

FY15 NM WRI Research Progress Report Form

Report Due Date: September 8, 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 update statewide groundwater level maps and to quantify the change in groundwater levels the 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 increase 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 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 is currently being collected from the USGS and is being compiled into a database of parameters for each well including latitude and longitude coordinates, well depth, land surface altitude, name of aquifer system, as well as sample dates and measurements of depth to water. Using both Microsoft Excel and the statistical program R, changes in groundwater level over time are being analyzed using locally weighted scatterplot smoothing (LOESS) trend analysis. Water level at a given time is estimated from the produced trend line to avoid seasonal fluctuations associated with point data. Future work will include further data collection and analysis. The trend data will then be compiled into a format for import into ArcGIS to complete the mapping of groundwater level change over time.

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):

Josh Richardson and Katharine Schleich (both Water Science & Management Ph.D. students) were supporting the project until September. Spencer Willman (Water Science & Management Master's student) has taken over work on this project.

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

We have been invited to submit an abstract and contribute a presentation at the NM WRRI's 59th Annual New Mexico Water Conference, New Mexico's Water Future: Connecting Stakeholder Needs to Water Information, which will be in Santa Fe on November 18-19, 2014.

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 are working to obtain approval to construct a server that will become a central repository for data collected for this and all research leading to the calculation of a statewide water assessment for New Mexico. We are developing the online structure that will allow these data to be uploaded, downloaded, and displayed to other researchers and the public through maps, graphs, and tables.

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.