



## FEBRUARY 2013 NEWSLETTER

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## GOVERNMENT GOINGS-ON

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On December 12, 2012 the Bureau of Reclamation released the final version of the Colorado River Basin Water Supply and Demand Study. You can look at all seven technical volumes at <http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/index.html> which is a lot of reading. The report was three years in the making, involved efforts from three major consulting firms, and covered both the Upper Basin and Lower Basin. It is an excellent example of how government can work to accomplish something that is far-reaching and badly needed. USBR is accepting comments on the report through March 14.

The report is a milestone for Colorado River management, and will be referenced for years to come. The study addressed two basic questions: 1) What is the future reliability of Colorado River system resources to meet Basin needs through 2060? 2) What are the options and strategies to mitigate future risks to these resources? Scenario planning was employed to address these questions. Scenario planning recognizes a broad range of possible future states. Quantification of scenarios allowed assessment of the reliability of the system and the viability of various options and strategies. Figuring out how the system might evolve amidst all the natural and cultural forces at work and the uncertainties associated with each demand such a sophisticated approach.

Out of the four supply scenarios, a 9% reduction in flows at Lees Ferry emerges. Given the six demand scenarios, a 3.2 million acre-foot imbalance (shortfall) by 2060 is the average value. This doesn't mean that the Southwest is facing the end of the world, but it does mean that planning for viable options to meet the shortfall should begin soon. And that is truly what this report is—a call to action for all users of Colorado River water to start looking ahead and planning for a future in which supplies are less than demands. Given Arizona's long history of planning for an acceptable water future, it is not a challenge that can't be met.

*Alan Dulaney,  
City of Peoria*

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## AHS 2013 SMPOSIUM UPDATE

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The 2013 Symposium Planning Committee is busily working to put together a strong program, exciting workshops and field trips, and fun social events at our "SHIFTING BOUNDARIES: Recalibrating the Hydrologic Approach" symposium in Tucson at the Doubletree Reid Park Hotel, September 18-21, 2013.

A call for abstracts will go out in March for session topics. We have secured Grady Gammage Jr. as one of the plenary speakers, and James Rumbaugh, creator of Groundwater Vistas, will be conducting an introductory workshop on MODFLOW-USG. In addition to session content, we are actively pursuing a variety of workshop and field trip opportunities which will be also be announced soon.

Our symposium website is expected to launch in February and the website address will be provided via e-mail announcement and in the upcoming March AHS newsletter. Symposium content is being secured daily and will be updated on our website regularly.

We have a very strong and enthusiastic group of volunteers this year, and we invite you to join the fun as part of the planning committee. Please contact Marla Odom ([modom@elmontgomery.com](mailto:modom@elmontgomery.com)) if you are interested in participating.

A biography of plenary speaker, Grady Gammage Jr., is provided below:

### **Grady Gammage, Jr.**

Grady Gammage, Jr. is a part time academic, a practicing lawyer, an author, a sometime real estate developer and a former elected official. He thinks life is more interesting if you do lots of different things.

In his academic role, Mr. Gammage is a Senior Fellow at ASU's Morrison Institute. His work there focuses on urban growth and development, quality of life, and local economic issues. He also teaches at the Sandra Day O'Connor College of Law and at the Herberger Institute of Design and the Arts.

As a lawyer, he has represented real estate projects ranging from master planned communities to sprawling subdivisions to high rise buildings and intense urban mixed use redevelopment.

He served on the Central Arizona Project Board of Directors for 12 years, and was President during a period of turbulence when the CAP was suing the Federal Government over the cost of the canal.

As a real estate developer, he built an intense, urban mixed use project in the City of Tempe which won three architectural awards and has been widely acclaimed.

Mr. Gammage is the author of the book "*Phoenix in Perspective*" and numerous articles on land use and growth issues. His most recent publication "*Watering the Sun Corridor*" was issued by the Morrison Institute in August of 2011



**Save the Date**

**SHIFTING BOUNDARIES:**  
Recalibrating the Hydrologic Approach

**September 18-21, 2013**  
Doubletree Reid Park  
Tucson, Arizona



ARIZONA HYDROLOGICAL SOCIETY  
26TH ANNUAL SYMPOSIUM

**Abstracts accepted  
beginning  
March 2013**

Symposium website  
and registration page  
launching soon!  
Watch AHS newsletter  
for updates.

Doubletree by Hilton  
520-881-4200

**GROUP CODE: AHS**

70 rooms reserved at \$90/night conference rate.  
Book early to guarantee best rate.



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## AHS FIRST QUARTER CORPORATE BOARD MEETING

The first quarter meeting for 2013 will be Saturday, February 16, 2013, at the offices of Montgomery & Associates, 1550 E. Prince Road in Tucson. An agenda will be posted when available.

Remember that all AHS members are welcome at any corporate board meeting. Please contact [Mike Hulst](#) or [Christie O'Day](#) to RSVP.

## AHS MEMBERSHIP 2013 RENEWAL REMINDER

Thank you to all of you who have renewed your AHS membership! If renewing is still on your "to do" list, then it's time to jump online at [http://www.azhydrosoc.org/join\\_ahs.html](http://www.azhydrosoc.org/join_ahs.html) and renew today! Please remember, though, that 2013

membership dues were included in both full registration and one day 2012 Symposium registration fees, so those of you who attended the symposium do not need to renew. You can also send your membership dues by mail to...

**Arizona Hydrological Society**  
**P.O. Box 1882**  
**Higley, AZ 85236**

Thank you for your continued support of the Arizona Hydrological Society!

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## PHOENIX CHAPTER NEWS

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The next Phoenix chapter dinner meeting will be held **on Tuesday, February 12, 2013**, at SunUp Brewing Co., in midtown Phoenix (on the north side of Camelback Road, just east of Central Avenue). Please join us for a beverage, to share business cards, and talk water!

