon Coal Measures and the overlying Springbok Sandstone. Some groundwater drawdown is also predicted in the Westbourne Formation, considered to be an aquitard. These water sources are within the Surat Basin, part of the Great Artesian Basin (KCB 2023, p. 72). Considerable cumulative drawdown is predicted across the project site, given the extent of approved CSG extraction in the wider region.

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 PD, particularly the baseline and modelled data, and the conclusions drawn by the proponent, are sufficient to assess the project's impacts to surface and ground water resources, GDEs and other third-party users, and cumulative impacts with other proposed and existing projects?

Question 2: Can the Committee identify and discuss what additional information is required to enable the assessment of impacts on surface and ground water resources?

1. The information provided in the Draft Preliminary Documentation (Draft PD) related primarily to potential impacts to water resources and management of those impacts (ERM 2023; KCB 2023; Senex Energy Pty Ltd 2023a-c). Some components of the Draft PD were not fully updated at the time that the request for IESC advice was received. Where this occurred, the regulator included information provided by the proponent at the Referral stage of the EPBC Act assessment process.

This included the Environmental Management Plan (Senex Energy Limited 2022a), the Queensland Environmental Protocol for Field Development and Constraints Analysis (Senex Energy Limited 2022b), the Terrestrial and Aquatic Ecology Assessment Report (ERM 2022a), the EPBC Act Significant Impact Assessment Report (ERM 2022b) and the Significant Species Management Plan (ERM 2022c). The IESC understands that all documents will be updated prior to the Draft PD being finalised.

2. The project documentation provided is severely limited, especially relating to adequacy of baseline data, hydrogeological analysis and presentation of conceptualisation, and the conclusions drawn by the proponent. This substantially constrains the assessment of impacts to surface and groundwater resources, GDEs and other third-party users and the assessment of potential cumulative impacts.
3. The proponent should, after collection of appropriate baseline data as outlined in Paragraphs 5c, 5e, 7a-7b, and 12-13, provide an evidence-based ecohydrological conceptual model and develop one or more impact pathway diagrams to describe the ecological implications of all potential impact processes, including groundwater drawdown, altered overland and flood flows, and potential seepage, spills, leaks or overtopping of produced water and brine stores.
4. Additional information that is needed to improve the assessment of impacts to surface and groundwater resources is detailed below.

Groundwater

5. The conclusion that the shallow alluvium is a perched groundwater system is supported by very limited evidence that is inadequately presented. The proponent has provided some limited evidence of hydraulic disconnection between the surface water (Woleebee Creek), alluvium and underlying strata through the installation of three sets of nested bores. However:
 - a. the rationale for the location of these bores was not adequately explained. The nested bores provide limited spatial coverage of the project site, with none installed in areas off-site where potential impacts to GDEs from the project have been identified. This limits the ability to extrapolate the conceptualisation of the groundwater systems and their connectivity beyond each specific location targeted by each set of nested bores to where impacts are predicted.
 - b. two of the three alluvial bores failed to find groundwater, possibly because these two bores are located approximately 250 m from Woleebee Creek (KCB 2023, p. 118). It is not clear whether groundwater recorded during drilling in alluvium (one of three bores) and underlying strata is partly an artifact of drilling methods.
 - c. water quality data presented (KCB 2023, Figure 7.36, p. 115) have only limited temporal coverage and do not demonstrate sufficient differentiation between the alluvial groundwater and the Springbok Sandstone and Westbourne Formation groundwaters to confirm no connection between the alluvium and these groundwater sources. The connectivity, or lack thereof, between depth groundwater units and the alluvium is a pivotal part of the impact assessment, and additional sampling and analysis are needed, using appropriate environmental tracers beyond stable isotopes of water (e.g., OWS 2020, Pearce *et al.* 2022).
 - d. the hydraulic connectivity analysis did not clearly consider the potential for connection with any underlying strata other than the Springbok Sandstone. As outlined in Paragraph 6a, however, the groundwater drawdown predictions are not sufficiently detailed to take account of specific GDE locations. Given that the Westbourne Formation underlies much of Wandoan and Woleebee creeks, potential connection with the Westbourne Formation should be considered when assessing potential impacts.

