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Attn: Tristan Roberts

5 December 2018

Dear Tristan,

Information Request Response – Amendment of Environmental Authority EPPG00700113 (Surat Basin Acreage Development)

In response to the Request for Information received from the Department of Environment and Science on 31 October 2018, we provide the following information:

- ATTACHMENT 1: Responses to information requested;
- ATTACHMENT 2: Overview of how QGC implements the Protocol; and
- ATTACHMENT 3: Logfile from Landscape Fragmentation and Connectivity (LFC) Tool.

If you have any questions in relation to the above or require further information, please contact Nick Fullerton on (07) 3024 8654 or email Nick.Fullerton2@shell.com.

Yours sincerely

Kelli How
Manager, Access

ATTACHMENT 1 – RESPONSE TO INFORMATION REQUEST

Part A: Groundwater

Given the increase in the intensity of the activity, there is the potential that the activity will impact on the availability of groundwater in the region. QGC has advised that the groundwater impact predictions for aquifers within and around the project area were derived from the Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (SCMA).

QGC advised that the following groundwater modelling was conducted to determine potential groundwater depletion impacts:

- *SCMA model – full cumulative run of all developments included in the 2016 UWIR; and*
- *A project specific run of all 1200 wells (including 460 existing wells and the additional 740 wells).*

QGC stated that a secondary modelling run of the additional 740 wells was not considered necessary as the nature of the CSG development is such that drawdown in the Walloon Coal Measures is spatially restricted to the area around the wells. This was demonstrated by the two previous modelling runs. QGC is confident that the 1,200 well modelling run will be sufficient to predict impacts from the project area.

1. ***How representative is the modelling undertaken of specific impacts likely to be caused by QGC's proposed project. The supporting information indicated that the modelling conducted to date by QGC has been based on the data from the 2016 UWIR which provides a broad overview of the cumulative impact of all coal seam gas activities on Surat Basin CMA. The supplied information also states that further investigations by QGC tend to show that the drawdown in the Walloon Coal measures is restricted to the area around the wells.***

QGC Response

The nature of the natural gas developments is such that the cumulative model (including QGC's proposed project) is a good representation of the specific impacts of all coal seam gas activities in the Surat Basin.

Typically, natural gas related water level declines are spatially restricted to the immediate development area and only propagate a short distance from the wells. This is why a development typically requires relatively close well spacing. Therefore, the cumulative model adequately simulates the impact of this development within and around the extent of the drilled wells.

For example, within the middle of the development area, the cumulative model predicts a maximum drawdown in the Walloon Coal Measures of 120 m; the 1,200 well only model simulates the same drawdown. The specific impacts of QGC's proposed project (i.e. an additional 740 production wells) is, therefore, predicted to be similar within the development area, and the 1,200 well model provides a conservative assessment of potential impact.

2. ***What impact will this have on any other adjacent activities that may also be taking water from these water tables?***

QGC Response

Other adjacent activities that may also be taking water are primarily water supply bores for landholders in the local area. As the additional wells set out in this application were included in the 2016 UWIR, all bores likely to be impacted have already been identified.

In total, 23 bores were predicted to experience a water level drop greater than 5 m. In accordance with the *Water Act 2000*, Bore Assessments have been completed and Make Good negotiations are underway, or have been completed, with all affected landholders. Any additional Make Good bores will be identified in the 2019 UWIR (draft due Q3 2019) and Make Good negotiations will commence from this point.

The majority of affected bores are within the Walloon Coal Measures and both modelling and monitoring data collected by QGC does not indicate any potential impacts on water users in underlying and overlying aquifers at this time.

3. ***Has a more accurate indication of any impacts such as drawdown from QGC's activities been developed that may better inform the selection of bore locations? If this is the case, please provide further information as to how the model was changed to reflect these changes.***

QGC Response

The OGIA model is part of an iterative process. It undergoes a major update and recalibration every three years, informed by the research activities undertaken by OGIA and the ongoing monitoring data provided by QGC and the broader industry. The next update of the model is due to be released for comment in Q3 2019.

Changes in the model since 2016 include:

- a revised geological interpretation;
- updated development plans and timing;
- incorporation of additional hydraulic testing;
- small scale sector models to examine specific areas;
- enhanced structural analysis; and
- the incorporation of an uncertainty analysis.

4. ***Confirm that the modelling conducted in the initial stages of the project is still relevant to the current application. Has field monitoring conducted during the operation of the established wells detected any discrepancies in the model that would require the model to be recalibrated and re-run? Demonstrate how any such changes have been incorporated into the model.***

QGC Response

The model is still relevant for the prediction of impacts resulting from the additional wells proposed as part of this application. The 2019 update is unlikely to significantly change the results of existing predictions. However, there is an adaptive process to manage any changes to the impact prediction through the UWIR process.

To date, field monitoring has not detected any discrepancies in the model beyond the normal reconstruction and calibration necessitated by another three years of data and additional research since 2016.

5. ***Alternatively has field monitoring validated the accuracy of the modelling conducted?***

QGC Response

Field monitoring generally confirms the model predictions.

For example, field monitoring has previously been used to validate:

- drawdown in the Walloon Coal Measures;
- limited spatial propagation of that drawdown due to restricted connectivity of the coal seams; and
- no general impact propagation to underlying and overlying aquifers, except for specific locations where there is a geological connection.

Part B: Production Waters

The application states that increased volumes of production water will be directed to the Woleebee Creek Water Treatment Plant (WTP), with the treated waters being directed to Glebe Weir Beneficial Use Scheme and the resulting brine directed to the existing onsite brine ponds at the WTP. No discharges to land or waters are proposed as part of the current amendment application. No additional production water storage dams are required to be constructed.

