

# Beneficial Use of Produced Water from Coal Seam Gas Development Using Managed Aquifer Recharge

Produced water to recharge an aquifer depleted by historical agricultural water use in Queensland, Australia

**CHALLENGE**

Assess the feasibility of injection and infiltration of treated coal seam gas (CSG) water into a depleted aquifer to offset historical agricultural drawdown.

**SOLUTION**

Apply technical expertise, proven technologies, and advanced numerical modelling to fully evaluate managed aquifer recharge strategy.

**RESULTS**

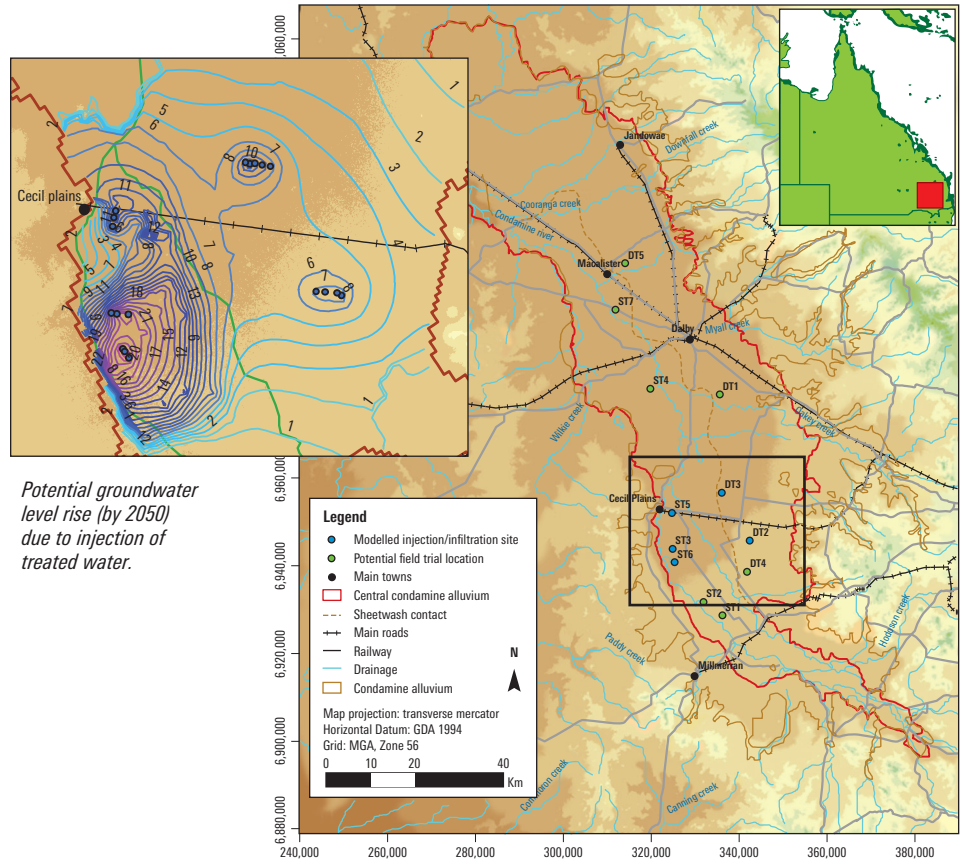
Demonstrated beneficial response of aquifer to recharge using numerical model and designed a comprehensive field program to validate the application.



**Aquifer depleted by historical agricultural irrigation**

Unconventional coal seam gas (CSG) extraction is developing rapidly in the Surat basin of Queensland, Australia. The gas fields are expected to continue expanding over the next 20 years in response to an emerging liquefied natural gas (LNG) export industry. CSG development, however, produces large quantities of groundwater as a by-product, which requires careful management and disposal. Government regulations require the beneficial use of treated CSG water where possible.

In the Surat basin, the gas is held in cleats and fractures of multiple thin coal seams of the Walloon Subgroup, buried at a depth of 200 to 1,000 m below ground surface. CSG is extracted by dewatering (depressurising) to the structural top of the coal seams for an anticipated project life of 30 years. The gas is piped to an LNG plant for foreign export. It is estimated that produced water extraction will average about 95,000 ML per year over the life of the project. The produced water is brackish and requires treatment by reverse osmosis before it is suitable for reuse.



Location of Condamine Alluvium and potential injection sites.

One such beneficial use of treated CSG water is managed aquifer recharge. The Queensland Department of Natural Resources and Mines (DNRM), under an Australian government funded project as part of the Healthy Headwaters Coal Seam Gas Water Feasibility Project, initiated an assessment to analyse the opportunities, risks, and practicality of using treated CSG water to adjust and sustain the water level of the 5,460-km<sup>2</sup> Central Condamine Alluvium (CCA) aquifer in the Murray-Darling basin. This aquifer has been depleted by historical abstraction of groundwater, primarily for agricultural irrigation. Since the 1960s, the aquifer water level has declined an average of 6 m, with local drawdown exceeding 26 m.