- e. the field data collated to date lack spatial and temporal coverage. Once an adequate spatio-temporal dataset is acquired, multiple lines of evidence are necessary to unambiguously demonstrate that near-surface groundwater within the alluvium is disconnected from the regional groundwater system where depressurisation is likely to occur. This should include schematic sections along and across the creek, derived from lines of evidence such as well log, permeability testing and piezometric head information for both the alluvium and underlying strata, as well as hydrochemical and isotopic data. Potentiometric head maps and depth-to-watertable maps should also be included. If perching of groundwater occurs, an evidence-based explanation of why it occurs should be given.
6. The prediction of groundwater drawdown impacts relied entirely on the 2021 OGIA regional model (KCB 2023, p. 151). The proponent acknowledged that the primary purpose of the OGIA model is to predict regional water pressure and water level changes (ERM 2023, p. 47). The regional OGIA model does not simulate the alluvial groundwater system in the project area or its interaction with deeper groundwater systems. The model's grid spacing of circa 1500 m means that its results must be interpreted with caution for features at that scale or smaller.
 - a. The ability to predict groundwater drawdown in the shallow alluvial aquifer is crucial for assessing potential impacts of the proposed project because a key impact pathway may be via the propagation of drawdown from deeper groundwater systems into the alluvium. Should this occur, GDEs which utilise the alluvial groundwater, including riparian vegetation that provides potential habitat for several EPBC Act-listed species and important landscape connectivity, could be adversely impacted. Given the identified limitations of the model used (KCB 2023, pp. 151-152), the groundwater drawdown predictions are not sufficiently detailed at the scale of areas of GDEs that may be impacted by the project.
 - b. The inherent uncertainty in mapping and characterising heterogeneity in the alluvium has also not been addressed, further limiting the robustness of impact predictions at the individual GDE-scale.
 - c. If the alluvial aquifer is demonstrated to be connected to deeper groundwater systems, additional site-specific modelling of riparian areas and other GDEs is required to better understand potential impacts to GDEs from the project. This modelling should occur at a scale suitable for predicting impacts to individual GDEs and should represent the connectivity between the alluvial groundwater system and underlying groundwater systems and include the interactions with surface water and potential watercourse springs. The results of field surveys to better map and characterise the heterogeneity of the alluvium should be incorporated into the modelling process.

Surface water

7. Insufficient spatial and temporal baseline data have been collected for the surface water systems. The proponent stated that there will be no diversion, planned discharge to or extraction of surface water (KCB 2023, p. 161), and hence concluded that the project will not impact surface water. However, should there be unplanned discharges of produced water or stored brine, or a spill of drilling chemicals, baseline conditions of the surface waters in the project area will need to be known to establish the magnitude and severity of any impacts.
 - a. Baseline data for both water quality and flow are needed. Sites on at least Wandoan and Woleebee creeks should be sampled, including reference sites. Given the ephemeral nature of the surface water system, water quality sampling will need to include event-based sampling.
 - b. Permanent or persistent pools should be identified for regular sampling, particularly as these could be important refugia (KCB 2023, p. 70). These data will also assist in characterising the ecological condition and water use requirements of the aquatic and riparian ecosystems.

8. The water balance modelling did not facilitate determination of the likely changes to storage requirements or an understanding of what produced water rates would likely result in the need for an additional WTF to be constructed. The proponent only stated that increased storage capacity for produced water and brine will be needed, and that an additional WTF may need to be constructed (ERM 2023, pp. 22 and 28-29). Details on the locations, sizes and design of these were also limited. Without a clear understanding of these, it is difficult to understand and assess the potential for impacts to water resources.
9. The potential for contamination of surface water and shallow alluvial groundwater from seepage, spills, leaks or overtopping of produced water and brine stores was not addressed in detail. Although a flood mapping overlay was provided, it is unclear that the proponent will ensure that all water stores are constructed in areas above the 1% Annual Exceedance Probability level and be constructed to minimise the risk of seepage or overtopping.
10. No assessment was provided of the potential for project infrastructure, including roads, to alter overland flow, flood depths or flood velocities. Further discussion of these potential changes and impacts is required.
11. Watercourse crossings will be required for the water- and gas-gathering lines. Although the proponent has indicated that horizontal directional drilling could be used to reduce potential impacts, this has only been committed to when crossing Woleebee Creek on PL 1037 (ERM 2023, p. 26). Horizontal directional drilling should be considered where riparian vegetation exists, given the importance of this vegetation in providing potential habitat to EPBC Act-listed species and landscape connectivity.

