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

Advice to decision maker on coal seam gas project

IESC 2018-100 Surat North CSG Project (EPBC 2018/8276) – Expansion

Requesting agency	The Australian Government Department of the Environment and Energy
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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 the Environment and Energy to provide advice on the QGC Pty Ltd's Surat North CSG 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

As set out in the Preliminary Documentation (PD), QGC Pty Ltd proposes to add 740 wells to the existing 400 wells at their Surat North CSG field. The proposed project lies in the Surat Cumulative Management Area (CMA) in Queensland, approximately 35 km south-west of Taroom. The project area is in the upper Dawson Catchment, a sub-catchment of the Fitzroy River drainage basin, which flows into the Great Barrier Reef lagoon.

The Surat CMA contains existing and proposed large-scale CSG developments. Modelling of cumulative groundwater impacts within the Surat CMA is undertaken by the Office of Groundwater Impact Assessment (OGIA) who publish their findings in Underground Water Impact Reports (UWIRs). The proposed project is incorporated in modelling undertaken for the most recent UWIR, which assumes 1335 wells in the project area, rather than the now planned approximately 1200. There are two mining leases

that overlap parts of the project area: one a subsidiary of Glencore for open cut coal mining east of the project area and the other by Taroom Coal for open cut coal mining in the centre of the project area.

Key potential impacts from this project are:

- declines in shallow groundwater level due to depressurisation of underlying aquifers and Walloon Coal Measures; and
- reductions in water availability to springs, riparian ecosystems, fringing vegetation of a wetland of High Ecological Significance (HES), several Regional Ecosystems listed as 'Of Concern' (Queensland) and other groundwater-dependent ecosystems (GDEs) as a result of groundwater depressurisation and drawdown.

The IESC strongly recommends that the proponent makes more effective use of existing data and information collected before and during the existing project to address the following:

- utilise the existing production data from the life of the project as an opportunity to improve both the regional and local groundwater models;
- demonstrate how they intend to monitor and manage impacts (including cumulative impacts) to water resources and EPBC Act-listed threatened species and communities from groundwater drawdown in the alluvium, and illustrate the likely efficacy of this methodology using existing available historic data;
- quantify residual impacts (after accounting for avoidance and mitigation measures) to water resources, EPBC Act-listed threatened species and communities, and migratory species from groundwater drawdown in the alluvium and explain how these impacts will be offset;
- expand modelling of drawdown in the alluvium to cover potential impacts to surface flow and sediment regimes of Canal, Eurombah and Juandah Creeks, and to GDEs (including riparian and terrestrial vegetation), to enable a robust impact assessment;
- describe how impending water level changes in springs will be identified early and mitigated to prevent impacts, should future model predictions (including cumulative effects with other operations) indicate potential for significant changes to spring source aquifers, and illustrate the likely efficacy of this methodology using historical data; and
- demonstrate how they intend to monitor and manage changes to surface water and groundwater quality as a result of inappropriately stored or unintentionally released drilling chemicals, co-produced water and brine. There is also limited information in relation to the transportation of the co-produced water, the exact location of the water treatment facilities, the water treatment process, transportation and any discharges under the existing Glebe Weir Beneficial Use Agreement.

Context

The current project proposes the infill development of 740 coal seam gas (CSG) wells and associated infrastructure within an existing gas field (123,290 ha) containing approximately 400 wells (PD, MNES, pp 2). The proposed action is within the existing petroleum lease boundary of the Surat North Development (EPBC 2013/7047) which was approved on 17 December 2014. The existing Surat North Development involved the construction of 400 CSG extraction wells for which the IESC previously provided advice in April 2014 (IESC 2014-042).

Broadly, the IESC advice on the existing operations suggested that the proponent should verify the conceptual hydrogeological model, conduct field assessment and mapping of GDEs as well as

groundwater – surface water interactions and account for springs and spring depletion in the groundwater model as the project progressed.

The IESC notes that both the OGIA model and the UWIR for the Surat Basin have been updated since the IESC advice in 2014. These updates have addressed some of the information gaps noted in IESC 2014-042. However, the assessment documentation provided by the proponent for the proposed Surat North expansion provides limited field verification of surface and groundwater connectivity, only desktop mapping of GDEs, and few details on existing water quality.

