



Verde Watershed

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USGS & VRBP to begin Verde Valley Water Resources Analysis

Private funding awarded in mid-June 2010 enables the U.S. Geological Survey (USGS) in collaboration with the Verde River Basin Partnership (VRBP or Partnership) to undertake a \$300,000 Verde Valley water-resources analysis that is consistent in outcome with the first deliverable specified under Title II of Public Law 109-110, the Northern Arizona Land Exchange, Title II and Verde River Basin Partnership Act of 2005. The work will begin in September 2010 and will be completed within 18 months (in February 2012). A grant of approximately \$250,000 from the Walton Family Foundation and a USGS match of \$50,000 together make this work possible. The Town of Clarkdale will administer the grant by receiving funds from the foundation, paying the USGS, and carrying out the accounting and verification that the grant requires.

The work plan was developed jointly by the USGS and the Partnership. The study will take advantage of the newly developed USGS Northern Arizona Regional Groundwater Flow Model as a powerful tool to meet the requirements of Title II's first deliverable report. Title II calls for an analysis of (1) the water budget for the Verde Valley and (2) the potential long-term consequences of various water use scenarios on groundwater levels and Verde River flows.

The study is expected to substan-

tially enhance the understanding of current and future water-resource strengths and limitations for the Verde Valley—between the USGS Verde River near Clarkdale streamgage (09504000) and Verde River near Camp Verde streamgage (09506000), and thus provide an important new basis for far-sighted decisions by water managers. In addition, it will codify and articulate significant gaps in the status of hydrologic knowledge in the Verde Valley in order to guide the formation of future studies.

Data Collection and Analysis

Data collection and analysis will be accomplished through completion of the following tasks:

Task A. Compilation and interpretation of existing published information

Task B. Use of Northern Arizona Regional Groundwater Flow Model (NARGFM) to provide specific water-budget information for the Verde Valley

A groundwater model is ideally suited to provide water-budget information. Although NARGFM simulates an area much larger than the Verde Valley it was constructed with particular focus on addressing water-resource issues in the Verde River Basin. Because NARGFM considers a much larger area than the Verde Valley, the smaller geographic

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USGS & VRBP *Cont'd from Pg 1*

subset of water-budget information directly pertinent to the Verde Valley can readily be extracted for the purpose of this project. As specified in Title II, the water-budget analysis will include: (1) the inflow and outflow of surface water and groundwater, (2) annual consumptive water use, and (3) changes in groundwater storage.

Task C. Evaluation of potential long-term consequences of water-use scenarios

The NARGFM was constructed as a best-available representation of the flow of water through the aquifer systems of Northern Arizona. That representation quantifies the movement of water into, through, and from the aquifers (part of the water budget) as well as quantifying how the movement of ground water into streams and rivers changes in response to stresses to the system such as withdrawals by wells. Two ongoing efforts are employing NARGFM to estimate responses of the aquifer system to groundwater pumping. The first is an analysis of system responses to three groundwater pumping scenarios provided by the Yavapai Water Advisory Committee (WAC). The second is the development of maps by the USGS in cooperation with The Nature Conservancy that plot the response of surface water features to groundwater pumping as a function of geographic location and depth of pumping for 10 and 50 years. For the purpose of this study, the time horizon of the response maps would be extended to 100 years and the resulting maps would be included in the report.

An initial set of three different water-use scenarios projected to year 2050 for the entire area of the upper and middle Verde watersheds has been supplied to the USGS by the WAC. Appreciable effort was invested in these scenarios, which represent a range of water-demand possibilities and have been sanctioned as appropriate by Yavapai County and the representatives of all of the incorporated communities of Yavapai County in the upper and middle Verde River watersheds and the Prescott Active Management Area. The USGS has committed to produce NARGFM runs for these three scenarios for the WAC. In this project the same scenarios will be run with the NARFGM with particular emphasis on the middle Verde River watershed and long-term impacts on the Verde Valley water supply. Although the scenario runs for Yavapai County WAC are specified to extend only to 2050, the scenarios for this project will be run for 100 years (to 2110) with the 2050 pumping values and other assumptions held constant for the remainder of years.