<b>Location:</b>	<a href="#">SunUp Brewery</a> 322 E. Camelback Road Phoenix, AZ 85012
<b>Event:</b>	TBA
<b>Chapter Board Meeting:</b>	4:30 PM – 5:30 PM
<b>Happy Hour &amp; Dinner:</b>	5:30 PM – 7:00 PM
<b>Program:</b>	7:00 PM – 8:00 PM
<b>Cost:</b>	\$15 member, \$20 non-member, \$5 student

Please RSVP to Michele Robertson at [mrobertson@elmontgomery.com](mailto:mrobertson@elmontgomery.com) or 480-948-7747.

Hope to see you there!

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### Future Event Calendar (see also calendar on [www.azhydrosoc.org](http://www.azhydrosoc.org))

- March and beyond – maybe you? Please contact [Tom Walker](#), Phoenix Chapter Vice President, if you would like to give us a presentation or if you know anyone else who could use an audience.

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## HERMAN BOUWER INTERN SCHOLARSHIP ANNOUNCEMENT

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- ▶ Deadline for Application (Students): March 18, 2013
- ▶ Deadline for Application (Employers): April 30, 2013

### Information for Students

The Herman Bouwer Intern Scholarship gives students enrolled in a hydrology-related discipline at any Arizona college or university the opportunity to gain practical experience in the multidisciplinary field of hydrology and water resources. Administered by the Phoenix Chapter, this scholarship acknowledges the extensive contributions of Dr. Bouwer to the science of hydrology and to the AHS. Known to many AHS members as “mentor and trusted friend,” Dr. Bouwer is a charter member of AHS and the 1996 recipient of the [AHS Lifetime Achievement Award](#). We are honored to have him, a scientist of international stature, in our midst.

Recipients are chosen after a rigorous selection process and serve their internship with employers in the Phoenix area. The Intern is required to complete 200 hours of service with three organizations of his or her choice in government, private industry, and environmental, and water-resources consulting. The employer organizations provide a meaningful training experience that will better prepare the intern for employment in their chosen career goals. A \$3,000 monetary scholarship is included as part of the award.

[E-mail us](#) if you would like more information about the Herman Bouwer Intern Scholarship Program. [You can also download an application by clicking here.](#)

## Information for Interested Employers

The Phoenix Chapter of the Arizona Hydrological Society is seeking interested employers from government, private industry, and environmental consulting firms to participate as a host to the Herman Bouwer Intern Scholar. The selected student recipient of this award will be in pursuit of a college degree in hydrology, geology, environmental science, civil engineering, environmental engineering, or a related field of study. This program is entering its 14th year of existence in the Phoenix area and will be selecting the 2013 Intern Scholar on April 30, 2013. The awarded student will have the opportunity to complete 200 hours of service between the dates May 1 and September 1, 2013, with at least three government or private industry organizations in the environmental, geological, or water resources field of study. The selected student will be required to complete a minimum of 40 hours of service at each organization. Part of the 200 hours of service will include the opportunity for the student to obtain their HAZWOPER training for entrance on hazardous waste sites. The scholarship program also provides a monetary award to the student of \$3,000 FULLY funded by the Arizona Hydrological Society

This is an excellent opportunity for government or private industry organizations to try out a potential employee. Participating host organizations reserve the right to have the scholarship recipient sign a liability and confidentiality waiver. The Herman Bouwer Intern Scholarship Recipient will have the opportunity to choose from a list of interested government or private industry organizations that are in line with the student's career goals. For this reason, the Intern Scholarship Committee wants any interested organization to respond by completing the [Employer Interest Survey Form](#) and e-mail it to [Steve Acquafredda](#) by April 30, 2013.

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## ASU GRADUATE STUDENT RESEARCH SYMPOSIUM

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Presented by the Graduate Students  
in the  
School of Sustainable Engineering and the Built Environment

Thursday, March 7<sup>th</sup>, 2013  
5:00-6:00pm - Poster Session / Social Hour  
6:00-7:30pm - Oral Presentations  
Location: ASU Tempe Campus, Memorial Union,  
Turquoise Ballroom, MU 220

Presentations will include Construction Management, Construction Engineering, Environmental, Geotechnical, Hydro-Systems, Structures and Materials, Sustainability, Transportation Materials and Transportation Systems.  
*More details on presentations to follow.*

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## TUCSON CHAPTER NEWS

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The Tucson Chapter will not have a February meeting. But please plan on joining us in March for pizza and to talk water!

## 2013 LEONARD HALPENNY INTERN SCHOLARSHIP

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**Applicants:** Undergraduate and graduate students in a hydrology-related field of study from an Arizona college or university. Qualified undergraduates will be given first preference in the selection process.

**Award:** \$3,000 stipend for 200 hours of experience within the 2013 calendar year with multiple agencies and private consulting companies in Tucson, Arizona.

The Tucson Chapter of the Arizona Hydrological Society (AHS) is now seeking applicants for the **2013 Leonard Halpenny Intern Scholarship**. The successful candidate will have the unique opportunity to work part-time throughout 2013 as an intern scholar at multiple hydrological work environments in Tucson. Previous participating companies have included: Tucson Water, the United States Geological Survey, Montgomery & Associates, Brown and Caldwell, HydroGeoChem, the Arizona Department of Water Resources, Metro Water, the Nature Conservancy, Pima County Flood Control District, Clear Creek Associates, Hargis+Associates, and Geo Systems Analysis. The intern scholarship is open to undergraduate and graduate students in the fields of hydrology, geology, civil, environmental and geologic engineering, renewable natural resources, wastewater management, soil and water science, and other hydrology-related studies. Students from any Arizona college or university may apply to participate in the program. Award winners must complete their internship in Tucson. The scope of work may include water sampling, regulatory aspects of recharge and water-resource management, fieldwork, retrospective analysis of existing data, and other types of activities that might be encountered in an entry-level hydrology-related position.