The area of the currently proposed project contains fragments of *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed endangered Brigalow (Brigalow (*Acacia harpophylla*) dominant and co-dominant), Coolibah (Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions) ecological communities along Eurombah and Horse Creeks, and small pockets of semi-evergreen vine thickets (Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions) near the south-eastern boundary. As 94 % of the project area is grazed (PD, MNES, pp 14), fragments of native vegetation are particularly important for the conservation of extant biodiversity and supporting ecological processes.

No EPBC Act-listed spring complexes are located within the project area. However, some are located in the surrounds, including Scotts Creek spring approximately 15 km west of the project boundary and the Dawson River 8 complex downstream along the Dawson River approximately 30km from the project area boundary.

The total CSG water abstraction from the QGC wells is estimated to be 88 GL by QGC and 623 GL by OGIA. This large variation requires justification. Most co-produced water will be supplied to the Woleebee Creek Water Treatment Plant (WTP) facilities where it will be supplied to the Glebe Weir Beneficial Use Scheme, operated by SunWater (PD, MNES Impact Assessment Report, p. 30). Existing water and brine storage ponds will be utilised at the WTP facilities and the brine will be crystallised into salt form, and encapsulated for long-term storage in purpose-built cells.

Response to questions

The IESC's advice, in response to the Department of the Environment and Energy's specific questions, is provided below.

Question 1: Does the Committee consider the key potential risks and impacts of the proposed action on water resources have been adequately identified and assessed, including through the development of numerical and conceptual modelling? If not, what additional work does the Committee consider is required to identify and assess the key risks and impacts of the proposed action on water resources?

Groundwater

1. The IESC commends the general approach to use a local-scale numerical groundwater model to complement OGIA's regional-scale groundwater model. This approach allows the OGIA model to be used for regional-scale and cumulative impact predictions, for which it is designed, whereas risks and impacts associated with the proposed project can be assessed using the local-scale model. The proponent's assessment of cumulative impacts is discussed further in response to Question 3.

2. The local-scale model of the area around Horse Creek (hereafter, the Jacobs model) is intended to investigate changes to saturation within the Horse Creek alluvium, based on depressurisation predicted by the 2016 OGIA model. The IESC considers that this aim is appropriate, but suggests that the modelling should be expanded to include the alluvium associated with Canal, Eurombah and Juandah Creeks, and other areas where GDEs may occur. Alluvium in these creeks is likely to be subject to similar drawdown to the Horse Creek alluvium, with associated risks to GDEs and surface

waters (see paragraphs 4-6). To model these systems in a robust manner would also require an expansion of the groundwater monitoring network. However, preliminary predictions from an expanded model prior to the collection of new monitoring data would still provide some insights into potential impacts.

3. The Jacobs model has several shortcomings. This results in a less complete assessment of, and reduced confidence in, likely impacts based upon the information available. There is, however, the opportunity for the proponent to utilise the existing production volume data for the life of the project to make improvements to the Jacobs model and provide related justification. To address these limitations and improve confidence in the Jacobs model, the IESC suggests the model should be revised and model documentation updated. This revision should consider:

    a. the nature and positioning of the boundary conditions;

    b. how the predicted depressurisation from the OGIA model is implemented in this model;

    c. reconciliation of predicted abstraction production volumes from the Jacobs model with those of the OGIA model (water balance);

    d. justification of model parameters, including hydraulic conductivity, storativity and recharge values;

    e. developing a calibrated model;

    f. accounting for the spatial variation in surface water-groundwater interaction that appears to be present, based on the surface water-groundwater interaction study and groundwater chemistry data (PD, Water Resources Assessment, App. M.);

    g. site-specific data for Canal, Eurombah and Juandah Creeks, and other areas where GDEs may occur. This would include additional monitoring bores in the other creeks' alluvium to define aquifer characteristics and conducting field tests to assess the degree of interaction between the creeks and the alluvial groundwater levels, in particular the hydraulic conductivity;

    h. incorporating an uncertainty analysis and additional sensitivity analysis (beyond the two scenarios presented in the PD). The IESC has recently published an explanatory note on uncertainty analysis (Middlemis and Peeters 2018), which provides useful guidance;

    i. providing estimates of the likely increase in zero-flow days in the three creeks as a result of drawdown in the alluvium; and,

    j. an independent peer-review of the model.