An important limiting factor for the long-term Verde Valley water supply is base flow entering the middle Verde watershed at the Paulden streamgage plus the groundwater flow entering the river between the Paulden and Clarkdale streamgages. The groundwater model allows estimation

of expected changes in groundwater levels and flows, and Verde River flows that may result from past and future pumping throughout the upper and middle Verde watersheds. The combination of future pumping scenarios run in the groundwater model and the surface-water impact maps will provide valuable information for water management in the Verde Valley. The reports planned for this project will synthesize these analyses and results with a particular focus on the implications for the water supply in the Verde Valley

D. Data collection to refine the Verde Valley water budget

Previous studies published largely the USGS and the Arizona Department of Water Resources provide important fundamental Verde Valley water-budget data. However, a better understanding of flows and uses of water in the shallow system in the vicinity of the Verde River, including agricultural and riparian uses, offers potentially important refinement of the water budget.

Diversions of stream flow for irrigation in the Verde Valley represent an important component of the valley's water budget. A detailed study in progress by researchers at Northern Arizona University offers improved quantification of the irrigation diversions. These new data will be applied insofar as possible to refine the water-budget analysis.

Evapotranspiration by crops and riparian plants is an important and large component of the overall water budget within the Verde Valley. Analysis of MODIS spectral satellite data provides a calculated "index of greenness" that will be used to estimate actual evapotranspiration of groundwater in the Verde Valley. The analysis relies on established correlations between the index of greenness and evapotranspiration. Satellite passes occur every 16 days, resulting in very good temporal resolution. Spatial resolution of the MODIS data pixels is 250 x 250 meters. The MODIS datasets in the Verde Valley for 2000 to 2007 have been compiled as part of an earlier USGS project and their analysis has been partially completed. For this work, USGS will update the datasets and analysis with the most recent available satellite data and will focus in greater detail on the evapotranspiration in the Verde Valley.

A critical complement to the remotely-sensed estimates of evapotranspiration from agricultural water use is field verification and analysis to provide an independent means of corroborating results. While the remotely sensed analysis uses data based on a 250 m pixel resolution, the field verification relies on visits by USGS personnel who take photos and notes concerning the types of crops being grown and the way irrigation water is applied. The field notes are then mapped into a GIS database using available high-resolution aerial photography to allow accurate calculation of the number of acres of specific crop and grass being grown at the time of analysis. *Cont'd on Pg 3*

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Consumptive water use is calculated using a method that considers latitude, average monthly temperature, total monthly precipitation, crop type, and crop planting and harvesting dates.

A winter base-flow analysis (seepage run) will be conducted to develop a detailed snapshot regarding the locations and amounts of water that enter and leave a stream along its length including both stream-aquifer interactions and agricultural diversions. Such information improves understanding of the stream's water budget as well as how effectively and where a stream is connected to its underlying aquifer. Occurring when evapotranspiration is at a minimum and many of the ditches are not operating, this complements data collected during the summer of 2007 between the Clarkdale streamgage and Beasley Flat and will better constrain inflows and outflows of surface water and groundwater along the course of the Verde River and its tributaries.

Reporting of results

The USGS, in collaboration with the Partnership, will produce two published reports. The first will describe the results of the study including its data, the limits and application of the data, and the conclusions with respect to long-term water supply of the Verde Valley under the posited water-management scenarios. The report will also include recommendations for enhancement of the NARG-FM to improve its utility for guiding water-management decisions. The report is intended to serve as a key building block in both defining future studies and establishing a well-documented basis for consideration by citizens and elected officials of the long-term potential and limitations of the water supply in the Verde Valley.

