Monitoring Challenges Teleconference 28 Jan 2013

Attendees:

Peter Evans, ICWP
Wendy Norton, USGS
Bill Cunningham, USGS
Donna Myers, USGS
Mike Norris, USGS
Kevin Dennehy, USGS
Jerad Bales, USGS
Jim Kolva, USGS
Robin O'Malley, USGS
Bill Lukas, USGS
Susan Trapanese, USGS
Pixie Hamilton, USGS
Bill Wilber, USGS
Lori Caramanian, DOI
Judy Campbell Bird, ACWI-NCL
Marie Garsjo, NRC Ret.
Mary Musick, GWPC
Dave Carlton, ASFPM
Steve Heiskary, NALMS
Doug McLaughlin, NCASI
Larry Larson, ASFPM
Tom Patton
Fred Bloetscher, AWWA
Bob Schreiber, ASCE
John Wells, ACWI-SWRR
Dave Wunsch, AASG
Bob Goldstein, EPRI
Darrell Osterhoudt, ASDWA
Tony Willardson, WSWC

Teleconference: The call-in number is 1-855-547-8255 (toll free); Access code: 53700#

Agenda:

1:00 pm I. Introductions and Agenda Review
1:10 pm II. Revision/Acceptance of Notes from Previous Meeting
1:15 pm III. USGS Groundwater Monitoring Network
   a. Overview – Bill Cunningham
      i. Existing monitoring network
      ii. Proposed monitoring network
      iii. Network support infrastructure
      iv. Quality assurance
   b. Question & Answer
2:00 pm IV. Federal Appropriations & FTEs – Status & Trends
   a. Overview – Jerad Bales
   b. Question & Answer
2:15 pm V. Discussion of Next Steps toward the "Advice and Recommendations"
   a. What ideas are in the "parking lot"?
   b. What preparation should we initiate now to inform and facilitate future meetings?
2:30 pm Adjourn

Action Items:

1. **ALL –** If people on this call can provide info about the other documents that have been mentioned (by NGWA, GWPC, and others), we can circle back to this question at a later meeting.
2. **Bales –** Someone asked the question, "What percentage of the total Water program is monitoring and assessments?" Bales will provide that information in the meeting minutes, along with the definitions that the Office of Management and Budget uses for research versus monitoring and assessment, and we'll include that in the notes. (**Status – Complete.** This information has been incorporated in the meeting minutes, below.)

Revision/Acceptance of Notes from Previous Meeting:

Are there any changes or comments on the meeting notes from our previous call? If not, then the minutes from the previous meeting are adopted. (No changes were suggested.)

Presentation by Bill Cunningham on USGS Groundwater Monitoring Networks:

Everyone on the workgroup should have a list of background materials related to USGS groundwater monitoring (Wendy emailed it to everyone this morning). The materials are also available on the website (http://acwi.gov/monitoring-challenges_wkg/minutes/backgrd/index.html), along with the presentation (http://acwi.gov/monitoring-challenges_wkg/minutes/index.html).

Slides 1 and 2 -- Introduction.

Slide 3 -- Why do we measure water levels? About half of the Nation drinks groundwater. About 50 billion gallons per day of groundwater are used for agriculture. Nearly everyone who provides their own drinking water does so through a well. Another important aspect of groundwater is its contribution to streamflow, particularly for ecological needs.

Slide 4 -- There are various methods for collecting water level data.

Slide 5 -- "Non-standard" measurements used include microgravity measurements, sonic measurements, and radar measurements. Of these three methods, microgravity measurements are used more by the USGS, but sonic and radar measurements are sometimes used, depending on circumstances.

Slide 6 -- Storage – surface water versus groundwater: for groundwater storage, many factors come into play, which are not a factor in surface water storage. For one thing, groundwater systems are more 3-dimensional. In a single basin there may be multiple aquifers, each with a different storage capacity. Water levels in an aquifer may also drop only in the immediate area where a well is located, so we need to monitor levels in multiple locations.

Slide 7 -- North Atlantic Coastal Plain system – the cross-section on the slide illustrates the fact that there are many aquifers in a single groundwater system, and often these aquifers are stacked vertically.

Slides 8 and 9 -- The next two slides show a 2-dimensional hypothetical monitoring design and the problems that this design poses when we try to apply it to a 3-dimensional system.

Slide 10 -- Now that we've looked at some of the complexities of groundwater monitoring, let's talk about USGS monitoring networks.

Slide 11 -- The bar chart shows expenditures for groundwater data collection within USGS. This represents real dollars in each of the years shown; note that there is a jump in time from 2006 to 2012, so not all the years depicted are consecutive. The funding categories shown are funds by provided by State, local, and tribal government agencies through the Cooperative Water Program, reimbursements from other Federal agencies, USGS funds appropriated to the Cooperative Water Program, and USGS funds appropriated to a program other than the Cooperative Water Program.

Slide 12 -- The three pie charts show what percentage of each program depicted (in blue) is dedicated to basic data collection (in green) – not infrastructure or research, but just basic data collection. You can see that the focus is different among the three programs depicted here.

Slide 13 -- The bar chart shows how many wells we have operated each year since 1983. You can see we had a significant decline in the number of wells for several years. The next slide explains why.

Slide 14 – In general, declines are due to loss of State partners; increases are due to an increase in the number of furnished records (see the background materials provided, for information about the USGS policy on furnished records).

