



QGC

ANNUAL REPORT 2017

WATER MANAGEMENT PLANS FOR APPROVALS EPBC 2008/4398 AND EPBC 2013/7047

October 2017
QCLNG-BE99-WAT-RPT-xx

TABLE OF CONTENTS

1.0	INTRODUCTION.....	3
2.0	ASSOCIATED WATER & BRINE MANAGEMENT	4
3.0	WELL STIMULATION ACTIVITIES AND THE CHARACTERISATION OF STIMULATION FLUIDS.....	7
4.0	AQUIFER MONITORING NETWORK DRILLING	8
5.0	CONNECTIVITY STUDIES PROGRESS	10
6.0	SPRINGS MONITORING AND ARRANGEMENT	11
7.0	TRIAL REINJECTION PROGRAM	12
8.0	GROUND MOTION ASSESSMENT	13
9.0	SHALLOW AQUIFER INTERACTIONS	14
10.0	EXCEEDANCE AND RESPONSE MANAGEMENT.....	16

1.0 INTRODUCTION

In accordance with condition 49 (i) of QGC's Environment Protection Biodiversity Conservation (EPBC) Approval 2008/4398, and Condition 34 of EPBC Approval 2013/7047, QGC is required to develop an annual report to be submitted to the Department of Environment and Energy (the Department) each year. The following report fulfils this requirement and demonstrates QGC's progress and performance against the Conditions within its approved Stage 3 Water Monitoring and Management Plan (WMMP) and Surat North Water Resource Management Plan (WRMP).

This report demonstrates progress and insights to protect Matters of National Environmental Significance (MNES). Any technical documents, reports and interpretative analysis required to support the progress indicated are included in the WMMP/WRMP or associated technical studies. Key areas of discussion include:

- Associated water and Brine management;
- Well stimulation activities;
- Brine management;
- Springs monitoring and management;
- Ground motion assessment;
- Connectivity studies; and
- Updates on action taken under Exceedance Response Plans.

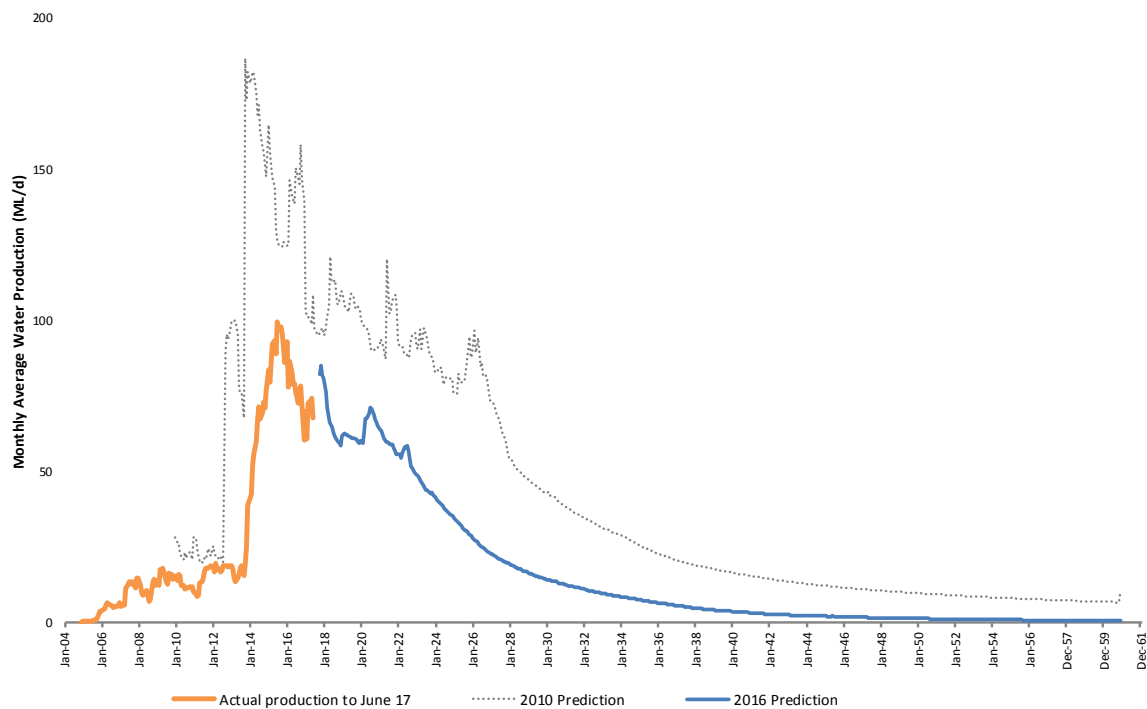
The timescale covered by this document is generally August 2016 to August 2017, although pertinent information outside this period has also been included.

