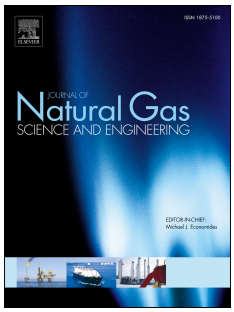
Accepted Manuscript



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PII: S1875-5100(18)30080-5

DOI: 10.1016/j.jngse.2018.02.010

Reference: JNGSE 2466

To appear in: *Journal of Natural Gas Science and Engineering*

Received Date: 24 November 2017

Revised Date: 23 January 2018

Accepted Date: 14 February 2018

Please cite this article as: Underschultz, J.R., Vink, S., Garnett, A., Coal seam gas associated water production in Queensland: Actual vs predicted, *Journal of Natural Gas Science & Engineering* (2018), doi: 10.1016/j.jngse.2018.02.010.

Coal Seam Gas Associated Water Production in Queensland: Actual vs Predicted

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Abstract

Coal Seam Gas (CSG) development in Queensland is currently going through a transition from less than 300 billion cubic feet/year (~315 PetaJoules/year (PJ/yr)) for domestic consumption to ~1400 bcf/yr (nearly 1500 PJ/yr) by about 2019 driven by additional Liquid Natural Gas (LNG) export contracts. Prior to this ramp up in production, industry, government and academia have been forecasting not only gas but associated water production (produced water) for the various purposes of financial investment decisions and field development planning, prudent governance and regulatory planning, and estimation of potential environmental impacts for planning management, monitoring and mitigation strategies. During the course of resource development, prediction methodologies and model sophistication has varied greatly as more data becomes available and uncertainty is reduced. In Queensland, now that all 6 LNG trains are running and at various stages of ramping up to full production, there is a substantial and growing data inventory to history match numerical models and improve forward forecasting.

We review the historical forecasting of CSG water production in Queensland leading up to the development and operation of CSG to LNG export, and compare that to the current actual produced volumes now that the projects have come on stream. The latest available measured produced water from CSG development (December 2016) equates to ~60.5Giga Litres/year (GL/yr) with combined operator forecasts defining a peak projected to occur for about 10 years at 70-80 GL/yr. When this is converted to cumulative water volumes over the life of the industry (based on combined operator forecasts), just over 1700 GL of water is expected to ultimately be produced. Current estimates of water and salt production in Queensland are about 25% of those made by government and academia prior to the expansion of CSG to LNG export and ~70% of the 2010-11 industry estimates. We show that this discrepancy can be attributable to a combination of the following factors:

1. Gas industry conservatism (over-estimation) driven by the bias to reduce project risk and achieve gas delivery targets;
2. Government conservatism driven by a bias for prudent forecasting i.e. to assure that a credible worst case can still be managed within the regulatory framework;
3. Academia conservatism driven by a bias for understanding worse case scenarios of environmental impact;
4. The use of numerical models for basin scale impact assessment that do not take account of near-well multi-phase flow characteristics of saturation and relative permeability; and
5. A systemic underestimation of the cumulative effects on depressurization of the coal resource where one operator's asset requires less water production to reach target reservoir pressures due to neighbouring operator production. This is mainly because each operator only has access to its own development plans.

Key Words: coal seam gas, water production, produced water, associated water, coal bed methane, production forecast.