Advanced Acoustic Technology Expands Groundwater Science: Example from Central Texas

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ABSTRACT

Networks of groundwater-level data are critical to understanding the hydrologic relationships of aquifer recharge, storage, discharge, and groundwater flow. In particular, long-term systematic measurements are essential to groundwater management.

Historically, monitoring networks have been hindered by the expense and logistics of either drilling a dedicated monitoring well or of retrofitting existing active (pumping) wells for traditional methods. Recently-developed technologies utilize acoustic sensors, wireless telemetry, and cloud-based platforms, greatly expanding the collection of continuous water-level data at a relatively low cost by utilizing pumping wells.

This paper presents an overview and case-study of monitoring expansion and enrichment opportunities that advanced acoustic technologies represent.

On a timed or pump-triggered schedule, WellIntel sensors deliver a non-random, programmable, sequenced acoustic signal into a well. The returned acoustic data are immediately transmitted to the WellIntel Water Data Cloud where water levels are determined considering signal characteristics, temperature data, and history. Data from across a network are integrated, analyzed, and visualized through an analytics dashboard to quantify the dynamics of the groundwater resource and the health of the network and sensors.

We compared groundwater level data collected using three methods - acoustic sensors (WellIntel), pressure transducers (InSitu), and manual measurements. Long-term data were compared for three years (2018 to 2021) from proximal sites in the same aquifer. Manual measurements for all wells correspond to acoustic sensors within 0.1 ft and in one well with multiple manual measurements over time a correlation of $R^2 > 0.99$. A well pair comparison using a pressure transducer and acoustic sensor also indicates an $R^2 > 0.90$. Short-term use of the acoustic technology for aquifer testing was also evaluated.

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Results from these three methods compare very favorably over time for both short- and long-term deployments. We demonstrate that the WellIntel acoustic sensors provide accurate and reliable continuous data with advanced cloud-based analytics at a low cost for deployment. This technology should be considered as an additional tool for monitoring water levels, particularly in actively pumping wells. The result will be networks with greater spatial and temporal data density, and enhanced science leading to better resource management.