2.0 PRODUCED WATER & BRINE MANAGEMENT

2.1 Produced Water Management

QGC measures flows throughout the water management system. The graph below illustrates the total upstream produced water profile since 2004 (orange line), the predicted water production volumes made in 2010 (grey dotted) and a more recent prediction for volumes made in 2016 is demonstrated in blue. These figures indicate that QGC's operations are tracking to produce approximately half of the water volumes predicted to be produced in 2010. This decrease is primarily driven by an enhanced understanding of the reservoir and water flow since 2010 as well as a revised development footprint.

Figure 1: Predicted and actual produced water volumes



The throughput of produced water from the two Water Treatment Plants is indicated in Table 1 below.

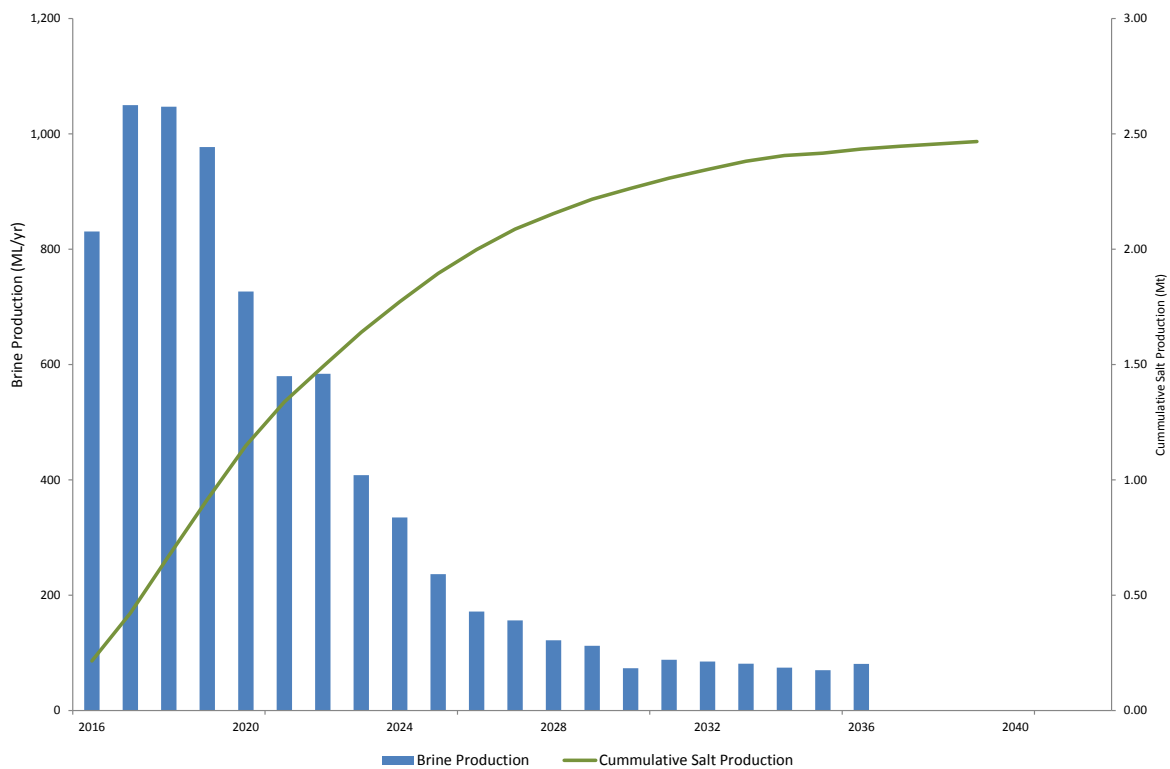
Table 1: Water volumes processed through QGC’s Water Treatment Plants

Water Treatment Plant	Average daily production (July 2017)	2017 Year to date production July 2017)
Kenya	28.9 ML/d	7028 ML
Northern	17.3 ML/d	4213 ML

2.2 Brine Management

The graph below illustrates the predicted brine and salt profile to 2040. As a direct result of declining brine/salt profiles, emerging crystallization technology and renewed industry collaboration discussions, QGC has also endorsed a strategy to defer the construction of a crystallisation facility and associated regulated waste facility until 2022 (operational in 2025).