Surface water

4. The proponent has not provided adequate information to identify or assess the likely impacts or risks to the majority of surface water resources within the zone of likely impacts. Although the proponent has provided information on the surface water for Horse Creek, little information is provided on the other tributaries of the Dawson River in the project area, including some watercourses that may partly rely on groundwater inputs. It is also noted that information collected during the existing project has not been presented to support assertions of the relationships between groundwater and surface water in creeks other than Horse Creek.

5. The IESC notes that the proponent is required to collect additional water quality data, monitor for suspended solids and turbidity, and conduct visual observations of visible slicks and sheens for the presence of hydrocarbons as per the Water Monitoring and Management Plan for the existing project

(PD, Water Resources Assessment, App. A). The proponent has not provided these data, nor is there sufficiently detailed analysis of these data to support the proponent's claim that there will be no risks or impacts to the surface water resources in the proposed project area.

6. To assess the impacts and risks to the surface water resources in the project area, the IESC suggests that the proponent provides a detailed assessment of water quality, measured at multiple times during the flowing, flooding and pool phases in Horse Creek and the other tributaries of the Dawson River in the project area, and should consider:

    a. monitoring a broader range of water quality parameters and comparing current water quality to guideline values such as the ANZG 2018 Guidelines for aquatic ecosystem protection for 95% of species to assess the condition of the current water quality in the creeks and the Dawson River;

    b. assessing water and sediment concentrations of potential chemical contaminants, including arsenic, barium, zinc, copper, lead, manganese, mercury and hydrocarbons;

    c. monitoring the surface water during both dry (including in remnant pools that may be crucial habitats or refuges for some aquatic biota) and wet seasons, while also monitoring water quality (see paragraph 22);

    d. drawing on times-series data, for example, from Water Observations from Space (WOfS) (http://www.ga.gov.au/scientific-topics/earth-obs/case-studies/water-observations-from-space) to more accurately determine the presence of water in the watercourses over time;

    e. developing a comprehensive risk assessment of potential impacts on in-stream, riparian and associated GDEs downstream of the proposed project. This risk assessment should include an ecohydrological conceptual model illustrating potential pathways and mechanisms of effects of alterations in surface flows, groundwater exchanges and in-stream water quality. This conceptual model would help the proponent to justify strategies proposed to manage and mitigate potential impacts; and,

    f. undertaking flood modelling to determine the risks of unplanned releases from water-gathering systems and storage ponds including interactions with CSG well heads, exposed trunklines and other associated infrastructure. Images from WOfS may add value in calibrating this modelling (e.g. Mueller et al. 2016).

Co-produced water quality

7. The proponent has indicated that there will be no releases of flowback or co-produced water into local surface water systems. However, treated and untreated ("to a suitable water quality") co-produced water may be used for project activities such as dust suppression, washdown facilities and emergency services. The proponent has only provided "typical" water quality data at the producing wells (Walloon Coal Measures groundwater) and not the range of volumes and concentrations for each parameter from their sampling. These data should be provided to confirm that the quality of the untreated and treated water will not degrade the environmental values of water resources near the location of these activities, especially in the long term. Further details on monitoring for water quality to ensure co-produced water does not pose a risk to the downstream environment are provided in response to Question 2.

Salt and brine management

8. The IESC remains concerned about the legacy issues of brine management and salt storages, because as such long-term storage does constitute a residual risk, particularly from leaks and seepages. Large-scale CSG extraction has been occurring in the region surrounding the project area

for approximately five years but a strategy for brine and salt disposal has not yet been determined. Without a long-term plan for permanent disposal, this remains an unmitigated risk. The IESC considers that if the plan is for long-term storage, a strategy should be developed and implemented now to prevent long-term legacy impacts. The long-term storage facilities should be adequately designed in terms of liners or compacted beds, and appropriate cover design and monitoring. Brine may also include other contaminants, such as metals, hydrocarbons and radionuclides, particularly if filtration plant solids are disposed of in the brine ponds.

