FY15 NM WRRI Research Progress Report Form

Report Due Date: April 1, 2015

1. **Project Title**: New Mexico statewide water assessment: Recharge data compilation and recharge area identification for the state of New Mexico.

2. **Investigators (names, university/agency)**: Talon Newton, New Mexico Bureau of Geology and Mineral Resources and Fred Phillips, Department of Earth and Environmental Science, New Mexico Tech. **Other Researchers**: Geoffrey Rawlings, New Mexico Bureau of Geology and Mineral Resources, New Mexico Tech.

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

Quantification of groundwater recharge by precipitation is the most important gap in current understanding of the New Mexico water budget. Other important components of the water budget (e.g., precipitation, surface water flows) have been systematically studied for over 100 years, yet no such systematic effort has been attempted for recharge. The objectives of this project are to compile previous estimates of recharge and to construct a map based on Geographic Information System (GIS) layers that identifies areas where recharge is likely to occur. The recharge area map will integrate existing GIS layers, including monthly and annual precipitation, potential ET, geology, major streams and drainages, and vegetation. This recharge area map will be a valuable resource in and of itself and is a necessary step towards calculating accurate recharge rates throughout the entire state.

4. **Brief description of methodology:**

Phase II: We are constructing a New Mexico recharge area map within a GIS framework by combining several individual layers containing spatial data that can help to determine where groundwater recharge likely takes place. These spatial data sets include a digital elevation model (DEM), precipitation rates, regional geology, vegetation cover, and soil data. These layers will be evaluated and integrated to quantitatively rate different areas in terms of propensity for groundwater recharge. Using these layers and methodology developed by Allen and others (1998), a computer program written in Python will utilize GIS functionality to perform a daily soil water balance for the entire state. Soil water depletions will be used to carry the daily water balance according to calculated rates of recharge, ET, and runoff. The difference between precipitation data and ET values will be used to evaluate the potential magnitude of recharge. Vegetation and geologic data will be categorized in a way that highlights areas where there is greater potential for recharge.

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

Results to date include ET estimates performed by an object-oriented Python computer program, which mathematically models daily ET and groundwater recharge based on the dual-crop coefficient method developed by the United Nations Food and Agriculture Organization Paper #56. The model automatically loads all input data (precipitation, reference ET, geology, soils), calls functions to process the data, performs calculations that mathematically model the loss of soil water to ET and recharge, and outputs the data into a format that is displayed by a GIS.

Work remaining includes corrections to the recharge algorithm, which is currently developed but performing poorly. Future improvements to the recharge algorithm include work precisely classifying the hydraulic saturated conductivity of New Mexico's bedrock geology, addition of an algorithm that accounts for storage of water in the form of snow, and a program to route generated runoff based on topography.

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):**

David Ketchum, Master of Science in Hydrology.

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):**

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

Allen, R. G., Pereira, L. S., Smith, M., Raes, D., & Wright, J. L. (2005). FAO-56 dual crop coefficient method for estimating evaporation from soil and application extensions. *Journal of irrigation and drainage engineering*, *131*(1), 2-13.

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

We are working to maintain common geographic data formats. These include the use of ArcGIS software georeferenced to the North American Datum (1983) State Plane #13 in the highest (where applicable) possible raster resolution.

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