1. ***Confirm that no changes are proposed to any existing production water storage dams that may affect their status as a regulated structure. Has the additional volume of production waters affected the risk category of any regulated structure as described by the department's 'Manual for assessing consequence categories and hydraulic performance of structures' (Ref ESR/2016/1933)? Will the additional volume of production water require any dams that currently do not meet the requirements to be considered a regulated structure to be re-assessed?***

QGC Response

No changes are proposed to any existing production water storage dams that will affect their status as a regulated structure. All existing water storage dams have been constructed in accordance with existing conditions contained in Schedule D of the Environmental Authority (EA) EPPG00700113.

Further, in accordance with Condition D6 of the EA, QGC has previously submitted a consequence category assessment report and certification to the Department for each of the existing regulated water storage structures.

Volumes of produced water, resulting from the development of additional wells sought in this amendment application, will not:

- affect the existing risk/consequence category currently applied to any existing regulated structure in accordance with the Department's 'Manual for assessing consequence categories and hydraulic performance of structures'; or
- require the re-assessment of any existing non-regulated structures.

As stated above, this EA amendment does not seek to authorise the development of additional water storages beyond those already included in the authorised activity table. QGC confirms that the volume of water to be produced from wells the subject of this EA amendment application can be safely and sufficiently contained within existing approved water storage structures and appropriately managed in accordance with existing EA conditions and standard operating procedures currently in place.

2. ***For any non-regulated structures, confirm that there is sufficient capacity available in the existing production water storage dams to not only handle the increased volume of production waters expected to be generated by the expansion of the existing project but to also contain any reasonably foreseeable climatic conditions?***

QGC Response

All existing production water storage dams have been designed and constructed in accordance with both the Department's 'Manual for assessing consequence categories and hydraulic performance of structures' and all applicable conditions within the EA EPPG00700113.

As previously noted, the authorisation of existing water storage structures is not the subject of this EA amendment application. Nevertheless, QGC confirms that all water storage dams and associated water management infrastructure designed as part of QGC's northern water network was over-sized to ensure that once constructed, it could accommodate all potential volumes and peak flows anticipated to be produced by the additional wells from within the Project area.

Additionally, in accordance with the Department's manual, hydraulic and hydrological analysis carried out as part of the detailed design of QGC's water storage structures within the Project area modelled an Extreme Storm Storage (ESS) allowance for a 1:10 Annual Exceedance Probability (AEP) 72-hour duration storm. This resulted in the adoption of a 0.3 m freeboard, as well as an additional water storage margin of 15% Maximum Operating Level (MOL) from pond size optimisation.

Furthermore, QGC's current and forecasted water production rates for the additional wells to be drilled within the Surat Basin Acreage Development area are significantly lower than previously anticipated. Please refer to the response provided to Item 6 below for further information.

3. ***Provide further information regarding the maximum rainfall events any production water storage dams associated with this project are designed to contain.***

QGC Response

The hydraulic and hydrological analysis completed for the design of QGC's water storage structures has been carried out in accordance with the Department's 'Manual for assessing consequence categories and hydraulic performance of structures'. The manual was followed to develop consequence categories and performance criteria for all production water storage dams associated with the Project.

These dams have been assessed as being regulated structures with an overall consequence category of "Significant". However, the dams were assessed in the "Low" consequence category for the 'failure to contain – overtopping' scenario. As a result, the determinations for Design Storage Allowance (DSA), ESS and Mandatory Reporting Level (MRL) were not required for their design.

However, in the interest of best practice and minimising risk, and as previously noted above, a freeboard from MOL to the spillway invert to the equivalent of ESS allowance of 0.3 m has been adopted. The ESS

has been estimated as the wave allowance for a 1:10 AEP 72-hour duration storm using a recognised engineering method as stipulated by DEHP 2013 for dams assessed as "Significant" consequence.

In addition to the 0.3 m freeboard, the dams have an additional water storage margin of 15% MOL from pond size optimisation.

For clarity, QGC confirms that the production water storage dams are approved and operational structures; and as such, are not the subject of this application.

4. ***Provide further information regarding the management of the production water storage dams. What contingency measures are in place in the event of a release? What measures are in place to monitor the depth of waters within these dams to ensure that the risk of overtopping is minimised or avoided? Will the increased volume of waters directed to these dams require an increase in the frequency of monitoring or inspections?***

QGC Response

QGC has prepared and implemented an Individual Ponds Operation Plan (IPOP) which provides an overview of the physical attributes and operational parameters of its regulated water storage ponds. It also provides:

- normal operating procedures and rules (including clear documentation and definition of process inputs in the DSA);
- contingency and emergency action plans including operating procedures designed to avoid and/or minimise environmental impacts including threats to human life resulting from any overtopping or loss of structural integrity of the regulated structure; and
- directions and instructions in pond operation, monitoring and maintenance procedures.

In addition, the IPOP has been structured to include pond-specific appendices which provide further detailed information including key operational attributes, locality and access requirements, design and operational criteria, relevant leak detection monitoring requirements and localized sensitive receptor details (in the event emergency response procedures are required to commence as a result of an unauthorised discharge).

QGC conducts regular monitoring of water storage structures to manage the volume, collate operational data and to monitor the physical condition of the pond and associated infrastructure to ensure that the ponds operate as per design.

The IPOP details monitoring frequencies currently applied to ponds. These include:

- Following all unexpected and/or unusual events – e.g. high rainfall event, etc.
- Monitoring – autonomous, continuous and live level monitoring occurs locally for all regulated ponds.
- Monthly inspections – to check pond integrity and for any potential high-risk issues requiring further investigation.