Figure 2: Predicted brine production volumes



Several options to safely manage the brine volumes long-term have been investigated. On balance, when all the safety, environmental, community and business factors are considered, crystallising brine into solid salt form and encapsulating it for long-term storage in purpose built cells is considered the most feasible and optimum solution.

3.0 WELL STIMULATION ACTIVITIES AND THE CHARACTERISATION OF STIMULATION FLUIDS

No hydraulic stimulation was carried out over the reporting period. No toxicity or ecotoxicity studies were undertaken.

QGC has no current confirmed forecast for stimulation for 2018.

4.0 AQUIFER MONITORING NETWORK DRILLING

In the 2012 Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (CMA), the Office of Groundwater Impact Assessment (OGIA) listed two phases of groundwater well drilling. The first to be completed by 2013 and the second by 2016. The format of the second phase was agreed with OGIA in January 2016 and following 12 months of land access negotiations, the drilling commenced in February 2017. Through 2017 8 wells were drilled as shown in the maps overleaf.

Monitoring also commenced at 24 shallow monitoring wells in the Charlie Project area as part of the Water Management Plan for EPBC Approval 2013/7047.

The complete network now constitutes 182 monitoring wells (incorporating a total of 227 separate pressure monitoring points) (4 to be drilled), including 43 water quality monitoring points.

To check for departures from trends, exceedances of thresholds and triggers and the early detection of potential impacts, a formal system of assessment of monitoring data is in place. This process sets out the frequencies on which data are checked and assessed and a reporting process and a framework within which actions are tracked. The process includes:

- Weekly basis: a system health check is run on the status of well groundwater pressure gauges and telemetry units so that faults can be identified and rectified. Production Operations (who manage the network) have a KPI of 92% network availability.
- Monthly basis: the database is checked to ensure that data is being correctly delivered by the telemetry system and there are no errors or outliers. The system allows plotting of hydrographs to facilitate this process.
 - If a significant change in a trend or value is observed in the raw data or constructed hydrographs, any rectification requirement will be fast tracked, otherwise the main data assessment process will continue at quarterly intervals.
- Quarterly basis: the levels/pressures are plotted and standard corrections and compensations applied, as appropriate. As per Commitments in the Stage 3 WMMP and the WRMP, data will be uploaded to the QGC website for public viewing on a 6-monthly basis. Relevant supporting data are also collated. Possible response actions from the quarterly review are:
 - If there is no significant change in a value or trend, then there is no further action. Monitoring will continue as will the quarterly assessment events.
 - If a significant change is observed to be taking place in formations adjacent to the Walloons i.e. Springbok, Eurombah, Hutton, then a hydrogeological review will take place addressing the following matters:
 - Has there been any significant change in stress to the groundwater system (for example, has nearby pumping initiated, or a significant recharge event occurred)? and
 - Has recent data and behaviour meant a change in the conceptual model is warranted, and consequentially, are additional or alternative data correction or trend analysis required to normalise the raw data?

- Following the hydrogeological review, a more rigorous trend analysis would be implemented if warranted.
- If a trigger is exceeded, then the relevant response plan is initiated.

5.0 CONNECTIVITY STUDIES PROGRESS

Connectivity studies have been completed. The focus of connectivity work has moved from smaller scale trials towards the wide scale assessment of whole system response as the fields have gone into production i.e. an examination of the complete monitoring network at a specified frequency to determine impacts of CSG water production more broadly.

Connectivity characteristics within the Walloon sub-group (WSG) and in the aquifers at nested sites can be derived in a variety of ways from the water level and groundwater pressure data. This includes:

- Comparison of pressure responses within the sub-units of the WSG to assess risk and understand pressure response in adjacent formations;
- Comparison of static water levels within each bore (at the same nested site) to determine the magnitude of the vertical hydraulic gradient between units. The larger the difference in head, the less connectivity between the units;
- Monitoring the production zone and overlying and underlying aquifers and observing for signs of impact. Presence or absence of an observable impact both provide valuable information regarding the connectivity of the monitoring bore to the underlying/overlying production zone.
- Comparison of dynamic water levels: typically induced through test pumping/applying stress to one of the units and monitoring for responses within underlying and overlying units. For example, monitoring bores overlying or underlying 5 spot pilot tests. Results from this style of test are analysed by 2D Analytical Models and occasionally 3D numerical flow models.
- Comparison of water levels across spatially separated nested well sites to determine whether hydraulic gradients differ/reverse across the region, potentially giving further insight to wider scale groundwater flow.

