

## Advice to decision maker on coal seam gas project

### IESC 2014-042: Development of new natural gas acreage in Surat Basin, Queensland (The Surat North Development) (EPBC 2013/7047) – New Development

<b>Requesting agency</b>	The Australian Government Department of the Environment
<b>Date of request</b>	28 February 2014
<b>Date request accepted</b>	03 March 2014
<b>Advice stage</b>	Assessment

#### Advice

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) was requested by the Australian Government Department of the Environment to provide advice on the development of new natural gas acreage in Surat Basin, Queensland (The Surat North Development) in Queensland.

This advice draws upon aspects of information in the Preliminary Documentation, together with the expert deliberations of the IESC. The project documentation and information accessed by the IESC are listed in the source documentation at the end of this advice.

The development area lies approximately 400 km west of Brisbane and 20 km east of Wandoan, within the Surat Basin. The development area is located in the upper Dawson Catchment, a sub-catchment of the Fitzroy River drainage basin. The proposed development is for the drilling and completion of a maximum of 400 wells gas wells (spaced approximately 750 m), construction of water management infrastructure, installation of well-site facilities, in-field compression and other associated infrastructure.

The total coal seam gas (CSG) water abstraction from the wells is estimated to be 35 GL over the life of the project, estimated at 30 years, CSG extraction water will be supplied to the Woleebee Creek treatment plant facilities where it would be treated and released into the Dawson River at Glebe weir.

The IESC observes that while this proposed project has a relatively small number of CSG wells, it is over a large area and is located in close proximity to a considerable number of large operations, springs listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and groundwater dependent ecosystems (GDEs).

The IESC, in line with its Information Guidelines<sup>1</sup>, has considered whether the proposed project assessment has used the following:

Relevant data and information: key conclusions

The following data and information would enable potential impacts arising from the proposed project to be fully assessed:

- Groundwater head maps, pre and post development, for the various hydrogeological units to verify the conceptual hydrogeological model.
- Provision of flow duration curves to enable the assessment between the pre and post development scenarios at Taroon and Glebe Weir.
- Predictive modelling of potential drawdown in the shallow alluvium material as a result of the development.
- Field assessments and mapping of terrestrial vegetation and watercourse condition within the study area to help determine areas and the nature of groundwater - surface water interaction.

Application of appropriate methodologies: key conclusions

- Model applicability: The use of the Queensland Office of Groundwater Impact Assessment model is appropriate to consider the cumulative groundwater impacts. However it is not considered suitable to assess the impacts on GDEs including springs; and quantifying surface water – groundwater interactions.
- As springs are not represented in the model it is suggested that springs be added and represented by boundary conditions, to assist in the identification of spring depletion.
- Field validation of desktop mapping for GDEs is needed along with mapping of terrestrial vegetation reliant on shallow groundwater.
- There will continue to be high uncertainty regarding estimation of impacts until existing operations become operative, and impacts are able to be detected and monitored.

Reasonable values and parameters in calculation: key conclusions

- CSG water production values are inconsistently reported in the documentation. The text refers to an estimate of 35 GL over the lifetime of the project. Figure 2-1 suggests significantly more water will be abstracted, ~ 90 GL.
- The anisotropy ratios (between horizontal and vertical hydraulic conductivities) used in groundwater modelling are unusually high and may result in underestimation of the vertical extent of drawdown.

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

*Question 1: The Proponent has used the Office of Groundwater Impact Assessment's Surat Cumulative Management Area model to assess risks of the project. Does the Committee consider that this is appropriate to assess the cumulative risks of the project?*

1. The proponent quantifies the extent of drawdown by using the Office of Groundwater Impact Assessment's (OGIA) Surat Cumulative Management Area (CMA) numerical groundwater flow model. This model is appropriate to assess the cumulative groundwater risks of the project but not to GDEs. Suggestions for improvements to the model when being revised are provided at the end of this advice.

2. Notwithstanding the above, there are several aspects of the proponent's application of the model that need to be addressed and that should be improved to more adequately predict impacts on groundwater and GDEs. These are listed below.