Ecology

9. The IESC notes that the GDE Atlas (Commonwealth of Australia, 2018) and the Queensland WetlandInfo (State of Queensland, 2018) online resources both show the presence of wetlands and other potential GDEs within and near the proposed project area, including downstream along the Dawson River where creeks enter into it.

10. The modelled drawdown in the Horse Creek alluvium exceeds 20 m in the north of the model after 40 years and is predicted by the proponent to desaturate the alluvial aquifer (PD, Attachment M, Water Resources Assessment, p. 99). The IESC considers this is likely to result in profound impacts to the ecology of the creek, its riparian zone and subsurface biota. This groundwater drawdown and alluvial desaturation are very likely to sever subsurface (hyporheic) flowpaths below Horse Creek and cause localised extinctions of alluvial stygofauna that have been collected at this site (PD, Surface Water Assessment, App. O). It is also likely to lead to the loss of deep-rooted groundwater-dependent vegetation such as riparian trees that access this water when the creek is dry. The loss of riparian vegetation will permanently affect fauna that use this vegetation as a corridor for movement and as a refuge during drought conditions. There will also be a loss of shade to the stream while flowing, or isolated pools during no-flow periods, accelerating evaporation and heating the water to levels that may exceed the tolerances of some native aquatic biota. Additionally, the loss of saturated alluvium will lead to a reduction in stream flow volume in transiently gaining sections of the creek, decreasing the duration of periods of flow and persistence of pools, further reducing the availability and quality of aquatic habitat.

11. Similar impacts associated with groundwater drawdown and desaturation of the alluvium appear likely for sections of other creeks in the project area such as Canal, Eurombah and Juandah Creek. These changes in flow regime, saturated alluvial habitat and riparian groundwater-dependent vegetation will further fragment the remaining patches of native vegetation across the landscape, potentially reducing habitat for biota, including some threatened species such as koalas (*Phascolarctos cinereus*), that are listed under the EPBC Act as vulnerable in this region. If this impact cannot be effectively avoided or mitigated, the proponent should account for this impact in their assessment of required offsets for water resources and EPBC Act-listed migratory and threatened species and communities.

12. Areas of riverine and palustrine wetlands (and wetland management areas (Figure 4.7 p. 64, PD MNES) occur along the major watercourses in the project area, including Horse, Canal, Eurombah and Juandah Creeks and their tributaries. Two of these wetlands are listed as HES but the proponent does not present detailed ecological data on seasonal variation in their aquatic biota and water quality (discussed below in paragraph 14).

13. The proponent concludes, for example, that one of the wetlands (Perretts Road Wetland) is unlikely to be groundwater-fed, although its fringing vegetation may depend on groundwater. However, the proponent has not provided enough data to support this conclusion. Satellite imagery, from Water Observations from Space (WOfS) (http://www.ga.gov.au/scientific-topics/earth-obs/case-studies/water-observations-from-space) can be used to determine, over time. the presence of water in the wetland. Fringing vegetation implies that potential groundwater drawdown from the project will adversely affect the ecology of the wetland, in turn potentially affecting listed migratory and other

species that rely on it for habitat and food. Without sufficient information to the contrary, the IESC considers the Perretts Road Wetland is potentially a GDE, typical of a semi-arid/arid zone wetland as being shallow and dry during the dry season but contains water during the wet season despite no rainfall, runoff or overland flow. These temporal changes in the water level may be the result of different rates of evapotranspiration in the fringing vegetation during the wet and dry seasons. The proponent needs to gather sufficient ecological data (including measurements of groundwater-dependence of dominant vegetation) to assess the potential risks and impacts of groundwater drawdown on this and the other wetlands and wetland management areas illustrated in Figure 4.7 (including those downstream and where groundwater drawdown is predicted).