To serve the latter purpose a second report will be written that is based on rigorous science while still being readily understood by nonscientists. Written intentionally for an audience of lay-readers including the stakeholders represented in the Verde River Basin Partnership and the resource managers of the area, it will emphasize interpretation of the conclusions and their implications for the strengths and liabilities of the water resources of the Verde Valley over the long term.

Proposal and project review

In order to assure the technical soundness and appropriateness of the planned work, the plan was reviewed and endorsed with minor modification on May 18, 2009, by the following panel of technical experts representing the Hydrology Subcommittee of the Partnership's Technical Advisory Group (TAG):

James Leenhouts, Hydrologist, Associate Director, USGS Arizona Water Science Center

Edward Wolfe, USGS geologist (retired), Chair, TAG

William Meyer, USGS hydrologist (retired), Chair, Hydrology Subcommittee

Abe Springer, Hydrogeologist, Professor, NAU

Jeanmarie Haney, Hydrogeologist, The Nature Conservancy

Lloyd Barnett, Hydrologist, USFS (retired)

Frank Corkhill, Hydrologist, ADWR

Greg Kornrumph, Principal Analyst, SRP

Steve Westwood, Geologist, SRP

Review of the project work by the Hydrology Subcommittee is planned on at least a quarterly basis in order to assure that the success of the project relies not only on the technical expertise of the USGS staff, but also on regular communication between USGS scientists and the Partnership. This communication will be bidirectional, serving both as a means for USGS to share ongoing progress and results, and for USGS staff to tap the technical expertise of the Hydrology Subcommittee of the Partnership's TAG.

Prepared by Ed Wolfe

MONSOON-RAINFALL OUTLOOK UNCERTAIN

Predicting the strength and persistence of the North American Monsoon is one of the most difficult forecast problems meteorologists in the Southwestern United States encounter, and even though summer 2010 has officially begun, this year's outlook is one of the more uncertain in recent memory. Although our understanding of the Monsoon is far from complete, the various long-range forecast indicators that are widely acknowledged to provide insight into the upcoming Monsoon's behavior have seemingly been at odds this spring. A few suggest a lackluster monsoon is ahead of us, a few suggest activity may at least approach normal levels and some are simply indeterminate. This has led most Arizona precipitation outlooks that cover the months of July, August, and September to follow that of the National Weather Service and indicate that odds of rainfall during this year's monsoon falling into the "above", "near", or "below" normal category are equally likely. Given this and the ongoing changes in the weather pattern over the Western United States, perhaps the only definitive statement that can be made about this year's monsoon is that no one really knows for sure exactly how it will happen, but it will happen. *Submitted by Salt River Project*

THE NATURE CONSERVANCY PURCHASES SHIELD RANCH

The Nature Conservancy and its partners made a significant step in late June in the protection of the Verde River through the acquisition of the historic Shield Ranch, a biologically important property in the Verde Valley that is adjacent to the river and between the Prescott and Coconino National Forests. The ranch is now part of nearly 6,000 acres that The Nature Conservancy and its partners have conserved in recent years along the Verde's headwaters and the Verde River Greenway Natural Area in the Verde Valley.

This 306-acre property, which was settled in the mid-1800s and which the Shill family owned and operated as a cattle ranch since 1944, is located at the confluence of the Verde River and one of its important tributaries, West Clear Creek, just outside of the town of Camp Verde. The property sustains a lush riverside plant community that supports a large wildlife population, including river otter, beaver, nesting bald eagles, several endangered bird species and native fish. Eventually, the Conservancy plans to transfer ownership of most of the property to the Coconino National Forest to be managed as part of the National Forest System.

The Shield Ranch acquisition is part of a collaborative effort to conserve the Verde River, one of the Southwest's few remaining free-flowing rivers. The Verde River is an important water source for people and wildlife along its 189-mile course, including communities in the Verde Valley and

in the Phoenix metro area. The property is directly across the river from the 209-acre Rockin River Ranch, which is the southern anchor for the 36-mile Verde River Greenway, a public-private effort to conserve the Verde Valley's river corridor for wildlife habitat and public recreation.