#### Stage 3 Abstractions

- a. There appear to be unexplained inconsistencies in the proponent's water abstraction predictions. The text refers to an estimate of 35 GL over the lifetime of the project, however Figure 2-1 suggests up to 90 GL. The inconsistency reduces confidence and reliability of the proponent's model predictions. It would be beneficial to re-run the model with updated abstraction scenarios to more realistically reflect operations.
- b. In addition, location information (maps) on the abstraction bores used in the model, both for the 35 GL (or amended) and 250 GL scenarios should be included to enable an accurate overview of the locations and their proximity to GDEs.
- c. The predicted drawdown maps provided indicate that, of the predicted 15-17.5 m maximum drawdown in the Walloon Coal Measures (WCM), 10-15 m will propagate to the Springbok Sandstone due to the two being hydraulically connected. In places, the Springbok Sandstone may become unconfined and the constant transmissivity assumption may become invalid. As groundwater head maps are not provided for the various units, it is not possible to assess the plausibility of interconnectivity assumptions and resultant predicted drawdown.

#### Application of the Model for Impact Assessment

- d. The model was used to predict changes in groundwater-surface water interactions and impacts to springs (by the use of a proxy-impact to spring source aquifers), even though the shortcomings of doing so is recognised. The IESC recommends that the limitations of usage of the model for those purposes are recognised and incorporated into risk, monitoring and mitigation plans.

*Question 2: How likely and severe is the risk of the project inducing interaction between aquifers?*

3. The proponent does not provide potentiometric head maps. These maps are needed before a thorough understanding of hydraulic gradients in both horizontal and vertical planes can be developed. This is a pre-requisite to assess interactions between aquifers.
4. The IESC recommends that groundwater head maps for each hydrogeologic unit be included as part of the conceptual hydrogeology section. The IESC also recommends that in addition to drawdown maps, pre-CSG and CSG affected potentiometric head maps be included.
5. The proponent concludes, from a small number of spatial observations, the existence of vertical upward gradient at the site. The head differences at a few sites do not provide sufficient basis for making area-wide judgements of hydraulic gradients.
6. There appears to be inconsistencies in the water balances. The proponent refers to three phases: baseline, long-term average and peak CSG times, but only two figures are presented. For the pre-CSG water balance (Figure 7-8) the explanatory text suggests that it is based on the long-term average (2013-2049). The null CSG abstraction in the figure suggests that the title is correct and the explanatory text should be amended.
7. As the water balances refer to the entire development area and no head maps or cross-sections are provided, it is not possible to analyse the spatial distribution of water balance components.
8. The resulting groundwater flux within the development area is predicted to change from upward to downward between the WCM and Springbok Sandstone and the upward flow between the Hutton

Sandstone and the WCM is predicted to double. These results are consistent with the abstraction from the WCM. Those drawdowns in turn will induce converging flows on the WCM (upward from below from the Hutton Sandstone and downward from above from the Springbok Sandstone).

9. A key uncertainty in the model parameterisation is whether the vertical conductivity values used are regionally representative. The conductivity ratios used in the model are likely to precondition the model towards unrealistically high horizontal flow without exploring the potential for vertical flow between aquifers. The consequence of this may be an unrealistic model prediction on the propagation of vertical drawdown.
10. A description of the predicted impacts of drawdown from the WCM on units below the Hutton Sandstone or units above the Springbok Sandstone is needed. If no impacts are presently predicted by the model this may be the result of the parameterisation of the model, in particular the low vertical hydraulic conductivities adopted for the intervening aquitards.

*Question 3: What does the Committee consider are the likely and potential impacts of the proposed action on springs, given the mitigation measures proposed? If appropriate, what additional mitigation measures could reduce the risk of impacts?*

