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The use of the hydrogeochemistry and multivariate statistical methods as a tool for groundwater management. Condamine River Alluvial Aquifer (CRAA), Australia.

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The alluvial aquifers of the Condamine River near Dalby have been increasingly used since the 1960s as a water resources to support Irrigated agriculture of mainly cotton and grain crops. Groundwater abstraction from the underlying Condamine River Alluvial Aquifer (CRAA) supplies 30% of the irrigation water (Dafny and Silburn, 2014). Over the past decade, Coal Seam Gas (CSG) exploration and production has expanded rapidly in the Queensland portion of the Surat Basin (SB), targeting the underlying Walloon Coal Measures (WCM), with tenements to multiple companies along the western flank of the Condamine Plain. To produce the gas, groundwater will be extracted in large quantities, depressurising the WCM. There is concern that the zone of depressurisation will impact the groundwater levels within the CRAA. In the last decade, great efforts have been made to improve hydrogeological conceptualization and modeling. The rapid expansion of CSG exploration and production in Australia has generated controversy within the public who are concerned about the impact on adjacent aquifers used to support irrigated agriculture, stock and domestic water supplies. The proximity of gas extraction to aquifers used for irrigation or domestic water supply is common to many CSG production sites globally. To address these concerns there has been increased research within the region to improve our understanding of aquifer connectivity and the regional water balance. To solve the uncertainties about the impact of CSG exploitation on the groundwater of the adjacent aquifers is necessary to have a robust conceptual model to understand the hydrological dynamics and hydrochemical processes. Most cases, spatial and temporal variability of groundwater chemistry is the result of mixing processes between different water sources. Understanding the mixing processes which take place between several groundwater inputs or groundwater with other water bodies is crucial for groundwater management. Mixing calculations have been successfully applied in many hydrogeological setting to improve the conceptual model and understanding the origins of groundwater compositions.

The main aims of this work are to improve the knowledge of the hydrogeologic system in the Condamine alluvium and to investigate the possible impacts of CSG exploration and production to the Condamine Alluvium. To attain these objectives, this study applies a methodology based on multivariate statistical methods for computing the mixing ratios of different water sources (end-members) in several observation points to evaluate the potential impacts. This included the identification and chemical characterization of the recharge sources (end-members), the evaluation of the mixing proportions for each sample, the quantification of the geochemical processes undergone, and the evaluation of CSG exploitation effects. Mixing ratios are computed using MIX code developed by (Carrera et al., 2004). MIX code is based on the maximum likelihood algorithm to estimate the mixing ratios taking into account the uncertainty of the end-members and mixed samples.

Building a robust conceptual model together with the application of multivariate statistical methods will serve as a useful tool for groundwater management.