"The Verde River is a lifeline for people and nature and is vital to the economic, recreational and natural future of the Verde Valley," said Patrick Graham, state director of The Nature Conservancy in Arizona. "The Shield Ranch is an important part of Arizona's history. We're pleased to partner with the Shill family, Doris Duke Charitable Foundation and others to conserve this special place and the Verde River for future generations."

The Shield Ranch was one of the first homesteads settled as a farm in the Verde Valley in the mid-1800s. According to historical documents at Fort Verde State Park, present-day ranch land near West Clear Creek was the site of a tent camp of soldiers sent to protect the farms in the area.

Partial funding for the project was provided by the Doris Duke Charitable Foundation as part of the foundation's \$13 million grant to The Nature Conservancy to support state wildlife action plans across five Rocky Mountain states: Arizona, Colorado, Montana, New Mexico and Wyoming.

*From a June 29, 2010, press release of
The Nature Conservancy*

STATE OF SRP VERDE RIVER RESERVOIRS (July 12, 2010)

	% Full	Current Storage, Acre-feet
Horseshoe	60	65,930
Bartlett	89	158,141
Total Verde System	78	224,071

Data from <http://www.srpwater.com/dwr/>

Yavapai County Water Advisory Committee (WAC) Update

As the new County fiscal year begins, the Yavapai County Water Advisory Committee (WAC) is continuing priority projects including the Central Yavapai Highlands Water Resource Management Study (CYHWRMS) with the Arizona Department of Water Resources (ADWR) and U.S. Bureau of Reclamation, and the NAU surface-water model for the Verde Valley system. Additionally, the WAC is continuing to fund basic hydrology data collection through the USGS and anticipating the arrival of the USGS Northern Arizona Regional Groundwater Flow Model.

The first phase of the CYHWRMS study has been completed and the Demand Analysis Table and supporting documentation are complete and posted to the WAC website (<http://www.co.yavapai.az.us/Content.aspx?id=20562>). The results of phase 1 indicate a potential unmet demand of approximately 45,000 to 80,000 acre feet per year in 2050 within the study area. The Technical Working Group (TWG) is now working on a second phase which is a water-supply assessment to characterize water resources that could be included into various water-supply portfolios to meet different combinations of 2050 water demands within the planning areas. Potential sources of water are being compiled in a table that includes location, type, availability, quantity, quality, and other comments. These are the "pools" of water that may be available to meet the future

demand. Phase 2 will be followed by development of alternatives to meet future demands. The TWG typically meets on the first Thursday of each month at 10:30 following the meeting of the Technical Committee of the WAC.

The WAC will continue to fund monitoring of surface-water gages installed as part of the NAU surface water modeling work on the Verde River. In addition to gaining basic knowledge about the Verde Valley surface-water system, the WAC hopes to incorporate some of these data into the USGS regional groundwater model. The Model Report for the current USGS Northern Arizona Regional Groundwater Flow Model is in the publication process. It is anticipated to be available to the public this summer. The WAC has prepared a set of scenarios for the model that will investigate a range of groundwater pumping conditions in the Big Chino, Little Chino and Verde Valley areas. The results of these model runs should be available this year and will be reported to the WAC. Other future scenarios may be developed based on the results of the first model runs and results of the CYHWRMS.

Please contact the WAC Coordinator, John Rasmussen, for meeting dates, details on any of the WAC activities or if you would like to be added to the WAC email-recipient list (john.rasmussen@co.yavapai.az.us or 928-442-5199).

Written by John Rasmussen

Membership Form for the Verde Watershed Association

Government units	\$ 100 per year
Business for profit	100 per year
Civic groups and non-profits	50 per year
Individuals	25 per year

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