**Program designed for CSG water reuse**

DNRM contracted Schlumberger Water Services to provide expert assessment and technical support needed to plan field trials using injection bores and infiltration trenches for recharging the CCA, as well as characterise the hydraulic connection between the CCA and the subjacent coal seams of the Walloon Subgroup.

Schlumberger Water Services technical experts designed a field program utilising surface geophysics, sonic core drilling, production bore and monitoring bore construction, borehole geophysics, aquifer pumping tests, infiltration tests, injection tests, and water quality analyses. Numerical modelling was also performed to predict how aquifer water levels may respond to treated CSG water injection and infiltration.

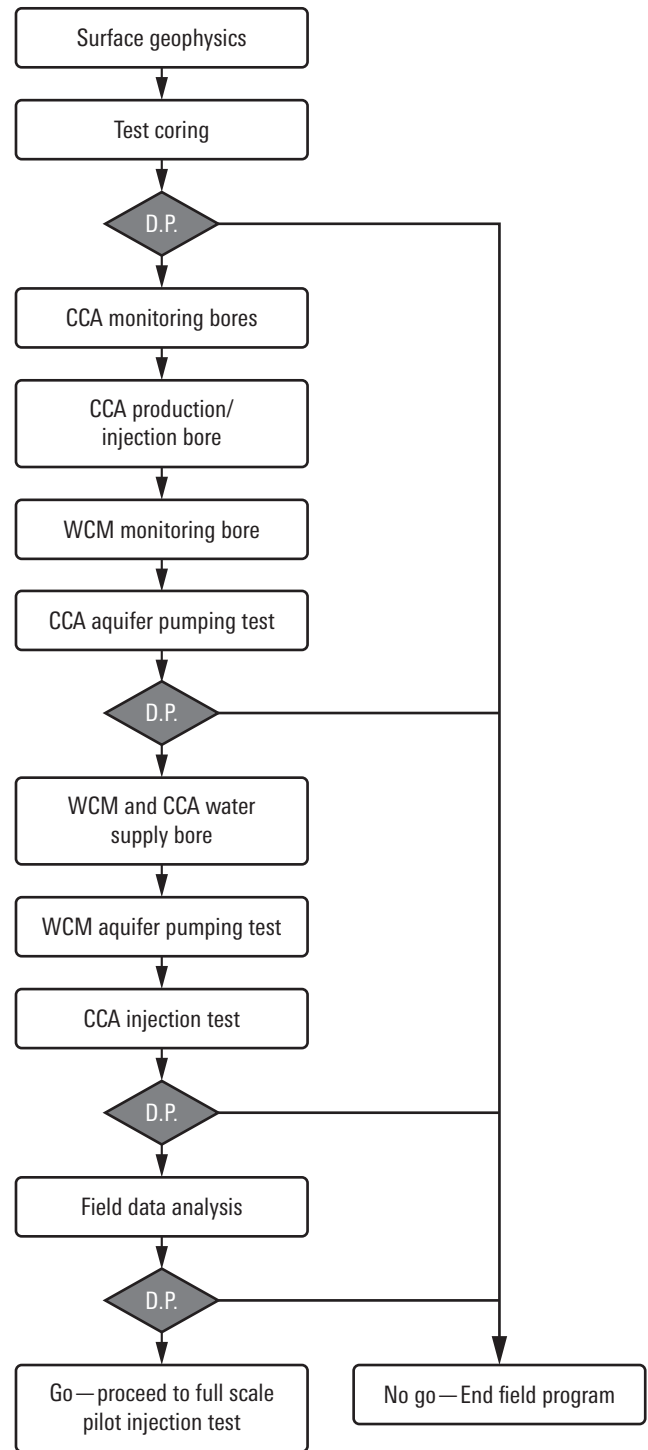
The team provided guidance to minimise potential impacts to the aquifer, the environment, and public health. As the trials were designed to serve as an integral element in assessing the feasibility of a long-term injection bore or infiltration trench system, Schlumberger Water Services specifically addressed data deficiencies associated with large-scale injection of treated CSG water into the CCA.

Applicable government regulations were also accounted for in detail, along with the logistical issues of mobilising all personnel and equipment needed for the trials, health and safety concerns, and opinions of probable cost.

Progress throughout the design process was communicated to DNRM in a series of meetings and stakeholder workshops comprising 15 to 20 representatives from local agricultural interests, CSG operators, government representatives, and others. Furthermore, the field program included four sequential independent decision points, enabling well-informed go/no go decisions.

**Significant potential identified in water injection strategy**

Numerical modelling performed by Schlumberger Water Services (as shown on reverse) demonstrated the beneficial response of the CCA to managed aquifer recharge. With this strategy, additional and previously unavailable water can now be used to replenish the CCA and benefit the agricultural community. And equipped with the study prepared by Schlumberger Water Services, DNRM can undertake needed field trials using proven technologies and a comprehensive guide of regulatory requirements, logistical issues, health and safety concerns, and opinions of probable cost.



D.P. = Decision point—Go/no go

Go/no go decision points during deep target site field program.

\*Mark of Schlumberger  
Other company, product, and service names  
are the properties of their respective owners.  
Copyright © 2015 Schlumberger. All rights reserved. 14-WS-0014