11. It is unclear why some springs are discussed and others are not. The proponent states that “The Cockatoo Creek, Dawson River 8 and Scott’s Creek spring complexes are in closest proximity to the development”. However, other figures suggest that EPBC listed Yebna 2, Dawson River 2 and Prices are situated at similar distances from the development area, but these springs are not discussed. The IESC recommends that, in the absence of more detailed mapping information being available, a field assessment needs to be undertaken for a reliable assessment to be made of GDE presence/absence (particularly those which are not springs).
12. A drawdown impact on Scott’s Creek spring is likely as a result of the proposed CSG activity; and impacts on the Cockatoo Creek, Dawson River 8 and Yebna 2 springs are possible.
13. Conceptualisation for selected springs links them to their potential source aquifers. Estimated or measured spring flows and groundwater head maps (or head contours on the vertical cross-sections) would make this section more robust and would provide more confidence in the interpreted connections between source aquifers and springs.
14. The proponent states that groundwater “discharges from seeps along the stream bed, and that springs provide perennial flow in the Dawson River downstream of Dawson’s Bend”. The Dawson River and surrounds, however, are not presented as GDEs. GDEs have not been recorded near the Scott’s Creek springs. The conceptualisation suggests the convergence of local and at least intermediate groundwater flow systems near Scott’s Creek Springs, which suggests likely shallow watertable conditions and a potential reliance on groundwater.
15. The proponent presents no evidence to demonstrate the likely efficacy of any of the proposed mitigation measures of the Joint Industry Plan (JIP) for Early Warning System for EPBC Springs. The proponent also does not discuss the feasibility of maintaining the mitigation measures given the length of time of predicted spring impact, with maximum impacts sometime after 2075 and an extended period of slow recovery.
16. The JIP is intended to align with spring monitoring and mitigation requirements obligated by the Underground Water Impact Report (UWIR) for the Surat CMA. The UWIR includes “managing water extraction” as a proposed mitigation measure. This may include rescheduling of CSG extraction or not extracting CSG from a buffer zone around a mitigation site, although this option is not mentioned in the JIP. Future consideration of this option could include identification of gas extraction wells most likely to contribute to predicted drawdown in a spring’s source aquifer and

include predictions of how various scenarios of well placement and operation may prevent or limit an impact to the spring.

17. The JIP states that the Clematis Sandstone is no longer classified under the Great Artesian Basin (GAB) resource operations plan as a GAB aquifer. However, it is understood that GAB aquifers are listed under Schedule 4 the GAB Water Resource Plan 2006. Schedule 4 of the current GAB Water Resource Plan includes the Clematis Sandstone. As such, springs sourced from the Clematis Sandstone are potentially excluded as GAB springs.

*Question 4: How likely and severe are the on-site risks of managing produced water before it reaches the existing Woleebee Creek treatment facility? What other measures would help to mitigate these risks? Has the proponent addressed whether the existing Woleebee Creek treatment facility has the capacity to deal with additional produced water volumes?*

18. The on-site risks of managing produced water prior to treatment would not be expected to be significant, if managed effectively. However, an as yet unspecified number of storage ponds will be required as part of the temporary storage and transfer of CSG water to the Woleebee Creek treatment facility. The proponent needs to ensure the design of these facilities incorporates sufficient freeboard allowance to avoid overtopping as a result of direct rainfall inputs or through wind generated wave action. Water level sensors (or equivalent arrangements) and control systems should also be incorporated into the design to avoid over filling of the storages. These measures collectively should ensure that untreated CSG water is kept separate from the natural resources of the development site or region.
19. Collected CSG water is to be treated at the Northern Water Treatment Plant located near Woleebee Creek. This is a suitable means of treatment if the plant's capacity to receive and treat the proposed volumes and quality of water for the duration of the project is demonstrated. Evidence that an agreement is in place with the plant operator to treat the CSG water has not been provided.
20. A network of pipelines and maintenance roads/tracks interconnecting the dewatering bores, collection storages and transfer lines will need to cross numerous watercourses. The design and construction of any watercourse crossings or works within the floodplain will need to include appropriate soil erosion and drainage/watercourse management.

*Question 5: Does the Committee consider that the Water Monitoring and Management Plan suitably addresses the uncertainties and risks of the project identified by the Committee? What modifications or additions would address any significant shortcomings?*

21. Noting the concerns raised about the use of the groundwater model as it relates to springs, it is difficult to assess the monitoring and mitigation plan. The proponent's monitoring plan should be presented in maps of potentiometric head and drawdown for each hydrogeological unit, with existing or proposed monitoring bores (both on- and off-tenure) of the appropriate unit displayed on the maps. In addition tables, for each hydrogeological unit, that lists the monitoring bores, status, function, and proposed trigger levels together with the P95 modelling results, should also be included.
22. There appear to be two monitoring site maps, the proponent's existing and proposed monitoring bores for various hydrogeological units with the JIP Early Warning System (EWS) related to springs. They use different scales and spatial coverage that make the assessment of proposed monitoring difficult and creates uncertainty in what is being proposed for each hydrogeological unit.
23. It is unclear why there are no monitoring bores to the south-west of Woleebee Creek GW1-9, where the predicted drawdown impacts are the largest in the WCM, Springbok and Hutton