### Description of the Intern Scholarship Program:

- **The application materials are to be received by 5:00 PM, April 5, 2013.** Applications which have not been received in full by the due date will be disqualified, without exception.
- Candidates must be available for an interview the week of **April 15<sup>th</sup>, 2013.** The Leonard Halpenny Intern Scholarship Committee will announce an intern by **April 19<sup>th</sup>, 2013.**
- The selected candidate will be required to complete 200 hours of service with at least four organizations. The student will serve a minimum of 40 hours with each organization and additional hours will be served at the students' and organization's discretion.
- Scheduling will be flexible and will be negotiated by the student and participating organizations. Service must be completed by December 31, 2013.
- Candidates must be willing to sign liability and confidentiality waivers for participating organizations prior to commencement of their intern scholarship.
- The intern will be required to keep and submit a record of hours completed, and to submit an article summarizing his or her own experience that will be published in the Arizona Hydrological Society newsletter.
- The candidate will be invited to attend the 2013 AHS Annual Symposium to formally receive the award. In the event that the intern cannot attend the Symposium, they will be invited to receive the award at a monthly meeting of the AHS Tucson Chapter.
- Prior AHS Intern Scholarship winners and students not currently enrolled in an Arizona college or university are ineligible for this award.

Those who wish to apply should obtain an application form from our web site: [www.azhydrosoc.org](http://www.azhydrosoc.org). The application consists of a one-page application form, a one-page essay, transcripts (unofficial), and two letters of recommendation (at least one from an instructor, the second can be from an employer).

Contact: Damian Gosch, AHS Tucson Chapter President ([dgosch@hargis.com](mailto:dgosch@hargis.com)), with any questions.

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## **UPCOMING WRRC SPONSORED EVENTS**

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### Water Sustainability Distinguished Speaker Series

**Tuesday, February 5, 3:00 - 4:00 pm**

Justice Gregory Hobbs, Colorado Supreme Court

Title: Living the Four Corners: Honoring our Water Short Character - Preserve, Conserve, Sustain and Inspire

Location: Ares Auditorium, College of Law, reception to follow

Co-sponsors: Water Sustainability Program, College of Law, WRRC

[More>>](#)

**Thursday, February 28, 3:00 - 4:00 pm**

Patricia Mulroy, General Manager, Southern Nevada Water Authority

Title: Las Vegas - Navigating the Perfect Water Resources Storm

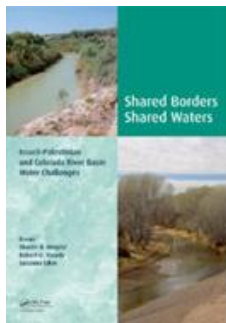
Location: Ares Auditorium, College of Law, reception to follow

Co-sponsors: Water Sustainability Program, College of Law, WRRC

[More>>](#)

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### WRRC Chocolate Fest, Book Launch, and Photo Contest Winners



**Friday, February 15, 3:30 - 5:00 pm**

Program begins at 4:00 pm with the book launch for **Shared Borders, Shared Waters: Israeli-Palestinian and Colorado River Basin Water Challenges** and announcement of Photo Contest Winners

Location: WRRC, Sol Resnick Conference Room

Co-Sponsors: Arizona Center for Judaic Studies, Center for Middle Eastern Studies, Udall Center for Studies in Public Policy, and Water Sustainability Program

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## **FLAGSTAFF CHAPTER NEWS**

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Please monitor the AHS-Flagstaff web page and AHS LinkedIn Group to see when the next meeting will be scheduled. Hope everyone enjoyed the 2012-2013 Jahn's Distinguished Lecture!

## HYDRO-NEWS

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### ARIZONA GEOLOGICAL SOCIETY MEETINGS

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#### Special Lunchtime Brown Bag Talk

Gold-silver deposits and alteration zones in the Miocene Bodie Hills volcanic field, CA-NV, and comparison among Miocene gold-silver deposits in the western Great Basin

**Peter G. Vikre**  
**U.S. Geological Survey**

**Tuesday, February 5, 12:10 PM**  
**Room 353**

**Environment and Natural Resources Building** (NE corner of Park Ave. and 6th St. Parking is available in the parking garage east of the building.)

#### Abstract

Peter Vikre, David John, Edward du Bray, and Robert Fleck  
 U.S. Geological Survey, Reno, NV, Menlo Park CA, Denver, CO

The Middle-Late Miocene Bodie Hills volcanic field, CA-NV, contains three precious metal mining districts (Masonic, Aurora, and Bodie), with combined production of ~3.4 Moz. Au and ~28 Moz. Ag, and nine variably-sized alteration zones (<1- >30 km<sup>2</sup>), which contain small mercury deposits and a significant sulfur resource (16.1 Mt @ 17.9% S). The ~40 by 30 km volcanic field is made up of coalescing, 15-6 Ma trachyandesite stratovolcanoes, trachydacite and rhyolite lava domes, and related volcanoclastic deposits, that cover an irregular erosional surface of Paleozoic and Mesozoic metavolcanic, metasedimentary, and granitic rocks. Volcanic rocks have compositions that reflect subduction zone magmatism. Hydrothermal systems that formed precious metal deposits and alteration zones were intermittently active during and following development of trachyandesite stratovolcanoes and rhyolite flow-domes at 13.4-11 Ma, and following eruption at 9-8 Ma of trachyandesite to rhyolite flows, domes, and associated volcanoclastic deposits. Based on volcanic stratigraphy, geochronology, remnant paleosurfaces and potentiometric surfaces, and ~11 Ma flora, present landforms in the volcanic field (elevation range ~5600- >10,000 ft) reflect incremental construction, mainly from 15-8 Ma, of large- and small-volume flow-domes and stratovolcanoes, magmatic inflation, and fault displacements. Estimated paleoelevations (~4300- >8500 ft) during construction imply little additional relief since the late Miocene.