- Quarterly inspections – a detailed assessment of the pond condition and all associated infrastructure. Information collected is used to schedule regular maintenance and repairs.
- Annual inspections – in accordance with EA conditions, all regulated ponds require annual inspection by a suitably qualified and experienced person. These inspections are detailed in nature and, among other things, specifically monitor and assess adequacy of available storage, review of pump sump flow rates and seepage monitoring data.

The increased volumes of waters directed to QGC's existing water storage structures will not have any significant effect on the operation, consequence category, regulatory classification or management regime applied to them, as the additional water will simply be transferred through the system to the Woleebee Creek Water Treatment Plant (WTP). All ponds have a series of safety-engineered capacity parameters applied to them; and the network features a series of automated level detection sensors and pumps which operate in unison to maintain total system reliability.

QGC's entire northern water network has been sized to ensure that once constructed, it has sufficient capacity and integrity to accommodate all potential volumes and peak flows forecast to be produced by the additional wells within the Project area. As such, the increased volumes of water will not require an increase in the frequency of monitoring or inspections beyond those already implemented by the IPOP.

5. ***Confirm the annual quantities of brine expected to be generated by the entire activity (existing and proposed). Confirm that sufficient capacity exists in the Woleebee Creek brine dams to contain this additional volume of brine from the proposed project, as well as being able to contain any reasonably foreseeable rainfall events. Provide further advice as to how QGC will address the increasing volume of brine generated by this activity over the lifespan of the project. Provide further advice as to how QGC intend to dispose of the brine generated from CSG activities.***

QGC Response

The forecast total brine storage over the life of the entire activity (existing and proposed) is shown in Figure 1 below. It should be noted that this is an approximate volume and is based off a modelled water production forecast (P50), which can vary depending on how the development of the wells are brought online and operated, but is considered a reasonable estimate.

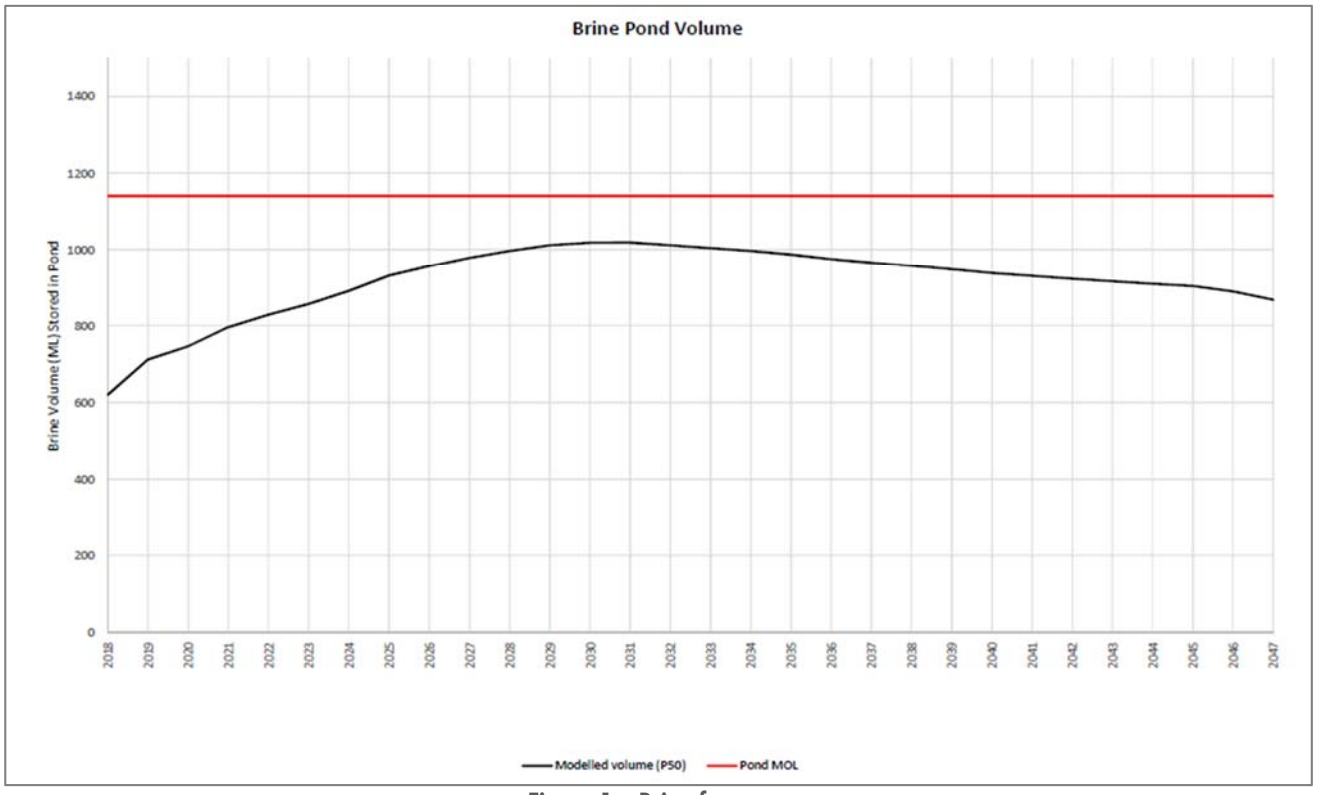


Figure 1 – Brine forecast

QGC runs complex water modelling software to determine expected water flows through the entire water cycle i.e. from Infield Storage Ponds / Regional Storage Ponds, through the Water Treatment Plant and into the treated water outlets (Sunwater Pump Stations) and brine storage ponds. Current modelling indicates that there is sufficient capacity within all existing water infrastructure, including the brine storage pond at Woleebee Creek, for current and proposed flows. A variety of scenarios are run, including average climate data and higher rainfall scenarios. The concentrated brine storage pond, like all regulated water storages, requires provision for high rainfall events.