Chemicals

14. To assess the interactive effects of mixtures of chemicals, direct toxicity assessments (DTA) can be used. The proponent has provided a joint industry report on the ecotoxicity of CSG hydraulic fracturing fluids (2018), which included testing of formation waters, source waters, hydraulic stimulation fluids and flowback waters from the Surat and Bowen Basins using acute and chronic freshwater toxicity tests. However, the fluids, waters and locations tested were not identified in the report, limiting its usefulness to assess the risk of the proposed CSG expansion. To derive ecotoxicity trigger values (i.e. dilutions of these waters that would protect 95% of aquatic species if there was an environmental release) acute data have been converted to chronic data using experimentally-derived acute-to-chronic ratios ranging from 0.3 to 432 (PD, Attachment G, Joint Industry Report, Appendix F). This confounds comparison of the toxicity of the flowback waters compared to source or formation waters, and how this changes over time. Conclusions about the relative toxicity of each fluid or water did not take into account the large confidence limits around the trigger values, so this report should be peer reviewed and revised.

15. The proponent has stated that the target coal seams are anticipated to have sufficiently high permeability to allow the flow of gas without any need for well stimulation. Although the proponent does not plan routine hydraulic stimulation as part of the project, it is stated that stimulation may be undertaken to enhance gas extraction (PD, Water Resource Assessment, p. 18). Additionally, chemicals will be used in the inhibited brine and as anti-caking agents as part of well construction and as flocculants to remove sediment during well production. Of these 17 additional chemicals, 15 have not been previously assessed as part of the drilling and hydraulic fracturing chemicals risk assessments.

16. The risk of these additional chemicals has been assessed using the methods previously used to assess drilling and hydraulic fracturing chemicals (Golder, 2014 and PD, App. F). However, the human and environmental risk assessment contains several ambiguities.

    a) How were human health hazard bands defined and assigned? The rating scale (between 0 and 4) is not defined but may be based on the Inventory Multi-Tiered Assessment and Prioritisation approach. However, this is different from the A-D rankings used in the National Industrial Chemicals Notification and Assessment Scheme risk assessment.

    b) How were toxicity scores in the Persistence, Bioaccumulation and Toxicity (PBT) assessment determined as half scores (e.g. 1.5) when the method documented for scoring toxicity in Golder (2014) only gives three rankings: 1 (low), 2 (moderate) and 3 (high)? While a hazard index is defined, the derivation of this for each chemical and the scores are not provided.

    c) How have the five inhibited brine proprietary chemicals been assessed? As these have not been identified, this lack of transparency severely hampers the ability of regulators and the community to assess their risk.

17. To enable a robust evaluation of environmental risks posed by these inhibited brine, anti-caking and flocculant chemicals, the proponent should provide a chemical risk assessment for each chemical listed in the PD that:

    a) states the identity and expected concentrations of each chemical;

    b) states risk quotients for individual chemicals and hazard indices for mixtures;

    c) is transparent about the approach used to calculate human health and environmental risk; and,

    d) outlines an approach that will be followed to assess toxicity where direct toxicity assessment (DTA) data are not available.

Question 2: Does the Committee consider the proposed monitoring, mitigation and management measures are adequate to monitor, mitigate and manage impacts on water resources? If not, what additional measures does the Committee consider are required to monitor, mitigate and manage impacts on water resources?

Groundwater

As detailed previously (See paragraphs 1-3), the limitations in the groundwater modelling constrains the ability of the IESC to provide advice to this question.

18. The key potential impact from the proposed project to water resources is groundwater drawdown. The predicted footprints of groundwater drawdown are substantial, noting the lack of coincidence between the drawdown contours and the area of the proposed project, with the maximum extent of drawdown of more than two metres extending tens of kilometres beyond the project area in the Springbok Sandstone (year 2110) and Upper Hutton Sandstone (year 3000). Apart from the impact on these two aquifers, the drawdown is likely to lead to desaturation of the alluvial aquifer which supports GDEs such as stygofauna and terrestrial vegetation along creek lines (PD, Water Resources Assessment) as well as impacting flows in several creeks (see response to Question 1). No effective mitigation measures are proposed for this spatially extensive and prolonged groundwater drawdown. Given the depth and extent of drawdown predicted in the alluvium, and the likely impacts on stygofauna, aquatic biota and groundwater-dependent vegetation described in response to Question 1, the IESC considers that there are likely to be material risks to water resources such as Horse Creek and its riparian vegetation. Similar risks and impacts are likely for other watercourses in the project area, especially those with transient reliance on alluvial groundwater.