Sandstones. The maximum predicted drawdown zones are outside the proposed project area. It is, however, not clear if there are no monitoring sites at all, or sites to the south-west of Woleebee Creek GW1-9 exist but are operated by other Joint Industry Partners. If there are no monitoring sites established to the south-west of Woleebee Creek GW1-9, the IESC recommends establishing the following additional monitoring sites:

- a. A Springbok Sandstone Monitoring site at approximately 35 km to the South-southwest of RN48978. This site should be situated in the 10-15 m predicted drawdown zone and augment the single existing Woleebee Creek GW2 Springbok Sandstone site.
  - b. A WCM monitoring site to augment the existing Woleebee Creek installations. The largest drawdown impact in the WCM is predicted to the south and south-west of Wandoan yet only one proposed WCM bore (Peebs GW16) is located in this zone.
  - c. A Hutton Sandstone Monitoring site at approximately 35 km to the south-southwest of RN48978. This site should be situated in the predicted drawdown zone and augment the single existing Woleebee Creek GW2 Springbok Sandstone site.
24. It is unclear how the limits and triggers for bores associated with the springs were determined. There appear to be inconsistencies in the model predicted drawdowns and the trigger levels. The IESC recommends that in addition to drawdown triggers and limits in monitoring bores, the corresponding potentiometric heads should be also stated.
25. The IESC suggests that a regular (e.g. quarterly) inspection and reporting program for all water collection, transfer and treatment infrastructure (including watercourse crossings and bore head integrity) be undertaken and any water quality treatment systems be incorporated within the collection and transfer system. The reporting program should also include a protocol for corrective action.

*Question 6: Does the Committee consider the risk plans and the proposed management and mitigation measures proposed are adequate for a project of this size and complexity?*

26. Given the uncertainties around the model's application and the proposed project's locality, the IESC has low confidence that risks to GDEs and ground and surface water connectivity have been identified. The IESC recommends that appropriately scaled analyses are undertaken to detect impacts. Based on the resultant risks from this, updated monitoring and mitigation measures should be assessed and documented.

*Question 7: What does the Committee consider are the likely impacts of the proposed action on surface and groundwater resources, in particular, changes to surface and/or groundwater dynamics and resources, including resources that may support surface habitat for listed threatened species and communities? Are there additional measures and commitments required to mitigate and manage impacts to MNES and water-related assets including ecological and human users of water?*

27. The likely impacts on groundwater resources are increased drawdown in the WCM, Springbok and Hutton Sandstones and potentially in the Gubberamunda and Precipice Sandstones. The vertical groundwater flow is likely to increase between the WCM and Springbok Sandstone and between the Hutton Sandstone and the WCM. The vertical groundwater flow may also change in the Gubberamunda and Precipice Sandstones.
28. Long term drawdown levels in Hutton and Precipice Sandstones through the Dawson River valley are anticipated to be between 0 and 1 m. The proponent indicates that there will be no impacts on surface water because there is no interaction between surface waters and the deep aquifers, but this conclusion conflicts with the proponent's drawdown maps. Drawdown of this magnitude (up to 1 m) is likely to have an impact on base flows in Dawson Creek.