QGC has studied a number of long-term brine management options. On balance, when all the safety, environmental, community and economic factors are considered, crystallising brine into solid salt form and encapsulating it for long-term storage in purpose-built cells is the most feasible option. QGC, in conjunction with the wider industry, will continue to identify new opportunities, technologies and partnerships with other industries and/or government and these will be examined as they arise.

6. ***Confirm that the increase in volume of material directed to the Woleebee Creek water treatment plant will not exceed the current daily limit of 100ML on the existing EA?***

QGC Response

Confirmed. QGC's current and forecasted water production rates for the additional wells to be drilled within the Surat Basin Acreage area are significantly lower than previously anticipated. As shown in Figure 7-2 of the application, the maximum predicted water production rate from the proposed wells would be

approximately 23 ML/day. Figure 2 below shows QGC's modelled produced water volumes output (both P50 and P10) from wells within the Project area which are processed through the WTP.

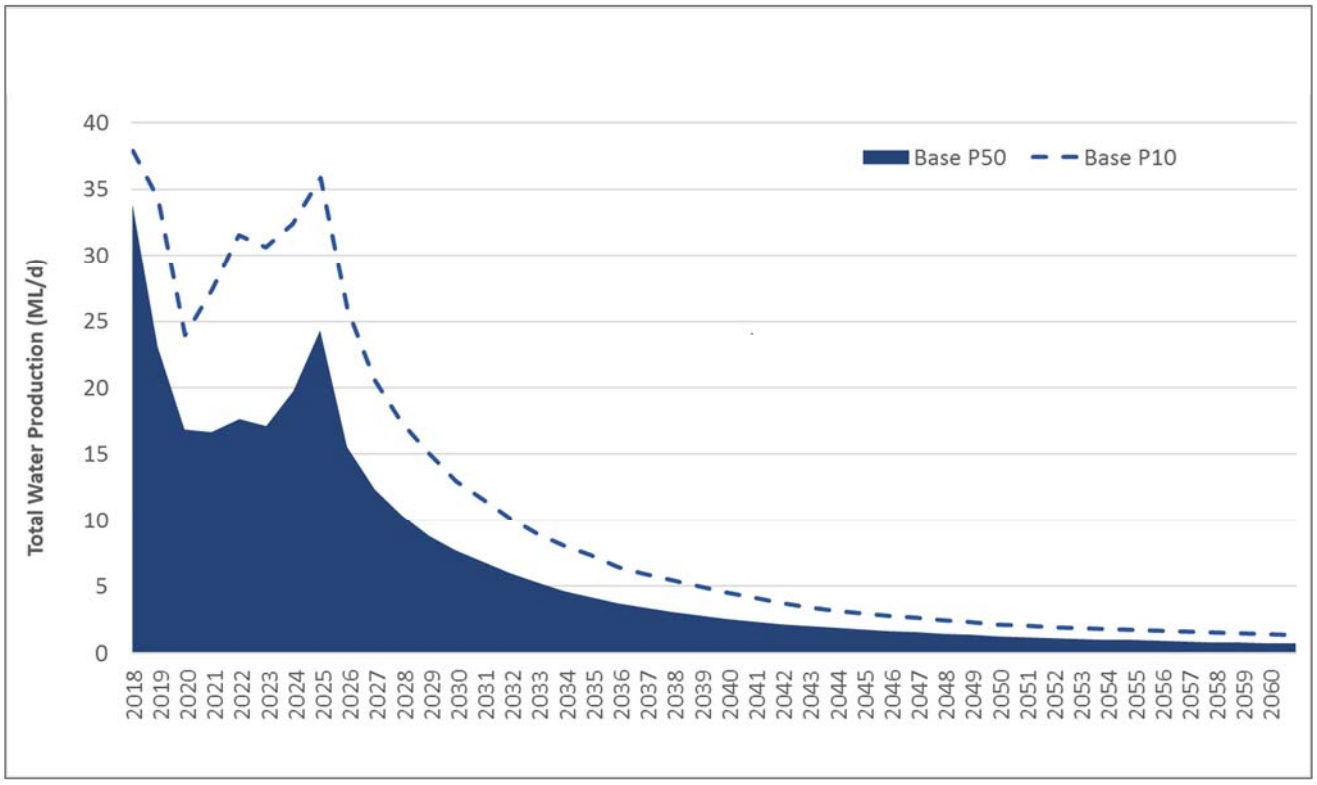


Figure 2 – Produced water volume forecast

The data presented shows a P50 water production volume that remains generally below 20 ML/day, with a gradual decline over the life of the asset. Water production has been significantly less than originally anticipated and is expected to decline (even with the additional wells proposed).

By comparison, QGC's WTP and associated water network has a design capacity of 100 ML/D which is far in excess of current and future requirements.

7. ***Confirm that the increase in volume of material directed to the Woleebee Creek water treatment plant will not affect the ability to comply with all current requirements of the existing EA and the Glebe Weir beneficial use agreement.***

QGC Response

Confirmed. As discussed above in response to item 6, the Woleebee Creek water treatment plant will not be capacity-constrained as a result of the proposed increase in volume of water to be processed. As such, QGC does not anticipate that this amendment application will have any impact on its ability to comply with all current requirements of the existing EA and the Glebe Weir beneficial use agreement given that both those approvals are currently approved to treat and discharge up to 100 ML/day.

Part C: Offsets

QGC have advised that at this moment of time the bore locations are not finalised and are still in the process of being selected. QGC has provided estimations as to the disturbance expected using the Landscape Fragmentation and Connectivity (LFC) tool on the Qld Government website. QGC state that the project infrastructure is not likely to result in a change of core areas to non-core areas. QGC state that it will generally avoid dissecting areas of remnant vegetation, and in area where this unavoidable (creek crossings etc.) that areas are unlikely to become non-core areas. QGC also state that it will be able to avoid significant impact to connectivity.