19. The proponent has an extensive monitoring network of 24 bores along Horse Creek. The IESC considers that this is appropriate for detecting changes in groundwater levels associated with drawdown and recharge along this creek and for refining the Jacobs groundwater model. The proponent should detail the anticipated frequency of future monitoring (PD, Water Resource Assessment, p. 83 states the frequency of monitoring will decrease over time) and the parameters that will be measured to refine the model and to test predicted levels of drawdown as the proposed CSG wells progressively come into production. Water level data should be collected continuously with pressure transducers.

20. As discussed in response to Question 1, the IESC considers that drawdown in the alluvium associated with transiently gaining sections of Canal, Eurombah and Juandah Creeks are likely to affect the stygofauna, aquatic biota and groundwater-dependent vegetation in a similar way to that predicted in Horse Creek. As detailed in paragraph 3g, the proponent should install a series of monitoring bores in these other creeks to provide information on groundwater levels, quality and hydraulic properties to support the establishment of baseline conditions before the proposed project occurs. This should include pump tests to derive hydraulic conductivity data suitable to support the

development of a numerical groundwater model (or expansion of the Jacobs model) to evaluate likely drawdown in the alluvium and to guide strategies for avoidance or mitigation of potential impacts.

Surface water

21. The IESC notes the documentation provided by the proponent relies partly on studies assessing the impacts to water resources used for the approved project (EPBC 2013/7047). On this basis, the proponent asserts that a significant impact on surface water resources is unlikely because similar impacts have already been assessed in existing monitoring and management plans for the initial 400 CSG wells and already approved. However, the IESC does not consider that any compelling evidence has been provided to support this assertion. This is in part because the differentiation between existing and proposed projects is not clear making it difficult to assess impacts of the proposed project in isolation.

22. The IESC notes that some surface water quality data is tabulated in PD App. H. However, the data are not compared to guidelines nor is comment made on background concentrations that may exceed guidelines. In addition, there is poor clarity in use of units (assumed to be mg/L) and whether all data are dissolved or total metals in all tables. The proponent has concentrated primarily on the surface water assessment for Horse Creek and provided information dated from 2012 and 2014. Given the proposed project is an intensification of a current development, the proponent's surface water assessment should be supported by the recently collected data, as outlined in the Water Resource Assessment (Attachment A, p. 77). Data need to be presented for Horse Creek and the other tributaries in the project area including Dawson River, Canal Creek, Eurombah Creek and Juandah Creek, and should also be matched with flow data collected during and preceding water quality sampling.

23. The proponent acknowledges that increased erosion and surface water flow disturbance may result from ground clearance, physical obstructions and increased run-off due to ground compaction, and that this flow disturbance and altered water quality could impact vegetation communities and fauna, particularly EPBC Act-listed migratory species around natural wetlands (PD, MNES, p. 73). The proponent should include a sediment and erosion monitoring and management plan in the Water Management Plan for the infrastructure construction associated with the project including river crossings, well pads, trunklines and pipelines which will result in areas of surface disturbance that will be prone to erosion. Such plans should be supported by modelling of the relevant flood regime and include extreme events. Erosion is discussed further in response to Question 3.

Co-produced water

24. As outlined by the proponent, co-produced water will be treated using the existing approved Woleebee Creek Water Treatment Plant (WTP) facilities located near Woleebee Creek. The IESC notes that treated water will be managed under the existing Glebe Weir Beneficial Use Agreement and any volumes generated under this project are already included in the EPBC 2013/7047 approval (PD, Water Resource Assessment, p. 25). However, specific details of the exact location of the approved Woleebee Creek facilities, how the co-produced water will be transported to the Woleebee creek facilities, the approved existing storage ponds, and the design and details of the trunklines and crossings to connect to the existing infrastructure have not been provided by the proponent in the documentation. To determine the efficacy of the existing facilities in managing and mitigating the potential impacts of the proposed larger project, the IESC considers the following further information is required:

    a. plans or maps showing the location of the WTP and storage ponds in relation to the new project area;

    b. the capacity of the existing storage ponds;

c. the design and construction of trunklines;

d. the locations where the trunklines will intercept watercourse crossings and works on the floodplain; and,

e. the inclusion of appropriate soil erosion and drainage/watercourse management plans.