6.0 SPRINGS MONITORING AND ARRANGEMENT

In accordance with Springs Management Strategy outlined in the 2016 UWIR, QGC is monitoring the Dawson River 8 springs on a six-monthly frequency.

The monitoring bores in the Joint Industry Plan (JIP) Springs Monitoring Network continue to be monitored for water pressure and quality. No exceedances of the triggers have been observed.

The proponents committed to a revision of the JIP in March 2017 (six months following approval of the 2016 OGIA UWIR). In conjunction with OGIA, this revision has already been undertaken. The key driver for the revised Plan is to integrate actions with the existing Queensland groundwater impact management system. The details of the proposed revision are contained in the Draft Water Resources Management Plan¹ delivered to the Department in December 2016.

¹ **WATER RESOURCES MANAGEMENT PLAN FOR APPROVALS EPBC 2008/4398 AND EPBC 2013/7047.**
December 2016 QCLNG-BE99-WAT-RPT-000025

7.0 TRIAL REINJECTION PROGRAM

To fulfil the requirements of this condition QGC has undertaken a program of work to characterise the subsurface and implement an injection trial at its Woleebee Creek site. That trial has entailed three Stages:

- Stage 1 – monitoring bore Woleebee Creek GW4 data acquisition.
- Stage 2 – construction of a trial injection bore and adjacent monitoring bore and surface infrastructure.
- Stage 3 - injection trial using water sourced from the Precipice Formation and CSG treated water.

Stage 1 and 2 has been completed. However, prior to Stage 3, major storm damage necessitated a project review. That review concluded that the body of work available from Woleebee Creek together with injection trials undertaken by APLNG were sufficient to prove the feasibility of a full-scale injection scheme for aquifer re-pressurisation. In addition, it showed that implementing an injection trial at Woleebee Creek would not add to the level of understanding needed for an injection scheme. Further, APLNG have commenced operation of a full-scale injection scheme at Reedy Creek. This 40 ML/d project is already raising Precipice Sandstone groundwater levels by a minimum of 1m over the northern tenements. Therefore, the probability of injection being required into the Lower Precipice at Woleebee Creek is very low.

The basis of the trial and purpose of these federal conditions is for QGC to be able to write a realistic development plan and schedule for the re-pressurisation of the Hutton and Precipice aquifers so that timely intervention is possible if required in the future. Based on the work undertaken to date, QGC has the knowledge and skills to fulfil this requirement. To demonstrate this assertion the Department requested that QGC prepare a revised Injection Management Plan. That was delivered to the Department and comments were received back in early 2017. QGC is in the process of finalising this revised plan and anticipates submitting this document to the Department before end 2017.

8.0 GROUND MOTION ASSESSMENT

A ground motion annual progress report was submitted to the Department in October 2017. In summary:

- The Stage 3 radar satellite data acquisition using RADARSAT-2 data commenced in January 2015 and will terminate at the end of 2017, with final data delivery in April 2018. A programme post 2017 is currently being procured.
- To date no area has triggered the exceedance response plan.
- The proponents continue to work together to try to resolve the complex influences on surface ground motion and have enlisted the assistance of the University of Queensland to attempt to quantify the role played by natural forces and land-use on satellite-inferred ground motion.
- Some areas of minor subsidence were identified in predominantly the Central and the Southern Eastern Regions of the Project Area. These areas are receiving further study to try to determine what proportion of the subsidence can be attributed to CSG extraction activities.

9.0 SHALLOW AQUIFER INTERACTIONS

Specific shallow aquifer studies are required in the Surat North Project Area in accordance with conditions under EPBC Approval 2013/7047. Progress on these studies has included:

- Surface Water Sampling Horse Creek Surat North area, Dawson River and selected tributaries

QGC has collected 20 surface water samples and undertaken laboratory analysis from up to 10 sites along Horse Creek, Dawson River and tributaries from four sampling rounds between 2015 and 2017.