Ecology

12. The information provided was insufficient to assess potential impacts to GDEs from the project. As discussed in Paragraph 6a, the groundwater drawdown predictions are not sufficiently detailed at the scale of individual GDEs and their associated communities and insufficient evidence for hydraulic disconnection between the alluvium and underlying groundwater system has been provided (see Paragraph 5). Furthermore, groundwater dependence of terrestrial GDEs has been inferred from indirect lines of evidence such as rooting depth and evaluation of surface water-groundwater interactions (KCB 2023, pp. 131-132). These measures should be supplemented with direct measures (e.g., Doody *et al.* 2019), especially for potentially groundwater-dependent riparian vegetation that provides disproportionately important habitat and ecological connectivity in this largely cleared landscape.
13. Some work has been undertaken to characterise the watercourse springs and other GDEs at the project site. However, sampling has been sporadic and temporal datasets have not been obtained in many instances. Further sampling is required to establish the baseline conditions and groundwater use requirements of potential GDEs (see, for example, Doody *et al.* 2019) to enable a full assessment of potential impacts from the project. Although the streams are ephemeral, subsurface flow was apparent at sites along most creeks with sandy substrates during a field inspection in March 2022 (KCB 2023, pp. 63-64), implying that the saturated alluvial sediments may support stygofauna. The pilot study of stygofauna (June 2022) apparently did not sample multiple bores in the alluvium (KCB 2023, App VII, pp. 7-10) although a review of groundwater invertebrates in Queensland (Glanville *et al.* 2016) showed that this habitat typically harbours the most biodiverse stygofaunal assemblages. This habitat should be sampled, especially soon after surface flow ceases, so that the proponent can assess potential project-specific and cumulative impacts of predicted drawdown on alluvial stygofauna, if present.
14. The conceptualisation of groundwater connectivity and impact pathways to GDEs provided (KCB 2023, Figure 7.46, p. 145) has limited applicability. The conceptualisation is mainly based on

information obtained at the ATLAS-14 nested bores and it has not been demonstrated that this conceptualisation is applicable beyond that specific site. Underlying geology and groundwater systems vary across the project site and the wider impact area, and the conceptualisation is not based on sufficient spatial and temporal data and information to be reliably extrapolated beyond ATLAS-14. After collection of appropriate baseline data as outlined in Paragraphs 5c, 5e, 7a-7b, and 12-13, the proponent should provide an evidence-based ecohydrological conceptual model and impact pathway diagrams to describe the ecological implications of all potential impact processes.

Chemicals and wastes

15. The proponent provided a chemical risk assessment for drilling fluids and additives to be used for CSG operations. Conservative assumptions were generally used when data were absent. The risk assessment should be improved through:
 - a. expanding the assessment of flowback and produced water to include relevant geogenic chemicals, including metals, metalloids and naturally occurring radioactive materials.
 - b. clarification of the additional options for the disposal of drilling muds on- and off-site, especially given the assertion that these methods are intended to be “certified as not causing environmental harm” (Senex Energy Limited 2022a, p. 35).
 - c. discussion of whether the contaminant transport modelling, which appears based on the state requirement that petroleum activities not be located within 200 m of a wetland of high ecological significance or a GAB spring (KCB 2023, App. I, pp. 59-60), is applicable to all water resources at the project site. In other words, ascertaining whether any petroleum activity will occur within 200 m of any water resource including a GDE, noting that all water resources are Matters of National Environmental Significance for this project.

Subsidence

16. Predicted vertical subsidence for the project is up to 0.058 m (ERM 2023, pp. 46-47). Prior predictions for the area, noting the proposed reduction in CSG wells from 240 to 151, have been much greater, with OGIA predicting up to 0.111 m (KCB 2023, p. 181) and QGC modelling predicting cumulative subsidence of up to 0.3 m to the west and north of the project (KCB 2023, Table 9.6, p. 182). Subsidence associated with CSG development approaching 0.1 m occurs across gasfields in the northern Surat Basin (Brennand *et al.* 2023). Further assessment of potential subsidence should be undertaken which includes:
 - a. providing additional information on the timeframes for the predicted subsidence impact to occur, and the potential for the adopted approach to underpredict long-term subsidence;
 - b. a more detailed discussion of the differences between the various predictions for the area and geology or soil types;
 - c. discussion of what magnitude of subsidence may occur in drainage networks to assess whether there will be potential impacts to surface water flow regimes;
 - d. comparison with observed subsidence data from adjacent and earlier developed CSG production in areas directly west of the project; and
 - e. consideration of site-specific impacts from subsidence on the landscape, including in the context of existing land uses.
17. Baseline data of the current land surface elevation, including temporal variability to account for changes in vegetation cover, soil types and wetting/drying cycles, must be collected prior to the

project commencing. This is needed to ensure that impacts from the project can be identified and differentiated from other sources of changes to land surface elevation.

