

Abstract

Cost of desalinated groundwater using stochastic estimates of groundwater storage volumes and salinity

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Strategic water planning in Texas is an important way to ensure future Texans have enough water. With increasing climate extremes (droughts and floods) and climate change, new drought resistant supplies, such as brackish groundwater desalination, will become more important in the overall water portfolio in Texas. Current brackish groundwater studies produced by the state provide deterministic estimates of brackish groundwater storage volumes and groundwater salinity estimates. These estimates have potentially high uncertainties; however, these uncertainties are not quantified or communicated. In this thesis two stochastic workflows were developed to reprocess results of a deterministic brackish groundwater study: Monte Carlo simulation to produce stochastic storage estimates and ensemble learning to produce stochastic groundwater salinity estimates. These workflows were tested against the results of deterministic estimates, showing that the stochastic P50 storage estimate was about two times greater than the deterministic storage estimate. The stochastic analysis also revealed that the aquifer storage estimates are highly uncertain due to a lack of measured data in the brackish aquifers. In reprocessing data from the original deterministic analysis, uncertainty in salinity estimates was found to increase with increasing salinity, which is expected due to the limited number of brackish and saline water quality samples in the public record. Finally, the stochastic estimates of storage and salinity were

used to assess the cost of desalinating groundwater from a San Antonio Water System project in the 2022 State Water Plan. Results show that brackish groundwater salinity uncertainties had a greater effect on the cost of desalinated groundwater than the uncertainties in the storage volume estimates. Overall, by developing stochastic workflows and estimates, stakeholders can target specific data to acquire to reduce uncertainties for specific projects. The additional context provided by uncertainty analysis could greatly benefit stakeholders.