- Construction of instrumented shallow groundwater monitoring bores adjacent to Dawson River south west of Taroom

A contract has been awarded for the construction of three monitoring bores in alluvium and/or shallow Walloons Subgroup strata at a site adjacent to the Dawson River approximately 29 km southwest of Taroom. Bore construction and equipment installation is planned for Q4 2017.

- Instrumentation of existing DNRM monitoring bores near Dawson River at Taroom

Data loggers have been installed in 2 bores in alluvium and shallow Walloons subgroup strata on the western side of the Dawson River at Taroom.

- Surface water flow monitoring Horse Creek

A contract has been awarded for the installation of streamflow monitoring equipment on Horse Creek Charlie block.

- Monitoring of shallow Walloons Coal Measure bores in vicinity of Horse Creek on Charlie block

Agreement has been reached with Taroom Coal Pty Ltd for data sharing and access to its shallow aquifer monitoring bores on QGC Charlie block. These bores along with two DNRM bores at Taroom and proposed bores adjacent to the Dawson River 29 km southwest of Taroom on QGC Leghorn block are referred to as the Shallow Aquifer Monitoring Network.

Data logger downloaders and/or water level measurements of 21 bores were completed in July 2016 and July 2017. Water quality samples were collected and analysed from 16 and 21 bores respectively from the 2016 and 2017 campaigns.

Further sampling rounds on a quarterly basis till mid 2018 are planned. The second round of monitoring commenced on 10th October 2017.

- Perrett's Rd wetland investigations in vicinity of shallow Walloon Coal Measures strata on Charlie block.

A contract has been awarded for soil sampling and vegetation surveys at the Perrett's Rd "wetland" on Charlie block. A survey of vegetation species distribution at the wetland and adjacent riverine vegetation is in progress.

10.0 EXCEEDANCE AND RESPONSE MANAGEMENT

QGC has developed several Response Plans to protect the water environment and MNES in the event that threshold values are exceeded. The following list of exceedance response plans are active. Listed below is an update on actions QGC has undertaken over the reporting period.

- **Response Plan iia: If Investigation or Mitigation Trigger Values or Drawdown Limits for aquifer drawdown in relation to EPBC listed springs are exceeded;**

Data are examined quarterly as part of the Aquifer Surveillance Process. No triggers have been exceeded.

- **Response Plan iib: If Threshold Values for aquifer drawdown in relation to groundwater-producing bores are exceeded;**

Activities are being managed under Queensland Legislation for Make Good of affected water bores. Following the publication of the 2016 UWIR, QGC has responsibility to undertake bore assessment and subsequent Make Good negotiations for 20 bores.

- **Response Plan iic: If Threshold Values for groundwater contamination are exceeded;**

Reviewed on a six-monthly basis as data are collected, no contamination identified.

- **Response Plan iii: If subsidence or surface deformation occurs which impacts on surface or groundwater hydrology;**

No trigger exceeded, see Section 8.

- **Response Plan iv: If there are unforeseen emergency discharges.**

Managed as part of operations.

- **Response Plan v: define triggers for aquatic ecosystems and ecology and investigation/mitigation actions prompted by those triggers within the Surat North Development Area**

Condition 23h of approval states the requirement to develop;

- Early warning indicators, trigger thresholds and their reference values derived from baseline data for each monitoring point, including investigation or mitigation activities for both early warning indicators and trigger thresholds;
 - i. for aquatic ecology and aquatic ecosystems

The Surat North WMMP concluded that abnormal changes in water level in shallow alluvial aquifers would be the best early warning indicator of potential impact to aquatic ecosystems derived from CSG

production. An initial trigger threshold of a 2 m drop in water level for shallow (unconsolidated) alluvial aquifers was adopted (a drop in water level is exclusive of seasonal or climatic water level fluctuations).

Work to develop a Long-Term Trigger and early warning indicators/investigation levels has commenced and to date has focused on:

- developing an understanding of natural seasonal water level fluctuations and groundwater quality changes in Horse Creek alluvial aquifers which have occurred across both dry and extreme wet conditions between 2009 and 2017.
- detailed geological modelling to improve understanding of spatial relationships between alluvium and the underlying weathered and fresh sedimentary strata of the Springbok Sandstone and Walloon Coal Measures.