FY15 NM WRRI Research Progress Report Form

Report Due Date: 30 March 2015

1. **Project Title:** Ground water level and storage changes – Regions of New Mexico
2. **Investigators:**

PI: Stacy Timmons, New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology. Collaborators: Alex Rinehart, New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology; Mike Johnson, Hydrology Bureau, New Mexico Office of the State Engineer; Nathan Myers, U.S. Geological Survey; Matt Ely, U.S. Geological Survey; and Kenneth C. Carroll, New Mexico State University.

3. Brief description of project, research objectives, and impacts on New Mexico.

Changes in water levels reflect the water issues in the arid southwest, such as variations in surface water, reservoir storage, recharge and changes in the management of groundwater reservoirs. The goals of this study are to (1) compile water level data from throughout the state, and (2) develop a systematic approach to estimating changes in groundwater storage in alluvial aquifers in the New Mexico. To date, we have completed the data compilation and are in the process of documenting the workflow in two disparate alluvial aquifers.

The work highlights both changes in water levels on a regional scale, and where data gaps exist that need to be addressed. In many regions of New Mexico, we know that water levels are declining, but the data have not been compiled to address the amount of decline in specific areas. Project deliverables will show changes in ground water systems, which will give the results visual impact useful for illustrating the potential impact of conservation efforts and other water management options. With up-to-date regional maps showing contoured changes in water levels (time interval depending on the available data), the state of New Mexico will have a useful tool to aid in communicating and planning for future water management needs.

4. Brief description of methodology.

This project has two stages: compilation of groundwater level data; and development of a workflow to visualize changes in water levels and estimate the changes in water storage in alluvial aquifers. Alluvial aquifers consist of relatively shallow (<500 ft) freshwater-bearing unconsolidated to poorly consolidated sediments. Because of their shallow depth and high porosity (>10%), these aquifers commonly have high yields. These aquifers are found underlying major agricultural areas and cities in New Mexico. Given both their societal relevance and hydrologic simplicity, we have chosen to focus on developing a method for estimating groundwater storage changes in alluvial aquifers.

In December 2014, the compilation of groundwater levels was completed for this project, and included all water level measurements taken by the Office of the State Engineer and USGS through the NM Groundwater Data Program. It also includes measurements from the NM Bureau of Geology, and Bernalillo County Public Works. This effort will be ongoing as additional groundwater level measurements are made and pending future funding.

To develop and evaluate the groundwater storage estimates, we first developed a workflow in the Mimbres Basin and then tested it in the Estancia Basin. The Mimbres and Estancia Basins are both closed groundwater basins with the majority of groundwater withdrawals occurring in relatively shallow alluvial aquifers. The workflow consists of (1) quality assurance and data extraction, (2) interpolation of median groundwater levels for 10-year intervals, (3) estimation of changes in groundwater elevations through time using ordinary kriging and inverse-distance

weighting (IDW) schemes, and (4) using literature-derived hydraulic parameters for each basin. With these parameters, we find upper and lower estimates of basin-wide groundwater storage changes from each interpolation. Storage changes are found both by finding the difference in groundwater elevations between recent decades and pre-development levels, and as a moving difference. This process has been streamlined with the interpolation and spatial groundwater depth changes performed in ArcGIS using an automated workflow, and the other steps done using custom MATLAB functions. The spatial groundwater level changes are visualized as maps.

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

At this time, we have compiled the database, developed the workflow for storage change estimates in the Mimbres Basin, and tested the workflow on the Estancia Basin. The method is only valid for alluvial aquifers and, possibly, other aquifers that are laterally extensive and non-compartmentalized.

Remaining tasks are post-calculation analyses to understand the reliability of the storage change estimates, further streamlining of the process, and documenting the method. The final products include files of winter and unflagged groundwater depths, median water levels for each well on a decadal basis, estimates of covariance lengths of groundwater levels, maps of changes in groundwater elevation based on kriging and IDW interpolation, and 8 estimates of the changes in groundwater storage through time in order to better constrain the uncertainty of the measurements.

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)

None.

7. Provide special recognition awards or notable achievements as a result of the research. Include publications in progress (all published work supported wholly or in part of NM WRRI must bear an acknowledgment of support)

None.

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

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

We have participated discussion during the monthly WRRI meetings, and the storage change calculations are based on OSE-defined basins in order to streamline the sharing process. We have had additional meetings with USGS, OSE and NMSU collaborators to ensure that the time-series analysis of the groundwater level database and the spatial estimates of storage change through time in alluvial aquifers are complimentary and consistent.

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

Attached.