25. The IESC considers a quantitative water balance is essential (IESC 2018). The proponent has not provided a quantitative water balance including the additional co-produced water from the additional CSG wells for the proposed project. Although the proponent has outlined that the WTP has an authorised capacity of 100 ML/d and has sufficient capacity to treat the water produced from the project area and accommodate the water produced from the additional proposed wells (PD, Water Resource Assessment, p.15), a quantitative water balance should be provided covering current and proposed activities. This should include:

    a. quantitative data supporting the water balance to allow an independent assessment of the methods, data and veracity of the model results;

    b. water balance predictions for the duration of water production for the existing and proposed project, which take into account a range of climate and weather scenarios;

    c. assurance that the proponent is the only user of the facilities and, if not, provide reassurance the WTP will be able to treat the co-produced water if the facility is used by other companies;

    d. details on the water volumes being treated for the new project area, including the water quality data of the untreated water and treated water after reverse osmosis;

    e. analyses of the potential volumes of salt and brine produced by the proposed project;

    f. an assessment of the model's sensitivity to parameter changes; and,

    g. details on storage pond capacity.

26. The proponent has provided insufficient water quality data (apart from typical concentrations for well heads from Walloon Coal Measures groundwater) to allow the IESC to determine the appropriateness of the proposed water quality monitoring, management and mitigation measures. It would be expected that any analysis of management of co-produced water would be supported by detailed water balance modelling. However, the documentation provided does not indicate that any such modelling has been undertaken. Residual risks could be managed by monitoring and the use of a Trigger Action Response Program.

Ecology

27. The IESC considers that additional surveys are needed to validate the proponent's predictions that the project presents a low risk to GDEs. This is particularly true for terrestrial GDEs and associated wetland management areas (see paragraphs 9-13), many of which currently lack monitoring programs capable of detecting alterations in groundwater levels and water quality, fluctuations in biota (including EPBC Act-listed species and components of endangered ecological communities) and changes to water regimes in surface and alluvial systems.

28. The Aquatic Ecology Assessment from May 2012 (PD, Attachment D), the Terrestrial Ecology Assessment from 2014 (PD, Attachment A) and several more recent desktop surveys (PD, Attachment C) of the project area are not sufficient to support the proponent's predictions of limited to no impacts to EPBC Act-listed species and threatened ecological communities. The limited field surveys that have been conducted are once-off sampling events that date back to either 2012 and 2014, and do not capture the temporal variations in species distribution and community composition

likely in this region. More recent on-ground surveys need to be conducted by the proponent across the whole project area, encompassing both dry and wet seasons, to provide a reliable baseline against which to test predictions about ecological responses to the likely impacts of the proposed expansion. These data, together with refined conceptual models of long-term responses downstream and across the zone of maximum groundwater drawdown, would support development of appropriate management measures to avoid or reduce impacts to surface waters, GDEs and associated biota, some of which are likely to be threatened species or communities.

Question 3: Does the Committee consider there is adequate consideration of the proposed action's contribution to cumulative impacts associated with other mining activities and coal seam gas production in the area? If not, what additional work does the Committee consider is required to adequately consider the proposed action's contribution to cumulative impacts?

Groundwater and springs

29. In the Surat CMA, impacts on EPBC Act-listed springs are managed under the Joint Industry Plan for Springs Monitoring and Management (JIP) and the Queensland Government Spring Impact Management System. The proponent concludes, based on the OGIA model, that the proposed project will not have a cumulative impact on groundwater drawdown of more than 0.2 m on any EPBC Act-listed springs for which they have been assigned responsibility under the JIP. The Dawson 8 spring complex is the only listed spring likely to be impacted and for which the proponent has been assigned responsibility for monitoring and management but the OGIA model predicts an impact of less than 0.2 m. The IESC applauds the collaborative approach among operators in the Surat CMA in developing the JIP but is concerned that the proposed project has the potential to contribute to cumulative impacts to Scotts Creek spring approximately 15 km west of the project area. The proponent has not described the project's potential contribution to the predicted cumulative impact to this spring, nor on spring-fed watercourses that contribute to flow in the Dawson River downstream (see paragraph 30).