1. ***Provide further information as to how QGC have incorporated the offset hierarchy into their operational plans. Demonstrate how QGC intend to 'avoid' impacting on MSES in accordance to the offset hierarchy. If avoidance on MSES in not possible, demonstrate how the impact will then be 'mitigated' in accordance with the offset hierarchy.***

QGC Response

Incorporation of hierarchy

QGC's Constraints Planning and Field Development Protocol (the Protocol) was developed specifically to operationalise the mitigation hierarchy of avoid, minimise and mitigate. The Protocol is discussed in section 5.3 of the Supporting Information report submitted with the application, as well as throughout the remainder of this response.

The Protocol assigns a ranking of No Go, Very High, High, Moderate or Low to a range of constraints including, but not limited to, environmental values and MSES. Rankings typically reflect permit conditions as well as the significance of the matter. For example, Category B ESAs including Endangered Regional Ecosystems (MSES) are categorised as a High constraint, meaning that environmental feasibility must be specifically assessed prior to any development. All MSES are covered in the Protocol as they overlap with other matters previously included, such as ESAs, watercourses, remnant vegetation and fauna habitat. Table 6-5 of the Supporting Information report submitted with the application demonstrates the different classifications of matters with regard to ESAs and MSES.

During QGC's conceptual design and early planning process, these rankings are taken into account when proposing infrastructure locations and alignments as the first attempt to avoid impacting areas featuring No Go, Very High and High constraints. Constraints mapping is available to all personnel through QGC's Spatial Mapping Portal.

The mitigation hierarchy is also built in to Shell's business principles and policies (to which QGC, a Shell asset, must conform). Shell has an HSSE and SP Control Framework, which is a set of rules and processes that all Shell businesses must implement as a minimum, regardless of where they operate in the world. The Framework's Biodiversity Manual includes the mitigation hierarchy of avoid, minimise and reinstate.

Processes for avoiding and minimising impacts to MSES

QGC's Upstream Delivery Process (UDP) is a phased approval process requiring stakeholders' signoff at multiple decision gates throughout infrastructure planning and design. All proposed infrastructure locations

require internal review and approval through the UDP and are surveyed by suitably qualified ecologists to validate constraints. Stakeholders may include, but are not limited to QGC's environment, land, cultural heritage, construction and engineering teams, who all must ensure the proposed location and alignment of infrastructure avoids, minimises or mitigates impacts to sensitive matters, is safe, and constructible. This ensures optimal positioning of all infrastructure and avoidance and minimisation of impacts to MSES.

Mitigation measures

Where impacts to MSES are unavoidable, a range of mitigation measures are employed, as outlined in QGC's various approved environmental management plans.

Examples of some of the mitigation measures QGC routinely undertakes includes, but is not limited to:

- Directional clearing, to direct fauna away from clearing activities;
- Staged clearing, to allow fauna to relocate outside of clearing areas;
- Use of fauna spotter-catchers, to locate, remove, relocate and care for fauna;
- Storing and re-use of soil for rehabilitation;
- Rehabilitation of the cleared areas after decommissioning;
- Fire prevention measures;
- Weed control, management and hygiene; and
- Monitoring of trenches and pits for fauna entrapment.

These measures are important for the ongoing management of MSES as they mitigate the impacts of any clearing activities by preventing harm to fauna, spread of weeds and ignitions of fires. They also ensure that environmentally sensitive areas, including MSES, are appropriately rehabilitated.

After all avoidance, minimisation and mitigation measures are implemented, any residual impacts are quantified, and where required, offsets are provided in accordance with the relevant legislation.

2. ***Demonstrate where areas where ecosystems and species that are determined to be of greater environmental value, or at greater risk from disturbance, have been completely excluded from any proposed development.***

QGC Response

The mitigation hierarchy of avoid, minimise, mitigate is inherently built into QGC's Upstream Delivery Process (UDP) through the implementation of the Protocol. All infrastructure must be assessed and approved through the UDP and there are many examples of where infrastructure has avoided areas of ecological value through early identification of constraints and field validation.

Specific examples of how the implementation of the Protocol has resulted in complete avoidance or minimisation of impacts to areas featuring greater environmental values are provided in Attachment 2.

3. ***What information was input into the LFC model to determine the significant residual impacts and impacts on connectivity posed by the project? Did the use of the model incorporate 'worst case scenarios'? How were these 'worst case scenarios' incorporated into the LFC model?***

QGC Response

QGC used indicative layouts for the proposed infrastructure which were loaded into the LFC tool. These layouts have not been through the full UDP process and therefore represent a conservative assessment of potential impacts. Further refinement through the remainder of the process will optimise the positioning of infrastructure to ensure that impacts are minimised. These layouts are being used internally to provide an indication of potential impacts resulting in fragmentation. The log file and significance output from the LFC tool are provided in Attachment 3.

There are two components to the LFC significance test – the percentage of core remnant areas impacted, and the change in areas from core to non-core. To ensure no significant impact on connectivity, the Project endeavours to minimise clearing of core remnant areas and avoid loss of core areas.

In the application, QGC have made the following commitments:

- clearing of remnant core areas will not exceed 119.5 ha; and
- there will be no reduction in the number of remnant core areas.

Through the implementation of both the Protocol and the UDP, achieving this outcome is standard practice for QGC's activities.