Question 3: Can the Committee provide comment on the adequacy of the proposed mitigation, management and monitoring measures? Does the Committee consider that any additional measures are needed to remain within the projected levels of impact or reduce the risks to surface and ground water resources, GDEs and other third-party users, considering project impacts alone as well as cumulative impacts with other proposed and existing projects?

18. Limited identification and discussion were provided of proposed mitigation, management and monitoring measures. Proposed mitigation and management measures were often generic and not project-specific. Baseline data collection, as outlined in Paragraphs 5c, 5e, 7a-7b and 12-13, will assist in improving proposed measures and their specificity. Trigger Action Response Plans (TARPs) were occasionally mentioned but not clearly defined. Overall, the adequacy of proposed mitigation, management and monitoring is difficult to determine given the lack of project-specific detail provided about these measures and components of project infrastructure as well as the limitations of the impact assessment described in the response to Questions 1 and 2 above. Topic-specific required improvements are outlined below.

Groundwater

19. Proposed groundwater monitoring is limited to the existing monitoring that occurs for the currently approved project, and the three nested bores installed to examine potential connectivity between the alluvium and underlying groundwater systems (KCB 2023, Table 10.1, p. 191). The IESC recommends installing additional nested piezometers, especially near any potential watercourse springs. Additional monitoring is needed of:
- a. any potentially impacted areas of GDEs following ground-truthing to establish groundwater-dependence (Paragraphs 11 and 12);
 - b. vertical hydraulic head gradients near potential watercourse springs and other GDEs;
 - c. potentially impacted private bores; and
 - d. potential seepage or spills from new produced water or brine stores constructed for this project.
20. The analyte suite for monitoring needs to be clearly outlined and must include parameters that relate to drilling fluids, hydrocarbons and geogenics, not only physico-chemical parameters, major ions and dissolved metals. Groundwater quality monitoring should be done at all monitoring sites.
21. Project-specific mitigation measures were not clearly identified. It appears that the proponent will rely on the general measures required by OGIA through the Underground Water Impact Report process, and the measures required under the Joint Industry Framework (JIF) to manage impacts, including cumulative impacts (Senex Energy Limited 2023a, pp. 41-42). It is unclear whether the proponent has the necessary baseline data and monitoring networks in place, or planned, that will enable successful mitigation and management of potential impacts, particularly to potential watercourse springs and terrestrial GDEs, under the JIF. For example, although the proponent has identified that the risk to terrestrial GDEs is currently low using the JIF processes (KCB 2023, p. 202), it is possible that within a few years of commencing the project, the risk could change (timeframe to potential impacts reduces, see DAWE 2021, Tables 3 and 4, p. 39) which may require the proponent to undertake additional site-specific risk assessments and have performance criteria, triggers and limits approved (see DAWE 2021, Figure 5, p. 32). If this occurs, the proponent will need a sufficient understanding of the pre-impact system to derive appropriate performance criteria, triggers and limits, and an established monitoring network (groundwater and ecological) to demonstrate that the performance criteria, triggers and limits are being met.

Surface water

22. Surface water monitoring appears to be proposed only during the construction phase with no details provided of locations or parameters. Ongoing surface water monitoring may be required should watercourse springs be potentially impacted or depending on the location of water and brine storage infrastructure and the potential for spills or leakage from this infrastructure to impact surface water systems and/or shallow alluvium.
23. It is unclear whether the generic mitigation measures proposed for potential impacts to surface water will be sufficient. Although surface water discharges, abstraction and diversions are not proposed (KCB 2023, p. 161), the information provided did not consider potential impacts arising from altered overland flows and changes to flood regimes from infrastructure, or clearly consider the risk of seepage, spills, leakage or overtopping of brine and produced water stores, to allow a determination of whether site-specific mitigation measures are needed for these potential impacts. Given the lack of clarity around project- and site-specific impacts to surface water, it is not possible to determine whether cumulative impacts will occur and require mitigation.