30. The IESC notes the OGIA model is subject to periodic updates, which result in refinement to impact predictions. The current version of the OGIA model does not include uncertainty analysis. Although the sources of the springs are attributed in the existing UWIR (though this requires further confirmation for a number of springs), it is still not clear whether the regional model is able to evaluate the potential impacts on springs in this circumstance. Further information on the source and volume of spring flows, including an assessment using environmental tracers and other suitable field methods to identify flow sources across multiple strata, could provide further information for the assessment of cumulative groundwater impacts. The use of isotope hydrology is recommended. This is now an established and relatively low cost technique that can be used to estimate the relative contributions of groundwater and surface water to a waterbody.

31. The proponent has also not clearly explained how impacts would be avoided or mitigated should monitoring or future predictions show greater impacts to listed springs.

Surface water

32. The proposed project will contribute, along with impacts from other resource projects and existing land-uses, to downstream sedimentation, altered flow and sediment regimes and reduced alluvial and surface stream flow (see response to Question 2, paragraph 23). The Dawson River is described as 'essentially perennial' (PD, Water Resource Assessment, p. 31), and Santos (2012) reports that groundwater discharges from seeps along the stream bed and springs provide perennial flow in the Dawson River downstream of Dawson's Bend. Although Eurombah, Horse and Juandah Creeks are major tributaries of the Dawson River and flow through the project area, the proponent has not provided an assessment of potential cumulative impacts to the downstream environment, including any reduction in their flow arising from groundwater drawdown. The proponent's study of surface

water-groundwater interaction, limited to Horse Creek, found evidence for interactions which implied that groundwater drawdown will reduce flows.

33. The proponent should use existing hydrological data to describe baseline flow conditions and model baseline sediment regimes in the Dawson River downstream of the creeks flowing over the area of predicted cumulative groundwater drawdown, including from the project. From this baseline, they should then quantify the contribution of the proposed expansion's impacts on sedimentation and flow regimes in the Dawson River, especially any reduction in stream flow duration and base flow volume. Groundwater models may also be useful to predict changes to subsurface flows in the alluvial aquifer.

34. The infrastructure associated with the project, including river crossings, will result in large areas of surface disturbance being prone to erosion. This impact will be cumulative with that from two potential open cut coal mines within the project area, other resource projects in the region and with existing agricultural disturbance.

Ecology

35. The proponent should provide an assessment of the risk of cumulative impacts reducing flows to the Dawson River on in-stream and riparian ecosystems, especially where these may be supporting aquatic biota (e.g. native fish, turtles) as well as providing water and habitat for EPBC-listed species. This assessment should be based on the sedimentation and flow investigations described in paragraph 32.

36. The IESC notes that treated and untreated co-produced water of suitable quality may be used for project activities such as dust suppression and will therefore contribute to existing changes in soil and surface water quality chemistry caused by CSG operations onsite and in the surrounding regional area. The proponent should demonstrate that the quality of this water will not degrade the environmental values of nearby water resources or groundwater-dependent terrestrial vegetation.

Date of advice	07 February 2019
Source documentation provided to the IESC for the formulation of this advice	Surat Basin Acreage Development Project – Water Resource Assessment (and attachments) 2018. QGC. MNES Impact Assessment Report (and attachments) (2018). Surat Basin Acreage Development EPBC 2018/8276 Preliminary Documentation.
References cited within the IESC's advice	ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments, Canberra ACT, Australia. Available [online]: www.waterquality.gov.au/anz-guidelines accessed January 2019 Commonwealth of Australia, Bureau of Meteorology 2018. *Groundwater dependent ecosystem atlas*. Available [online]: http://www.bom.gov.au/water/groundwater/gde/map.shtml accessed January 2019 IESC 2014-042: Development of new natural gas acreage in Surat Basin, Queensland (The Surat North Development) (EPBC 2013/7047) – New Development IESC, 2018. *Information Guidelines for proponents preparing coal seam gas and large coal mining development proposals*. Available [online]: http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-may-2018.pdf accessed January 2019 Middlemis H and Peeters LJM (2018) *Uncertainty analysis—Guidance for groundwater modelling within a risk management framework*. A report prepared for the

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