Percentage of remnant vegetation cleared

The LFC tool shows that the *regional* extent of core remnant areas is 5,977.86 ha, or 6.62% of the Project area. QGC's application states that only 4% of the Project area supports remnant vegetation. There are two factors behind the difference in these figures:

1. The LFC tool uses the government RE mapping, not the more refined mapping that BAAM developed for QGC; and
2. The tool looks at the regional extent, which includes a 20 km buffer around the Project area.

The change threshold for a significant impact in the region is 2%, or 119.5 ha, of core remnant areas. Therefore, if clearing of remnant core areas exceeds 119.5 ha it is a significant impact. The LFC tool output showed that 215 ha, or 3.6 % of remnant core areas would be cleared and that this was a significant impact.

Despite the output from the tool being above the significance threshold, QGC will implement the mitigation hierarchy to reduce the remnant vegetation cleared. QGC have committed to a maximum impact of 119.5 ha to remnant core areas. This will avoid a significant impact to connectivity and will be tracked using QGC's spatial data. QGC have minimised impacts from a worst-case assumption of 215 ha to a more refined total area of 119.5 ha.

Core to non-core

Core areas are lost when they are fragmented and cleared to the point that the individual polygons are less than 1 ha in size. For example, if an area of 4 ha was cleared and fragmented with only polygons less than 1 ha in size remaining, that would be a loss of a core area, and subsequently, constitute a significant impact.

The indicative layout input to the LFC tool showed no loss of core areas – there were 15 core areas before and after proposed Project impacts.

The mitigation hierarchy QGC implements includes measures to avoid dissecting remnant polygons:

- For smaller polygons, linear infrastructure will generally follow the edge line of vegetation communities to go around the polygon.
- For linear areas (e.g. along drainage lines, etc), gaps in the vegetation are used wherever possible to cross so that impacts resulting from the infrastructure are limited to the greatest extent possible.
- In larger areas, where impacts are unavoidable, the linear infrastructure will avoid completely dissecting the polygon of vegetation.

These impacts will all be planned for, and managed through, QGC's UDP to ensure no reduction in the number of remnant core areas.

4. ***Has any 'overlap' of areas of environmental significance at state and federal levels been identified? Has the 'Valkyrie' site been identified as being a suitable location for all of the types of ecosystems and areas identified as being critical habitat for a species that occur within the project area and will require to be offset? Where ecosystems or critical habitat occur within the project area that cannot be replicated (or analogous to those) within 'Valkyrie', how will QGC offset these matters to ensure a conservation outcome consistent with the Offsets Policy***

QGC Response

Overlap with federal matters

The state and federal areas of environmental significance do overlap within the Project area. Some Matters are protected at both state and federal government levels and/or hold values suitable to support different species protected at either the state or federal level.

For example, a remnant area of regional ecosystem 11.9.5 is both an Environmentally Sensitive Area (ESA) Category B (Endangered Regional Ecosystem) and a MSES (regulated vegetation) under state legislation. The area would also feed into the connectivity MSES, as it is remnant vegetation and, if of a certain size, may be a 'core area'. Federally, there is potential for 11.9.5 to represent Brigalow Threatened Ecological Community (TEC). The area may also be considered suitable habitat for state or federally listed threatened species, depending on habitat values.

Therefore, *one* area, or polygon of vegetation, of one ecosystem type (e.g. 11.9.5), could be classified as four or more different 'Matters' as described in state and federal regulation.

Other examples of overlapping matters include:

- Pale imperial hairstreak butterflies are only listed at the state level; however, they only occur in old growth brigalow ecosystems, which are typically also a Threatened Ecological Community federally.
- Glossy Black Cockatoos are a threatened species at the state level only, however, they feed exclusively on *Casuarina* and *Allocasuarina* tree species. In the Project area, this typically includes Belah (*Casuarina cristata*), a key element of Brigalow TECs listed federally.
- The koala is listed at both state and federal levels of government. They occur in eucalypt-dominated ecosystems which may or may not be listed at either state or federal levels. These areas would be MSES core areas and regulated vegetation at the state level.

Under section 15 of the *Environmental Offset Act (2014),* where substantially the same matter and impact has been assessed federally, offsets are not provided at the state level. This Project is being assessed federally and as such, there is no requirement for offsets at the state level as offsets will be provided in line with federal requirements.

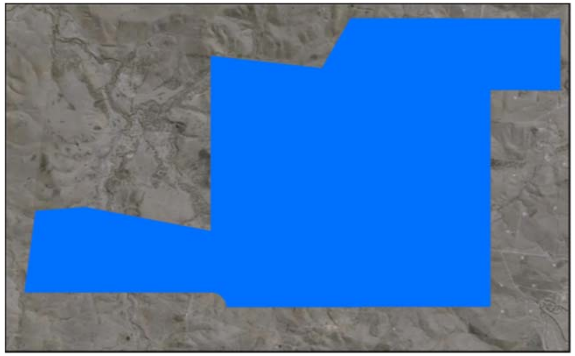
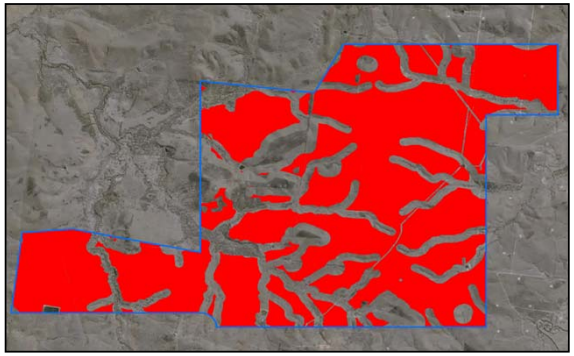
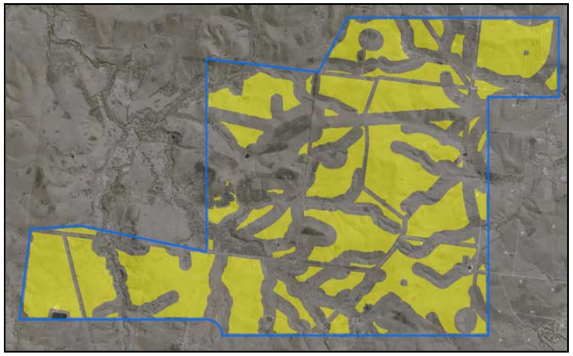
Suitability of Valkyrie

Valkyrie is a large property that supports many areas of environmental significance, including flora, fauna and ecosystems at the state and federal level. It has been identified that the property contains all values required to suitably offset all proposed impacts resulting from this Project.