Masonic Au-Ag-Cu deposits, which formed at ~13.4-13.3 and 13 Ma, comprise two styles of mineralization: (1) high-angle, fault breccia deposits in Mesozoic granodiorite and 15-14 Ma trachyandesite flows, and (2) stratiform deposits in 15-14 Ma trachyandesite volcanoclastic and chemical (pool sinter) sedimentary sequences. Both types of deposits consist of quartz, enargite, pyrite, small (tens of m) inclusions and intergrowths of numerous Cu-As-Sb-Fe-Bi-Au-Ag-S-Se-Te minerals, Au-rich electrum, alunite, kaolinite/dickite, pyrophyllite, and K-mica. Strata enclosing both styles of mineralization have been altered to quartz, alunite, pyrite, kaolinite/dickite, pyrophyllite, K-mica, and montmorillonite.

Aurora Au-Ag veins, which formed at ~10.5 Ma mostly in 13.1-12.6 Ma trachyandesite of Aurora, consist of fine-grained layered to granular quartz, and up to several percent pyrite, electrum, acanthite, naumannite, sphalerite, galena, polybasite, tetrahedrite, a Ag-Au-S mineral (~Ag<sub>4</sub>AuS<sub>3</sub>), K-mica, calcite, and K-feldspar. Trachyandesite wall rocks proximal to veins, vein zone septa, and breccia fragments have been altered to K-mica, K-feldspar, and pyrite. Distal, pervasively altered trachyandesite contains variable proportions of chlorite, albite, calcite, montmorillonite, and lesser fine-grained quartz, K-mica, and pyrite (FeOx).

Bodie Au-Ag deposits include three distinct vein sets and sinter that formed from 8.5-8.1 Ma in ~9 Ma dacite of Silver Hill domes. *Burgess series* veins, which are composed of relatively coarse-grained, quartz±adularia layers, and up to 5% electrum, Ag-S-Se minerals, pyrite, sphalerite, and galena, are enclosed by m-wide selvages of dacite altered to K-feldspar, K-mica, and pyrite. Most Au and Ag were produced from finely banded quartz±adularia *Incline series* veins that contain small amounts of electrum and Ag-S-Se minerals and are enclosed by dacite altered to K-feldspar, lesser quartz, and minor K-mica and pyrite. *Silver Hill series* veins, which consist of fault breccia cemented by quartz, adularia, K-mica, calcite, and up to 10% metallic minerals, predominantly sphalerite, galena, tetrahedrite, and chalcocopyrite, and lesser, pyrite, acanthite, electrum, bornite, and hessite, are enclosed by m-wide selvages of dacite altered to quartz, pyrite, and K-mica.

Differences between Miocene quartz±adularia Au-Ag sinter-vein systems and quartz+alunite ±Au-Ag-Cu veins and alteration zones in the Bodie Hills, and among Au-Ag-Cu deposits and alteration zones in the southern part of the Cascades magmatic arc, relate to: emplacement depth of magma, magmatic composition, oxidation state and volatile concentrations (mainly H<sub>2</sub>S and SO<sub>2</sub>), multiple intrusions of magma, metal and volatile partitioning paths during cooling and decompression of magma, sources of hydrothermal mineral components, tensile strengths and permeabilities of host rocks, and climate.

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#### Regular Evening Dinner Presentation

***Succession of Laramide magmatic and magmatic-hydrothermal events in the Patagonia Mountains, Santa Cruz County, Arizona***

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Peter G. Vikre  
U.S. Geological Survey

**Sheraton Tucson Hotel & Suites**

**Oasis Room** (On the ground floor by the pool in the hotel courtyard)

**5151 East Grant Road, Tucson**

(The hotel is on Rosemont north of Grant, just north of the International House of Pancakes.)

**Lecture at 8:00 PM**

**Tuesday, February 5, 2013**

[Reservations are required for the dinner.](#) Admission to the talk only is free. Please also note that although there is limited surface parking around the hotel, there is ample parking in the garage beneath the hotel.

**Special Meal Deal for Students! Dinner is FREE for students who make a reservation online at the website below. Please bring a student ID with you.** Note: AGS is pleased to provide free meals for student members with an online dinner reservation. Please remember that these meals are paid for by AGS. If you make a reservation and do not attend, AGS must still pay for the meal. Please cancel your reservation by 5 PM on the Friday before the meeting if you are unable to attend. The AGS Executive Committee may consider charging for unclaimed student meals, as we do for regular members, if the cost of no-shows continues to be a problem.

**SCHEDULE: CASH BAR @ 6:00 PM, DINNER @ 7:00 PM, TALK @ 8:00 PM. WITH RESERVATION: MEMBER = \$24.00, GUEST = \$27.00.** If you do not have a reservation, an extra \$3.00 will be charged. Also, without reservations you may not get dinner. To make dinner reservations please call the AGS answering machine at (520) 663-5295 or reserve online at <http://www.arizonaageologicalsoc.org/meeting-information/dinner-reservations> by 5:00 P.M. on the Friday before the meeting. Leave name, number of attendees, and whether a vegetarian or low-salt meal is required. This number can also be used for field-trip reservations and leaving messages for Society officers. Please cancel your reservation via the answering machine if you find that you will be unable to attend.

