EXPANDING CALIFORNIA'S WATER RESOURCES WITH DEEP GROUNDWATER

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Deep groundwater aquifers, developed for oil and gas extraction, could yield important sources of water in California and elsewhere. Assessing groundwater quantity and quality requires baseline data and a monitoring framework for evaluating impacts.

Stanford researchers have found that California's Central Valley alone has close to three times the volume of fresh groundwater than previously estimated. The Stanford study is the first to measure California's groundwater below 300 meters (the depth of a typical well).

By analyzing data available from public records through the California Department on Oil and Gas combined with data about the geologic characteristics of the rock in those regions, the Stanford researchers were able to extrapolate the size, volume, and water quality of aquifers beneath eight California counties at a depth of up to roughly 5000 meters.

From this analysis, they surmised that deep groundwater aquifers could turn out to be important groundwater resources for agriculture and potable water in the future.

Large fresh and saline groundwater is found in the most physically and economically accessible top 1,000 m in the Central Valley. Accounting for deep (but relatively fresh) groundwater can substantially expand California's groundwater resources.

The Carlsbad desalination plant in San Diego County, CA opened in December of 2015 and is desalinating 37 billion gallons of seawater annually. Moderately saline groundwater aquifers, containing lower TDS concentrations than seawater, require less desalination and are useable for drinking water.

The Impact of Subsurface Activities on Deep Groundwater Resources

Ongoing and future subsurface activities could impact deep groundwater resources. Fluid injections, including wastewater disposal, CO2 storage, and enhanced oil and gas recovery, could cause formation pressures to increase, and groundwater contamination can occur through permeable vertical pathways, such as abandoned wells or geologic faults.

California recently closed 56 oil and gas water disposal injection wells because the wastewater was being pumped into potentially drinkable aquifers. The recent passage of California's well stimulation bill (State Bill 4), which required monitoring of hydraulic fracturing in the state beginning in July 2015, will be helpful in obtaining data from groundwater monitoring associated with hydraulic fracturing in the state.

The Sustainable Groundwater Management Act

California's Sustainable Groundwater Management Act outlines other potential negative impacts from the use of deeper groundwater. For example, "significant and unreasonable reduction of groundwater storage," and "significant and unreasonable land subsidence"

caused by deeper groundwater extraction, shallow groundwater withdrawals and oil production. For deeper aquifers, there may be additional costs associated with the treatment of anthropogenic or naturally occurring contaminants, such as radium. In addition, desalinization can be costly.

Nonetheless, Stanford researchers suggested that groundwater at intermediate depths may be a cost-effective alternative water source for desalination or other treatment.

Ongoing and future monitoring of deep groundwater will help assess impacts that may or may not be caused by fluid injections into deeper formations, including water disposal and waterflooding for enhanced oil and gas recovery. In addition, monitoring of geologic storage of CO2 and hydraulic fracturing of shale formations involving higher pressure and volume injections would help to detect whether there is a potential contamination event.

Our California water attorneys know that in the past, California has not monitored deeper freshwater and USDWs. Stanford's study suggests that a monitoring program that is mindful of the extents of freshwater zones and USDWs, both horizontally and vertically, is needed to further assess California's deeper, useable groundwater resources.

The research conducted by the Stanford Woods Institute for the Environment, by Mary Kang and Robert Jackson, was published in the journal Proceedings of the National Academy of Sciences the week of June 27.