In the event that "like-for-like" is not available on Valkyrie

Valkyrie does contain the relevant environmental values and areas to provide like-for-like offsets for the proposed Project. Development of the Offset Plan will be undertaken in consultation with the Department of Environment and Energy and will require their approval prior to its implementation. All offsets will comply with the requirements of federal regulations and supporting policy.

ATTACHMENT 2 – IMPLEMENTATION OF THE PROTOCOL

		
• The figure above shows an example property/development phase from within QGC's Project area. • In accordance with the relevant tenure instrument (e.g. a Petroleum Licence issued under the P&G Act) and Landholder Agreement, QGC has access to the entire property to undertake it's activities.	• In accordance with QGC's Constraints Planning and Field Development Protocol, a series of constraints and development rules are applied to the site. • This is an automated process that applies predetermined rankings and/or rules of development to a range of identified constraints. • Examples of constraints at this stage include, but are not limited to, environmental (e.g. MSES), cultural (e.g. heritage finds), landholder (e.g. cropped areas), legislative and/or existing permit (e.g. setbacks from waterways) requirements. • The figure above shows the remaining available areas in red.	• Next, further constraints resulting from existing surface developments are removed. • Once again, this is an automated process. • Examples of constraints identified at this stage include, but are not limited to, existing mine plans, existing aboveground infrastructure, etc. • The figure above shows the remaining areas available for development yellow.

		
• The next step involves the development of a separate layer that identifies existing sub-surface constraints. • This automated process takes into account all existing surrounding development activities (more specifically, their impacts below ground) as well as known geo-physical constraints. • Examples of matters considered by this layer include, but are not limited to, drainage/ depletion of gas reservoirs from existing wells, locations of known sub-surface faulting, and results of strata permeability studies. • The figure above shows this separate layer in blue.	• In the final automated stage, the yellow area is intersected with the blue layer, resulting in the green area shown in the figure above. • This green area represents the available areas in which well development can be considered by QGC once above and below ground constraints are taken into consideration. • Proposed well locations are automatically distributed throughout this final development area using an optimised well spacing algorithm. These are represented by the red dots in the figure above.	• The identification and placement of QGC well infrastructure to this point has been largely automated, and planned at a development phase scale (often involving multiple properties at once). • The subsequent steps in this process are undertaken by specialist QGC personnel and at an individual well scale. • An individual well has been used to demonstrate these final stages in QGC's well placement process.

		
• The proposed well above was automatically located by QGC's well placement tool. • It has been placed outside of all mapped/ modelled above ground constraints (represented by the purple areas in the figure above). • Despite this, the well was placed in a location featuring a small community of scattered vegetation.	• As part of a peer desktop review process, the location of the well was shifted north-east from its original location. • This new position optimised it's relative positioning amongst other surrounding wells (not shown – out of frame) so as not to detrimentally impact on total reservoir depletion and drainage models.	• During field ground-truthing and survey activities, it was identified that if the proposed well location was shifted a further 80 m east, the well pad could be feasibly constructed in an existing cleared area and would not result in any impacts to existing vegetation. • The well was subsequently shifted and developed as shown in the figure above, resulting in impacts to the scattered vegetation to be avoided. • Other previous examples of where QGC has been able to avoid impacting on ecosystems and species of environmental value are provided in the following aerial figures.

		
In the above example, the infrastructure placement was revised to utilise previously cleared land and circumvent vegetation polygons, to avoid dissecting and clearing vegetation. The following MSES were present and completely avoided by the final layout: • Regulated vegetation (Endangered) • Potential wildlife Habitat (Painted Honeyeater – Vulnerable) The area of vegetation was also found to be an unmapped palustrine wetland. Infrastructure was able to be located entirely within previously cleared areas.	The wells, access and gathering constructed by QGC in the above example were strategically located around several large vegetation polygons, utilising cleared land so as to avoid dissecting or and clearing existing vegetation communities. The following MSES were present and completely avoided by the final layout: • Regulated vegetation (Endangered) Other areas of vegetation not constituting an MSES were also avoided and the infrastructure was able to be contained entirely within previously cleared areas.	The above example demonstrates QGC's ability to operate within a highly constrained site featuring numerous environmental values. Impacts to remnant vegetation could not be totally avoided due to its extent, however, areas of highest value were avoided completely by the final layout. The following MSES were present and completely avoided by the final layout • Regulated vegetation (Endangered) • Wildlife Habitat (Pale Imperial Hairstreak Butterfly – Vulnerable) The area was also found to be an MNES – Brigalow TEC. Disturbance to vegetation was limited to Least Concern RE's.