**Succession of Laramide magmatic and magmatic-hydrothermal events in the Patagonia Mountains, Santa Cruz County, Arizona**

Peter G. Vikre<sup>1</sup>, Frederick T. Graybeal<sup>2</sup>, Robert J. Fleck<sup>1</sup>, Mark D. Barton<sup>3</sup>, and Eric Seedorff<sup>3</sup>

<sup>1</sup> U.S. Geological Survey; <sup>2</sup> Exploration Management LLC; <sup>3</sup> University of Arizona

**Abstract**

The Patagonia Mountains of southern Arizona, U.S.A., consist of Precambrian, Paleozoic and Mesozoic sedimentary, granitic, and volcanic rocks, Laramide volcanic rocks, and a core of Laramide intrusions that comprise the Patagonia Mountains batholith. Laramide igneous rocks and adjacent Paleozoic and Mesozoic rocks contain significant porphyry Cu-Mo deposits, Mo-Cu breccia pipes, Ag-Mn replacement deposits, and numerous other Cu-Pb-Zn-Ag replacement and vein deposits. Uranium-Pb and <sup>40</sup>Ar/<sup>39</sup>Ar ages of igneous and hydrothermal minerals define 4 magmatic and magmatic-hydrothermal events that formed the batholith and altered parts of it and adjacent rocks; cumulatively the events span at least 16 Ma, from ~74 to 58 Ma. The oldest event of this succession includes the 74 Ma-Washington Camp stock and spatially associated Cu-Pb-Zn-Ag replacement deposits (0.45 Mt @ 2% Cu, 3% Pb, 8% Zn, 3.6 oz/t Ag) in Paleozoic carbonate rocks of the Washington Camp-Duquesne district in the southeastern part of the range. Some to most of these deposits could be 61-59 Ma, the age range of large-volume quartz monzonite, granodiorite, and quartz monzonite porphyry that make up most of the batholith and surround the Washington Camp stock and Paleozoic strata. The next youngest event was eruption of 73-68 Ma-volcanic rocks in the northern part of the range, which temporally coincides with replacement and vein deposits in Paleozoic carbonate rocks at the Flux mine (~71 Ma; 0.85 Mt @ 2.5% Cu, 5% Pb, 8% Zn, 5 oz/t Ag). An event at 65-62 Ma is marked by emplacement of small-volume quartz monzonite, granodiorite, and diorite intrusions, formation of the Ventura breccia deposit in Jurassic granite (65-64 Ma; 3.6 Mt @ 0.24% Mo, 0.24% Cu), and formation of other Pb-Zn-Ag-Cu replacement and vein deposits (~62 Ma; Blue Nose and Morning Glory). The Red Mountain porphyry Cu-Mo system occurs in ~62 Ma-granodiorite and Laramide volcanic rocks (73-68 Ma) at the northern end of the batholith. It includes a deep, chalcocopyrite-bornite resource (~60.4 Ma; 434 Mt @ 0.64 % Cu, 0.011 % Mo), associated with potassic and sericitic alteration, and a near-surface chalcocite-enargite resource (60 Ma; 140 Mt @ 0.31% Cu, 0.022% Mo), associated with advanced argillic alteration that has been supergene-enriched.

The youngest event includes the Sunnyside porphyry Cu-Mo system, ~4 km (~2.5 mi) south of Red Mountain, and a Cu-Mo breccia deposit at Red Hill (Four Metals mine) in the south-central part of the batholith, both of which formed in large-volume quartz monzonite, granodiorite, quartz monzonite porphyry, and quartz feldspar porphyry (~61-59 Ma). Similar to the Red Mountain system, the Sunnyside system consists of a deep chalcocopyrite resource (1.5 Gt @ 0.33 % Cu, 0.011 % Mo, 0.16 oz/t Ag), that occurs in ~60-59 Ma-quartz feldspar porphyry, and a near-surface, slightly younger (~59-58 Ma) enargite-chalcocite-tennantite resource (800 Mt @ 0.183 % Cu, 0.02 oz/t Ag), that occurs in quartz feldspar porphyry, quartz monzonite porphyry, and Mesozoic rocks. The Red Hill Cu-Mo breccia deposit (7.8 Mt @ 1.2% Cu, 0.11% Mo, 0.08 oz/t Ag) occurs in large-volume quartz monzonite, granodiorite, and quartz monzonite porphyry (~61-59 Ma). Discrepancies between field relationships and some analytic ages at Sunnyside and Red Hill preclude precise dating of mineralization stages, and reflect disturbance of isotope systems by multiple, co-spatial to juxtaposed intrusive and hydrothermal events, and/or unrecognized intrusions. Numerous vein and replacement deposits at the northern end of the batholith, including the Hardshell Ag-Mn resource (52.3 Mt @ 2.1 oz/t Ag, 7.3% Mn), and the Three R supergene chalcocite resource (79 Mt @ 0.32 % Cu), are distal deposits of the Sunnyside and Red Mountain systems. Small Cu-Mo deposits in the southern part of the batholith that consist of hydrothermal biotite, K-feldspar, K-mica, chalcocopyrite, and molybdenite, are ~60-59 Ma.

Other lengthy magmatic-hydrothermal successions in the western U.S. that consist of episodic magmatism and associated porphyry Cu-Mo systems are the Wasatch-Oquirrh igneous trend, UT, and the Boulder batholith, MT. These successions span ~17 Ma and include the Bingham and Butte porphyry Cu-Mo, vein and replacement deposits, respectively. Magmatism and mineralization in the Pima district, AZ, which includes the porphyry Cu-Mo deposits at Sierrita-Esperanza, Mission-Pima-San Xavier North, and Twin Buttes, formed over an interval of ~14 Ma.



Dr. Vikre can be reached at [pvikre@usgs.gov](mailto:pvikre@usgs.gov)

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## DRAGONFLY DAY AT THE RIO SALADO HABITAT RESTORATION AREA, PHOENIX

Mark your calendars for Dragonfly Day on February 23rd at the Rio Salado Habitat Restoration Area! The event will incorporate science, art, and recreation into a fun filled event for adults and youth alike in order to connect people with their local waterways and build a greater understanding of the importance of water resources in our arid climate. Educational booths, food trucks, and artwork will be located around the parking area and trailhead at 2439 S. Central Avenue, just south of downtown Phoenix. Families, youth, and adults can join in expert-lead walks to the demonstration wetlands where they will look for dragonflies, view the new butterfly habitat, and participate in water-quality testing activities. [Click here for full flyer.](#)

This is the first major event at the Restoration Area since the 2006 grand opening and a fun collaboration among the Arizona SciTech Festival, Master Watershed Stewards, and the City of Phoenix. The Rio Salado Audubon Center will also be hosting activities and a trail will connect the two sites. For more information, go to <http://azscitechfest.org/events/dragonfly-day-rio-salado>.