Ecology

24. It is unclear that any monitoring is proposed at potentially impacted GDEs. Given the proponent's intention to manage impacts to GDEs through the JIF (ERM 2023, p. 48), baseline monitoring and ongoing monitoring will be required to demonstrate whether there are any adverse effects on the function and environmental values of the GDEs from the project (see Paragraph 21). Given the highly modified landscape, cumulative impacts will require careful consideration when proposing monitoring, management and mitigation measures to ensure that retention of ecological connectivity is prioritised especially along riparian corridors and ephemeral surface water networks.
 - a. The proponent should monitor riparian vegetation condition along Wandoan, Woleebee and other creeks before and during the operational phase of the project to detect any changes in the riparian vegetation condition, composition and suitability as habitat, especially for EPBC Act-listed species. Monitoring should also include faunal use (e.g., movement, foraging, tree hollow use) of all riparian corridors across the project area to demonstrate that ecological connectivity is being maintained across the entire drainage network. If impacts are detected, the proponent should propose suitable mitigation options (e.g., targeted re-vegetation, supplementary watering).
 - b. Monitoring of groundwater levels in the alluvium is needed along creeks with potential watercourse springs and other GDEs to capture changes in levels which could impact these GDEs, especially where either full or opportunistic dependence on groundwater has been demonstrated (see Paragraphs 12 and 13). As changes in groundwater levels will typically occur prior to impacts to vegetation condition being detected, this monitoring would provide the earliest opportunity to identify potential impacts and implement a TARP to ensure timely intervention and an increased likelihood of successful mitigation. This approach would complement the JIF process, assisting in demonstrating that the ecosystem functions of the terrestrial GDE are being maintained.

Chemicals and wastes

25. Further information on the management of produced water is needed, particularly in relation to early flowback water following initial production well development because this water will likely contain higher concentrations of drilling chemicals, making it a greater risk to the environment. Monitoring of the produced water and brine stores should target chemicals identified in the chemical risk assessment as being a higher potential hazard. This monitoring will provide baseline data against which to assess the potential impacts of any accidental releases.

26. The proponent has predicted that approximately 5 tonnes of salt will be produced for every megalitre of water at the project (KCB 2023, p. 31). Based on the estimated total water production of 6,800 ML over the life of the project (KCB 2023, p. 29), this equates to approximately 34,000 tonnes of salt. Although the proponent proposes to truck the salt slurry from the site and dispose of it at a regulated waste facility (ERM 2023, p. 29), the IESC strongly encourages continued research into alternative approaches to dealing with the legacy issue of brine in the landscape.

Subsidence

27. No subsidence monitoring appears to be proposed other than that conducted by OGIA (KCB 2023, pp. 199-200). The proponent should develop a program for monitoring of potential subsidence across the project area that includes field validation of remotely sensed data.

Date of advice	31 August 2023
Source documentation provided to the IESC for the formulation of this advice	<p>ERM 2023. <i>Draft Preliminary Documentation for IESC Review – Atlas Stage 3 Gas Project. Preliminary Documentation (EPBC 2022/09410)</i>. 14 July 2023. Project No.: 0639876. Prepared by ERM for Senex Energy Pty Ltd. (Draft PD including Attachments D, I, J and K)</p> <p>ERM 2022a. <i>Senex Atlas Stage 3 Gas Project. Terrestrial and aquatic ecology assessment report</i>. 14 November 2022. Project No.: 0639876. (Attachment E of the Referral).</p> <p>ERM 2022b. <i>Senex Atlas Stage 3 Gas Project. EPBC Act ecology significant impact assessment report</i>. 11 November 2022. Project No.: 0639876. (Attachment G of the Referral).</p> <p>ERM 2022c. <i>Senex Atlas Stage 3 Gas Project. Significant species management plan</i>. 11 November 2022. Project No.: 0639876. (Attachment H of the Referral).</p> <p>KCB 2023. <i>Senex Energy Pty Ltd. Atlas Stage 3 Gas Project. EPBC water resource impact assessment. Revision 1</i>. DX10171A12. Prepared by KCB for Senex Energy Pty Ltd. (Attachment D of Draft PD).</p> <p>Senex Energy Limited 2023a. <i>Atlas Stage 3 water monitoring and management plan</i>. Document Number: SENEX-ATLS-EN-PLN-017. Revision 1. (Attachment I of Draft PD).</p> <p>Senex Energy Limited 2023b. <i>ATP 2059 coal seam gas water management plan</i>. Document Number: SENEX-ATLS-EN-PLN-013. Revision 1. (Attachment J of Draft PD).</p> <p>Senex Energy Limited 2023c. <i>PL 445 and PL 209 coal seam gas water management plan</i>. Document Number: SENEX-ATLS-EN-PLN-014. Revision 1. (Attachment K of Draft PD).</p> <p>Senex Energy Limited 2022a. <i>Environmental management plan. Project Atlas Stage 3</i>. Document Number: SENEX-ATLS-EN-PLN-015. Revision 1. (Attachment B of the Referral).</p> <p>Senex Energy Limited 2022b. <i>Queensland environmental protocol for field development and constraints analysis</i>. Document: SENEX-CORP-EN-PRC-019. Revision 2. (Attachment C of the Referral).</p>

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