29. The proponent advises that treated CSG water will be released to the Dawson River at Glebe weir but has not assessed the potential impacts from these releases.
- a. The present median daily flow measured at Taroom monitoring station is approximately 26ML/d. The projected CSG water generation during the years 2016 to 2024 is predicted by the proponent to be approximately 30ML/d. These comparisons indicate that the median daily flow at Glebe weir could be doubled. The proportional increase on smaller flows will be larger. It is likely that this increase in flow at Glebe weir will have a significant impact on the physical and ecological characteristics of the watercourse.
  - b. The potential impacts on streamflow could initially be quantified by developing flow duration curves at Glebe weir for the pre and post CSG development scenarios. An assessment of the impacts on the geomorphology and ecology of the Dawson River downstream of Glebe weir could then be undertaken.
30. The proponent advises that there are several water harvesting and irrigation licenses located near the Juandah Creek / Dawson River confluence. A reduction in baseflow and flow duration along Dawson Creek may have an adverse impact on these water users. This has not been assessed. The extent of impact could be assessed by developing a post development flow duration curve for the Taroom monitoring station and comparing this information with the existing flow duration data.
31. The potential impacts on the shallow alluvial groundwater systems have not been quantified. These systems are likely to support terrestrial vegetation via recharge from direct rainfall infiltration and infiltration from stream beds and banks as well as floodplain infiltration. A drop in groundwater level in the alluvium as a result of the development could have adverse impacts on native vegetation.
32. Evidence is presented that both vegetation and in-stream aquatic community GDEs are likely to be present. However, this is contradicted by a statement that no aquatic ecosystems with dependence on groundwater are thought to occur within the development area. It is further stated that flow in the streams in the study area is ephemeral, has no connection with underlying groundwater and is purely reliant on rainfall runoff, or is intermittent, having seasonal connection with underlying groundwater.
33. An aquatic ecological survey of the development area was performed in 2012, but the report from this survey was not provided. There is no information provided on the timing, location, method or results of the survey, other than that no rare or otherwise noteworthy species were recorded. Provision of the report, together with an assessment of likely impacts on aquatic systems from potential groundwater drawdown, would help to address deficiencies in the current assessment.
34. Consideration of impacts of the proposed action on surface and groundwater resources requires an understanding of the interconnectivity between the WCM and the underlying formations including the Hutton and Precipice Sandstones which are potential source aquifers for EPBC-listed springs. Where these sandstones outcrop, discharge may occur through stream incision. Impacts from the proposed action on the vegetation and in-stream aquatic community GDEs associated with Horse Creek are unclear due to the uncertainty regarding the vertical interconnectivities between the WCM and the overlying formations including the Horse Creek Alluvium. Additional measures to improve understanding of aquifer interconnectivity and the impacts of the project could include: monitoring of groundwater levels in the alluvium, investigations to determine the reliance of riparian vegetation on alluvial groundwater, and understanding the influence of potential groundwater drawdown on this vegetation.
35. The Surat UWIR is to be revised every three years to incorporate new knowledge. As part of this review, the IESC suggests the following:

- a. Explanations are needed for the use of the evaporation package to simulate CSG extraction as well as the assumption of constant transmissivity in the model. As a localised issue, the predicted drawdown map provided indicates, in places, the Springbok Sandstone may become unconfined and the constant transmissivity assumption may become invalid.
  - b. Springs do not appear to be represented in the model by any specific boundary conditions. The IESC recommends that springs be represented by appropriate boundary conditions in the model and spring flow depletion, as a flux, be calculated by appropriate water budgets. Impacts to springs have been characterised by the modelled drawdown in the aquifer which has been identified as the primary spring source at the location of the spring. Spring flow depletion (flux or volume/time) is different from drawdown (dimension: length) and it is spring flow that ultimately supports spring ecology. Furthermore, it is spring flow that is the subject of spring monitoring.
  - c. Only a small sub area was selected for transient modelling. The transient model is situated 70 km to the south-east of the development area and therefore is not appropriate to model the transient impacts of the proposed activities within the development area. It would be beneficial to convert the entire model domain to a transient state model and re-run the model with updated extraction scenarios to reflect more realistic operations.
  - d. Anisotropy ratios, from the groundwater model, appear to be extremely high (values up to 5000). This is likely to restrict the amount of induced groundwater flow predicted by the groundwater model from the Hutton Sandstone and potentially the Gubberamunda and Precipice Sandstones, thereby underestimating drawdown in these formations.
  - e. As the scalability of lab tests to the regional scale is questionable, the use of such data in such a broad regional model should be reviewed and hydraulic conductivity values specific to the Surat Basin should be used in future iterations of the groundwater model. This would provide greater confidence in the plausibility of formations with high anisotropy (>100) ratios being used in the groundwater model and would provide an opportunity to demonstrate the sensitivity of vertical leakage to this parameter.
36. The Northern Inland Catchments, which includes the Surat Basin, has been identified as a Bioregional Assessment priority region. Data and relevant information from the proposed project should be made accessible for this Bioregional Assessment to assist the knowledge base for regional scale assessments.

<b>Date of advice</b>	10 April 2014
<b>Source documentation available to the Committee in the formulation of this advice</b>	Development of Surat Basin Acreage EPBC Referral (2013/7047) Preliminary Documentation.
<b>References cited within the Committee's advice</b>	<sup>1</sup> Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources available at: <a href="http://iesc.environment.gov.au/pubs/iesc-information-guidelines.pdf">http://iesc.environment.gov.au/pubs/iesc-information-guidelines.pdf</a>