If you are interested in becoming a sponsor or having a booth contact Summer Waters at [swaters@cals.arizona.edu](mailto:swaters@cals.arizona.edu).

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## WRRC'S 2013 ANNUAL CONFERENCE TAKES ON "WATER SECURITY FROM THE GROUND UP"



### Earlybird Registration for Annual Conference Extended Through Feb. 5

Water enthusiasts will now have an additional five days to take advantage of the special earlybird registration rate for the UA Water Resources Research Center's Annual Conference. The WRRC has extended earlybird registration through Tuesday, Feb. 5, following a weekend web server outage that affected the conference's registration page. We apologize for any inconvenience our server issues may have caused.

[REGISTER NOW](#)

### Future Water Leaders Focus on Water Security at WRRC Conference Lunchtime Panel

The perspectives of students and early career water professionals on the future of water in Arizona will be the focus of the lunchtime panel discussion at this year's WRRC Annual Conference on March 5.

A panel of Arizona's future water leaders - UA School of Geography and Development Ph.D. candidate Jamie McEvoy, UA Dept. of Agricultural and Resource Economics student Ross Rayner, and Carollo Engineers' Process Engineer Lisa Snyders - will share their insights and vision.



*Guy Carpenter*



*Jamie McEvoy*



*Lisa Snyders*



*Ross Rayner*

Carollo Engineers Vice President Guy Carpenter will chair the event and will question the panel on a wide array of water security topics, including: the meaning of water security; constraints, problems and solutions; and how we can better secure our water in the future.

McEvoy will present her views based on her background in climate, water and population growth in northwestern Mexico and the southwestern United States, and her research into the risks and hazards of using desalination technology to address water scarcity. Rayner will answer questions from the perspective of his family, which has been farming in central and southern Arizona for more than 100 years, and whose holdings currently span more than 5,000 acres. Snyders will contribute her opinions based on her experiences in engineering, water infrastructure, planning, design and construction of water and wastewater facilities.

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## THE WATER FESTIVAL



### SUNDAY • APRIL 21 • 9AM - 2PM

Reid Park DeMeester Outdoor Performance Area  
(Country Club Road, N. of 22nd Street, Tucson)  
FREE to attend!

**YOU'RE INVITED** to participate in Tucson Arts Brigade's 4th Annual Water Festival, integrating art, science and culture to raise awareness, promote stewardship, and foster creative expression about our water future. This year, The Water Festival is partnering with the Earth Day Festival at Reid Park!

THE WATER FESTIVAL is the ONLY large-scale water-focused community event in Pima County and is a prime opportunity to engage the public through diverse activities for learning, networking, family fun, and creative interactions with water.



#### SPONSORS & EXHIBITORS:

[DOWNLOAD THE WATER FESTIVAL PACKET](#)

- Exhibitor Fair
- Performances
- Art Show
- Music
- Speakers
- Workshops
- Kids Activities
- 3-Mile Walk for Water (8-9am)
- Cultural / Spiritual Connections
- Design for Water Solutions Contest
- "The Vibe" LIVE Art Happenings
- Fun Surprises & Special Guests!

**REGISTER** as a [sponsor](#), [exhibitor](#), [artist / inventor](#), [activity leader](#), and/or [volunteer](#). Be part of an initiative to promote water stewardship while offering the community access to information and art experiences.

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## EARLY FRACKING REPORT HINTS AT WATER QUALITY

*Associated Press*

Mon Jan 7, 2013 12:44 AM

PITTSBURGH - An ongoing U.S. Environmental Protection Agency study on natural gas drilling and its potential for groundwater

contamination has gotten tentative praise so far from both industry and environmental groups.

Glenn Paulson, the EPA's science adviser, describes the project as "one of the most aggressive public outreach programs in EPA history."

The final report won't come out until late 2014. But a 275-page progress report was released in December and, for all its details, shows that the EPA doesn't plan to address one contentious issue — how often drinking water contamination might occur.

Congress ordered the EPA to study the potential effects of hydraulic fracturing, or fracking, which entails blasting a mixture of water, sand and hazardous chemicals at underground shale to release the gas or oil captured in the rock.

As a gas rush surged in parts of the Marcellus Shale region that underlies Pennsylvania, New York, Ohio and West Virginia, concerns arose for the watershed that provides drinking water for 17 million people from Philadelphia to New York City.

For the study, the EPA is talking to experts from the industry, the environmental community and universities. It's conducting its own research and using federal supercomputers to analyze the possibility of contamination.

Read more: <http://www.azcentral.com/news/free/20130107fracking-water-contamination.html>

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## SNOWBOWL SNOWMAKING GETS OK

### ADEQ: Treated wastewater safe source

by **Brandon Loomis** - Jan. 29, 2013 10:50 PM  
The Republic | [azcentral.com](http://www.azcentral.com)

State environmental regulators ruled Tuesday that snowmaking is an allowable use for recycled water, thwarting the most recent attempt to block Arizona Snowbowl from misting Flagstaff's treated wastewater over ski runs in the San Francisco Peaks.

An inspection report generated by a Dec. 27 visit to the ski resort also found that Snowbowl is largely in compliance with permit requirements that it warn skiers not to ingest melted snow.

The resort had adequate signs on its ski runs, buildings and even the backs of lift tickets, the Arizona Department of Environmental Quality found. But the department ordered the resort to add warning signs on the delivery pipes and hydrants.

The resort had added those signs before Tuesday, Snowbowl General Manager J.R. Murray said. "We intend to comply fully with all rules and regulations," he said, adding that the snowmaking, meant to ensure a minimum season that will always start by Christmas, is simply augmenting nature.

"We have much more natural snow than we have man-made," Murray said.

As of Tuesday, the resort had received 46 inches of snowfall during the past three days.

