

## **FY15 NM WRI Research Progress Report Form**

Report Due Date: December 1, 2014

**1. Project Title:** New Mexico statewide water assessment: Assessment of Spatiotemporal Groundwater Level Changes Throughout New Mexico

**2. Investigators (names, university/agency):** Kenneth C. Carroll NMSU; Stacy Timmons, New Mexico Bureau of Geology and Mineral Resources; Matt Ely, USGS; Mike Johnson, Hydrology Bureau, New Mexico Office of the State Engineer; and Nathan Myers, USGS.

**3. Brief description of project, research objectives, and impacts on New Mexico (provide performance measures and outcomes):**

Fundamentally, fluctuations in groundwater levels reflect changes to the total water storage within an aquifer or aquifer system, which can highlight changes in either recharge or discharge to an aquifer. As groundwater is an important freshwater resource for both agriculture and municipal use in New Mexico, tracking and understanding changes in groundwater levels is beneficial for the overall assessment of freshwater resource allocation. More importantly, identifying localized changes in groundwater trends on a regional to statewide scale can help identify potential areas of current or future water stress, where groundwater is being mined instead of being pumped at a sustainable rate.

The hypothesis evaluated herein is that the spatial distribution and magnitude of change in groundwater elevation can be assessed and will support the evaluation of groundwater pumping change on the potential depletion of groundwater as a resource. The objectives of this study are to 1) transmit data from a groundwater database into a Geographic Information System (GIS) to map out the spatial distribution of groundwater level changes for visual and spatial analysis, 2) calculate groundwater elevation, change in groundwater elevation, and change in groundwater pumping and population, and 3) evaluate the potential impact of increased groundwater pumping on changes in groundwater elevation. The potential impact will be evaluated through comparisons of changes in groundwater elevation change and groundwater pumping through space and over time.

This work will help illuminate changes in water levels on a state wide scale, while also highlighting data gaps where future work is needed. In many regions of New Mexico, water levels are declining, but the data have not been compiled and analyzed to quantify regional changes in groundwater levels. Specifically, this project aims to update statewide groundwater level maps and to quantify the change in groundwater levels from 1994 to 2014, showing intermediate times with corresponding groundwater levels, within the state of New Mexico. As a result of this project, regional to statewide scale maps of groundwater levels and changes in groundwater levels will be produced alongside a spatial database containing groundwater level data for New Mexico. Additionally, this project will attempt to identify trends in population increase, change in land use, or other possible causes for groundwater depletion by creating maps comparing changes in groundwater levels with changes in the external variables mentioned above.

**4. Brief description of methodology:**

In order to evaluate changes in groundwater levels within individual wells in New Mexico, trend analysis will be applied to groundwater level measurements collected from various agencies including, but not limited to, the United States Geological Survey (USGS) and the New Mexico Office of State Engineer (NMOSE). The change in groundwater elevation will be calculated for individual wells as point location measures of the groundwater system. The groundwater level

change is the difference between the water level at an earlier time and at a later time. The change in groundwater level will be plotted as a map across NM State, which will consist of a point map of the changes in groundwater over time at specific wells. The data will be plotted to support spatial analysis and visualization of trends (e.g., variable color or point size proportional to the amount of change) The trend of groundwater levels calculated for individual wells will then be used as a model for estimating relative groundwater levels at specified time intervals for each individual well. Once the trend analysis has been applied to the different well data points, GIS will be used to map the estimated changes in groundwater level across the state. After statewide groundwater level maps are created, census, land use, and other relevant spatial data will be collected and imported into ArcGIS to compare trends in groundwater depletion and changes in potential drivers for groundwater depletion.

**5. Brief description of results to date and work remaining:**

Data are still being collected from the USGS, and are being compiled into a MS Access database. The bulk of the data is from the USGS, NMOSE, and NMBGMR, which now includes about 5400 well locations and over 130,000 water level measurements. We are using the same data as the “Ground water level and storage changes” project to insure common data are being used between the two water-level projects. We have also been developing an R program for trend analysis of groundwater level over time using locally weighted scatterplot smoothing (LOESS) trend analysis. The code can be applied to individual wells currently, and we are automating the data entry and processing to work with all well data from the database. The trend calculations method will be used with the complete database, and exported results will then be imported into ArcGIS to complete the mapping of groundwater level change over time. We have also been compiling and developing a data subset into GIS coverages to support the project.

**6. Student participation - List all students participating in the project, their classification level (undergraduate, master’s, Ph.D., post doc) and their field of study (degree major):**

Spencer Willman (Water Science & Management Master’s student) has been working on the project.

**7. Provide special recognition awards or notable achievements as a result of the research:**

We contributed a presentation at the NM WRRI’s 59th Annual New Mexico Water Conference, which was in Santa Fe on November 18-19, 2014. The presentation is currently online at the <http://2014.wrri.nmsu.edu/power-point-presentations> weblink.

**8. Include references as needed (limit to one additional page):**

Burns, E.R, Snyder, D.T, Haynes, J.V., and Waibel, M.S., 2012, Groundwater status and trends for the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho: U.S. Geological Survey Scientific Investigations Report 2012–5261, 52 p., <http://pubs.er.usgs.gov/publication/sir20125261>.

**9. Provide a few sentences on progress toward uploading data to a common/standardized platform, if applicable:**

We had a meeting with WRRI’s data manager and the “Ground water level and storage changes – Regions of New Mexico” project group (and the other groups working on similar data types) to develop a common data platform for sharing water level change component of the Statewide Water Assessment. We have been discussing the development of analysis capabilities into water level databases to support this project.

**10. Provide two PP slides that provide summary information on your project appropriate for viewing by state legislators:**

Two slides have been attached with summary information about the project.