ATTACHMENT 3 – LFC TOOL LOGFILE

Department of Environment and Heritage Protection (DEHP)
Landscape Fragmentation and Connectivity (LFC) Tool version 1.4 LOGFILE
Process started at 13-07-2018 02:47:18 PM
Python version: 2.7.13 (v2.7.13:a06454b1afa1, Dec 17 2016, 20:42:59) [MSC v.1500 32 bit (Intel)]
Arcpy version: 10.5.1
Username: Grazia.Chiavegato

INPUT PARAMETERS
Output Workspace: T:\01_Projects\Temporary\0452822 Bris\5. GIS_Graphics\Data\SHP\Analysis\20180713
Threshold lookup table: T:\01_Projects\Temporary\0452822 Bris\5. GIS_Graphics\Support\Tools\LFC_data.gdb\tbl_Regional_frag_local_threshold
Remnant cover layer: T:\01_Projects\Temporary\0452822 Bris\5. GIS_Graphics\Support\Tools\LFC_data.gdb\QLD_VEG_RVM_100K_v2p0
Remnant cover layer edited: False
Regional buffer extent: 20 kilometres
Local buffer extent: 5 kilometres
Impact layer: Proposed_infrastructure_20180712
layer projection: GCS_GDA_1994
Raster cell resolution for analysis: 10 metres
Edge Width: 50 metres
(The distance from non-remnant landscapes through to the core ecosystem - the edge of remnant ecosystems)
Default projection: T:\01_Projects\Temporary\0452822 Bris\5. GIS_Graphics\Support\Tools\scripts\QLD Albers Equal Area Conic.prj

14:47:18 Checking out the spatial analyst tool - required for LFC

14:47:19 _____BEGINNING LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS_____

14:47:19 This tool will categorise the landscape into:
{0: 'non-rem', 1: 'patch', 2: 'edge', 3: 'perforated', 4: 'core (< 100 hectares)', 5: 'core (100-500 hectares)', 6: 'core (> 500 hectares)', 7: 'water'}

14:47:23 T:\01_Projects\Temporary\0452822 Bris\5. GIS_Graphics\Data\SHP\Analysis\20180713\lyr_file does not exist, creating it now.
14:47:23 Copying across impact site feature(s) and calculating area in hectares (AreaHA)
14:47:25 Making a local copy of the impact site
14:47:28 Preparing remnant cover layer for analysis
14:47:38 Created regional scale buffer of 20 kilometres
14:47:56 Created local scale buffer of 5 kilometres
14:48:08 Clipped the remnant cover to the regional buffer extent
14:48:12 Unioned the pre impact remnant layer with the impact site
14:48:20 Attributed the impact area as not RVM Cat B
14:48:20 Area of RVM Cat B clearing is 66.58 hectares
14:48:20 SQL selection used is "RVM_CAT" = 'B' and "Cover" = 'Not RVM

Cat B' on shapefile
T:\01_Projects\Temporary\0452822 Bris\5.
GIS_Graphics\Data\SHP\Analysis\20180713\main_output\clip_remcover_post.shp

14:48:23 Categorised the cover attributes in clip_remcover_pre.shp ready for raster conversion
14:48:37 Converted clip_remcover_pre.shp to raster

14:48:43 Categorised the cover attributes in clip_remcover_post.shp ready for raster conversion
14:48:58 Converted clip_remcover_post.shp to raster

14:48:58 Run Landscape fragmentation analysis on the pre impact regional landscape

REGULATED VEGETATION TYPES BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES
CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 9.0 MINUTES)

14:58:01 Run Landscape fragmentation analysis on the post impact regional landscape

REGULATED VEGETATION TYPES BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES
CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 8.2 MINUTES)

Extracting a local subset of lfc_regional_pre_impact
Extracting a local subset of lfc_regional_post_impact

Collating pre and post impact statistics and trigger assessment
15:06:36 Summarising area statistics for: lfc_localmsk_pre_impact
15:06:36 Summarising area statistics for: lfc_localmsk_post_impact
15:06:36 Summarising area statistics for: lfc_regional_pre_impact
15:06:37 Summarising patch count for lfc_localmsk_pre_impact
15:06:47 Summarising patch count for lfc_localmsk_post_impact

Analysing impact on Connectivity Areas

SIGNIFICANCE TEST ONE

The regional total area is 434953.51
The regional extent of core remnant is 28808.55
The regional extent of core remnant is 6.62 percent
This level of regional fragmentation sets a local impact threshold of: 2.0

percent

The table below lists the local impact thresholds for categories of regional core remnant extent:

REGIONAL CORE CATEGORY	LOCAL IMPACT THRESHOLD
< 10	2.0
10 - 30	5.0
30 - 50	10.0
50 - 70	20.0
70 - 90	30.0
>90	50.0

Area of core at the local scale (pre impact): 5977.86
Area of core at the local scale (post impact): 5762.57
Percent change of core at the local scale (post impact): 3.60 percent

SIGNIFICANCE TEST TWO

The number of core remnant areas occurring on the site: 15
The number of core remnant areas remaining on the site post impact: 15
(Only core polygons greater than or equal to 1 hectare are included)

RESULT

15:07:17 This analysis has determined a SIGNIFICANT impact on connectivity areas
(A significant reduction in core remnant at the local scale is True OR a change from core to non-core remnant at the site scale is False)
(Total area of RVM Cat B clearing is 66.58 hectares)

The significance table has been written to:
..\main_output\lfc_significance_assessment.csv
The local scale summary table has been written to:
..\main_output\lfc_local_scale_summary.csv
The site scale summary table has been written to:
..\main_output\lfc_site_scale_summary.csv
GIS layer files copied into folder \lyr_file within the project folder.
View layers in ArcMAP using..\T:\01_Projects\Temporary\0452822 Bris\5. GIS_Graphics\Data\SHP\Analysis\20180713\lyr_file\lyr_file\Connectivity Area Impact Assessment.lyr

Please scrutinise the output tables and spatial layers to confirm the desktop modelling of connectivity area impact

This analysis used an unedited copy of the Regulated Vegetation layer.

15:09:23 _____COMPLETED LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS_____