Snowmaking, with or without treated sewage water, has long been controversial on the federally owned slopes that 13 Southwestern tribes consider sacred.

Read more: <http://www.azcentral.com/arizonarepublic/local/articles/2013/01/29/20130129snowbowl-snowmaking-gets-ok.html#ixzz2JnndKKO7>

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## URANIUM-MINING BAN IS EXTENDED

### Feds hint at 20-year halt of new claims near Canyon

by **Shaun McKinnon** - Jun. 21, 2011 12:00 AM  
The Arizona Republic

The Obama administration dug in its heels Monday against the expansion of uranium mining on public lands near the Grand Canyon, extending a short-term ban on new claims and renewing support for longer-term limits.

Interior Secretary Ken Salazar traveled to the Canyon with other high-ranking officials to announce the decisions, based on choices, he said, that "could profoundly affect the Grand Canyon in ways we do not yet understand."

Salazar talked about the negative effects of new mines on the region's tourism economy and the opposition of Indian tribes who live near the canyon, but threats to the environment and specifically to the water supply clearly played an important role in the decision.

Uranium mines active a decade ago were blamed for polluting the ground and water, and while mining companies say the industry is far more responsible now, Salazar said more study is needed to assure protection of the Canyon.

The temporary moratorium on new mining claims will remain in place through Dec. 20 on about 1 million acres surrounding the canyon, Salazar said. Meantime, federal officials will complete a review of a proposal to withdraw the land from new mining activities for 20 years.



## NAVAJO COAL PLANT'S FUTURE CLOUDY

by **Brandon Loomis** - Fri Jan 11, 2013 11:54 PM  
The Republic | [azcentral.com](#)

PAGE - Three smokestacks looming on the orange plateau above Lake Powell stand as monuments to America's evolving love-hate relationship with coal, which could take a dramatic and costly turn for the cleaner any day now.

The Navajo Generating Station's operators at Salt River Project are awaiting word on whether the Environmental Protection Agency will propose pollution-scrubbing requirements that would cost at least \$500 million and maybe as much as \$1.1 billion to install.

An EPA spokesman confirmed this week that the haze-reduction proposal, long in the works, is "forthcoming" and that some

observers expect it this month.

Clean-energy advocates hope the rule causes the plant to reduce pollution by closing one of three generators and investing in other energy sources instead of pollution controls.

"My question is how much solar could you put up for a billion dollars?" said Andy Bessler, a Sierra Club representative in Flagstaff.

Not enough, plant operators say, and not consistently enough to pump Arizona's water supply.



If the federal government seeks rapid installation of the best pollution controls, known as Selective Catalytic Reduction, SRP and partner utilities and agencies face a tough decision about whether to close the West's largest coal-fired power plant or raise electric rates around the Southwest.

Navajo is not just any power plant. Its three 750-megawatt generators employ nearly 1,000 Navajos, pollute the air over the Grand Canyon and convey Colorado River water to Phoenix and Tucson.

Read more:

<http://www.azcentral.com/business/articles/20130111navajo-coal-plant-pollution.html>

## HALF-BILLION-DOLLAR FIX WEIGHED FOR NAVAJO GENERATING STATION

By **Brandon Loomis**  
The Republic | [azcentral.com](#)  
Fri Jan 18, 2013 1:05 AM

Federal regulators propose cleaning up the Grand Canyon's air by requiring a half-billion-dollar catalytic converter at a coal-fired power plant that touches the lives and wallets of most Arizonans.

The U.S. Environmental Protection Agency is offering a 10-year window for installing the equipment. That is five years beyond the congressionally set 2018 deadline for haze reduction.

The extension puzzled environmentalists but accommodates statewide economic interests including the Navajo Nation and water suppliers who use the power to pump the Central Arizona Project's take of the Colorado River.

The 2,250-megawatt Navajo Generating Station outside Page is the largest industrial contributor to hazy vistas at the Canyon. It also affects air quality at all five southern Utah national parks and Mesa Verde in Colorado.

In all, 11 parks, monuments and wilderness areas are within the 186-mile zone in which Congress mandated action on haze.

Navajo "is the fifth-largest producer of oxides of nitrogen in the nation," EPA Pacific Southwest Regional Administrator Jared Blumenfeld said Thursday. "It's a very large power plant."

Reducing nitrogen oxides emissions would clear the air substantially — perhaps reducing visible Grand Canyon haze by at least one-third — on days not affected by forest fires or dust storms. The EPA and the plant's operators differ on how much haze the plant contributes or could reduce.

Acknowledging the Southwest's economic realities, Blumenfeld said, "I personally wanted to make sure — and the agency wanted to make sure — that our action did not lead to the closure of the plant."

That won't be decided until the plant's operator, Salt River Project, and its partners see the proposed rule's details and can analyze what it will take to meet the emissions standards. The EPA planned to provide those details this morning.

Read more: <http://www.azcentral.com/news/articles/20130117navajo-generating-station-half-billion-dollar-fix-weighed.html>

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## MINING CONCERN TO PAY \$60K FINE FOR MARANA SPILL

### Silver Bell Mining also to spend \$50K to fix water-quality violations

*David Wichner Arizona Daily Star  
January 30, 2013 12:00 am*

An Asarco mining operation has agreed to pay a \$60,000 fine and take preventive steps valued at \$50,000 to resolve water-quality violations caused by a June 2010 pipeline spill at the Silver Bell Copper Mine near Marana, state regulators said Tuesday.

The consent judgment against Silver Bell Mining LLC follows a \$170,000 fine the company paid in 2009 to settle similar charges at the same site.

Silver Bell, which is majority owned and operated by Tucson-based copper giant Asarco LLC, has agreed to preventative measures including:

- Implementing a pipeline operations and maintenance manual covering more than 20 miles of pipelines.
- Performing periodic pipeline physical inspections, tests and repairs.
- Training employees on proper procedures for fusing pipe segments together.

Silver Bell admitted no wrongdoing as part of the consent judgment, which is subject to court approval.

Read more: [http://azstarnet.com/business/local/mining-concern-to-pay-k-fine-for-marana-spill/article\\_f30ff847-7a72-5324-a343-475ae2047460.html](http://azstarnet.com/business/local/mining-concern-to-pay-k-fine-for-marana-spill/article_f30ff847-7a72-5324-a343-475ae2047460.html)

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## 'CLIMATE CHANGE AFFECTS EVERYTHING,' REPORT SAYS

*January 12, 2013 12:00 am • Associated Press*

WASHINGTON - Global warming is already changing America from sea to rising sea and is affecting how Americans live, a massive new federally commissioned report says.

A special panel of scientists convened by the government issued Friday a 1,146-page draft report that details in dozens of ways how climate change is already disrupting the health, homes and other facets of daily American life. It warns that those disruptions will increase in the future.

"Climate change affects everything that you do," said report co-author Susan Cutter, director of the Hazards and Vulnerability Research Institute at the University of South Carolina. "It affects where you live, where you work and where you play and the infrastructure that you need to do all these things. It's more than just the polar bears."

The blunt report takes a global environmental issue and explains what it means for different U.S. regions, for various sectors of the economy and for future generations.

The National Climate Assessment doesn't say what should be done about global warming. White House science adviser John Holdren writes that it will help leaders, regulators, city planners and even farmers figure out what to do to cope with coming changes.

Read more: [http://azstarnet.com/news/science/climate-change-affects-everything-report-says/article\\_4506a52a-0b83-59fb-868f-e58ce742c2bb.html](http://azstarnet.com/news/science/climate-change-affects-everything-report-says/article_4506a52a-0b83-59fb-868f-e58ce742c2bb.html)

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## DROUGHT STOKES WATER FIGHTS

By KELLEY SHANNON

Austin Bureau | [kshannon@dallasnews.com](mailto:kshannon@dallasnews.com)

Published: 22 January 2013 11:11 PM

AUSTIN — The state is running out of water. So much so that Texans may need to brace for quick showers, low-flush toilets and irrigation restrictions.

That's a slice of the water-saving steps that are being talked about as the Legislature considers bankrolling larger projects and other incentives for voluntary conservation.

Advocates for a new "conservation culture" want water-wasting to one day be as taboo as the littering vilified in "Don't Mess With Texas" ads.

The state's future water supply may depend on it. Conservation accounts for a whopping 24 percent of new supplies in a state water plan that looks ahead 50 years, offering a long list of ideas to ensure water availability keeps pace with Texas' booming population.

"It can be painless. We just have to get started," said former Sen. Kip Averitt, who chaired the Senate Natural Resources Committee. He's now a board member for the nonprofit group H204Texas, which is pressing for implementation of the water plan.

Texas' severe drought has grabbed the attention of legislators, business groups and others — and Capitol leaders are making water a priority this session.

Water restrictions regularly take hold in Dallas and many North Texas communities in times of little rainfall.

True conservation, though, is more than imposing immediate drought restrictions and would help places like Dallas-Fort Worth cope with immense growth, Averitt said.

Read more at <http://www.dallasnews.com/news/state/headlines/20130122-texas-state-water-plan-calls-for-heavy-dose-of-conservation.ece>

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## PLANTS ADAPT TO DROUGHT BUT LIMITS ARE LOOMING, STUDY FINDS

By Daniel Stolte/UANews and Ann Perry/USDA ARS, January 22, 2013

An international research team including UA rangeland ecologists has discovered that plants' demand for water fluctuates depending on how much water is available. However, this resilience has a limit, and prolonged drought conditions threaten the survival of these plant communities.



*The UA's Santa Rita Experimental Range is one of the large-scale/long-term study areas that are crucial for this research. Using techniques like repeat photography, inclusion or exclusion of livestock and vegetation surveys since the 1950s, scientists study how ecosystems react to different influences such as climate change and grazing. (Photo: Mitchel McClaran)*

Scientists with the [U.S. Department of Agriculture](#), or USDA, and their partners have determined that water demand by many plant communities can fluctuate in response to water availability, indicating a capacity for resilience even when changing climate patterns produce periodic droughts or floods.

But their research also suggests that a limit to this resilience ultimately could threaten the survival of these plant communities.

Sensitive environments such as the arid grasslands in the Southwestern U.S. already are approaching this limit.

Results from this study were [published in the journal Nature](#) by a team of Agricultural Research Service, or ARS, scientists, including three scientists affiliated with the UA. ARS is USDA's chief scientific research agency.

The study was led by UA-affiliated ARS researchers [Guillermo Ponce Campos](#) and [Susan Moran](#) and an Australian team led by Alfredo Huete from the University of Technology, Sydney.

"We found that plants have a capacity for resilience even in the face of the severe drought over the past decade," said Ponce Campos, the study's lead author. Ponce Campos led the research as part of his doctoral work at the UA and now is a research associate working with Moran.

Read more at <http://uanews.org/story/plants-adapt-drought-limits-are-looming-study-finds>

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## JOB POSTINGS

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Find these and other positions posted on the [AHS jobs board](#):

- Ø [Environmental Specialist - Atwell Group](#)
- Ø [Water Conservation Specialist - U of A Extension Office](#)
- Ø [WESTCAPS Director - WESTCAPS/Epcor](#)
- Ø [Staff Geologist - Conestoga-Rovers & Associates](#)

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## ADDITIONAL INFORMATION

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*For more information about the Arizona Hydrological Society, or to view current job listings and announcements, please visit our regularly updated web site at:*

<http://www.azhydrosoc.org/>

*Membership may be renewed by credit card through the AHS website or by mailing a check to the Arizona Hydrological Society, P.O. Box 1882, Higley, AZ 85236. Dues remain at \$45.00 year for regular membership and \$15.00 for students. Please remember that your 2011 membership was included in the 2010 Symposium registration fee!*