Slide 15 -- Over time, the number of continuous wells has increased. This is partly a reflection of relative cost reductions in continuous monitoring, and the fact that our cooperators tend to retain our services for continuous data preferentially over periodic/discrete measurements.

Slide 16 -- Why do we have different sampling frequencies for measuring groundwater levels? The chart shows some of the factors.

Slide 17 -- The pie chart shows the breakdown of the frequency of water level measurements for 2013. About 20,000 wells are measured only once or twice a year, and many of those are furnished records. This accounts for much of the increase in the previously-mentioned bar graph (slide 13).

Slide 18 -- Frequency of measurement can be due to aquifer type (some aquifers don't change levels as radically or as often). The chart shows the differences among Wisconsin, Nebraska, Florida, and Georgia. Number of wells: Nebraska 4,056, Florida 716, GA 415, WI 160.

Slide 19 -- The next few slides show our existing networks spatially.

- Groundwater Level Network
- Climate Response Network
- Active Spring Monitoring Sites

Slides 22-24 -- Proposed Networks include:

- Climate Response Network – proposed improvements to this network would be responsive to the SECURE Water Act, which directs the Secretary of the Interior to expand "the network of monitoring wells to reach each climate division, support the groundwater climate response network to improve the understanding of the effects of global climate change on groundwater recharge and availability").
- National Ground Water Monitoring Network – Federal-State collaboration of groundwater levels and groundwater quality monitoring; data are available through a common portal; we provide the data indicate who collected it. This network also was recommended by the SECURE Water Act.

Question – how can you make any sense out of the data from the Climate Response Network, when the number of wells is so small, and there are different aquifers with depth? Which aquifer units would you choose to monitor if you're in an area with stacked aquifers? Answer – the design of this network is to monitor the water-table, or shallow confined aquifers that respond relatively rapidly to climate. Other aquifers would be monitored through other networks.

Slide 25 -- Supporting Infrastructure – DCPs and telemetry: We have many more DCPs than we did a couple of decades ago. These are mostly the same type of DCP that are used by NSIP and other USGS networks. If two monitoring sites (groundwater and surface water) are close enough together, they may actually be served by the same DCP.

Slide 26 -- Quality Assurance – the background information we provided includes some of the documents listed on this slide. We also do site reviews of all our offices (going to each office once every 3 years).

Slide 27 -- Calibration of water level measurement tapes is required annually.

Slide 28 -- This slide shows measurements from 14 brand new water-level tapes that have not yet been calibrated. You can see the wide difference among these measurements; this is why we require calibration every year.

Slide 29 -- Water level measurement training is provided for USGS personnel and cooperators, as shown on the slide.

Slide 30 -- In summary, there is a difference between surface water and groundwater monitoring. It is essential that we do our groundwater level monitoring in context, with a clear understanding of the local groundwater system. We have adjusted to shrinking budgets by finding new partners and improving efficiency.

Question – have you looked at the GRACE technology and ground-truthed it for looking at the amount of water in an aquifer and whether you can see the layered aquifers, etc.? Answer – The GRACE system is a space-based system that makes a measurement similar to the microgravity measurements we do on the ground (though not quite as precise as the ground-based method). They can estimate within about 3 centimeters. USGS does not partner with NASA on this, but we do talk with them about ways to ground-truth their information. They cannot differentiate among aquifers, since GRACE uses a gravity signal, without having some additional information. Also, GRACE measurements are indirect measurements, and thus there is modeling required to clarify the data from the GRACE system. (More information on NASA's GRACE system is located here: http://www.nasa.gov/mission_pages/Grace/overview/index.html.)

Question – do you see the use of any other techniques (besides the ones you described) that might help in the near future with getting more measurements over a wider area or with better coverage? Also, regarding the steel tape errors, can you get the word about those errors out to the wider community, since a lot of people probably aren't aware of this problem? Answer – those were actually electric tapes that we showed the errors for in a previous slide, and once we have written that up, we will share it with the world in a USGS report or journal article. There are some additional methods available, but none of them are going to help us in the short term. Our best chance is to reduce the cost of monitoring at individual wells.

Question – do you see it being possible for States and Tribes to link in directly to the telemetering set-up process? Is it possible for partners to run those, or do you feel strongly that USGS should always be installing and running them? Answer – it's not really possible for States or Tribes to use them on their own; I'm not sure what NOAA's policy is for who they allow to use the GOES satellite system. There's

also the issue of the downlink; a State or Tribe might be able to install and operate their own downlink, but it might be encoded.

Question – you state that your budget is constrained. Under what situation would it NOT be constrained? Won't it *always* be constrained? Answer – That's a valid point; we always feel like we don't have enough money. But there is a design of a National Groundwater Monitoring Network, and that design is a long way from being implemented; ditto for the Climate network and assessment of principal aquifers. At the rate we're going, the constraints are causing these things to drag out for decades instead of being done in just a few years.

Question – Have the groundwater experiences of the last 20-30 years of constraints yielded any products that would help this committee to understand what "constrained" means and what it can translate into, in terms of decision making. Answer – AWWA often uses USGS Circular 1323 (*Ground-Water Availability in the United States*), which clearly shows that there's insufficient areal extent of monitoring. The report really needs to be updated; there's not enough information out there for the regulatory agencies to draw complete conclusions.

The Central Valley Project might provide examples of how the data available are insufficient.

It might be valuable to point to some cases where decisions were made based on insufficient information. This could be something we could discuss at our March 11 session on "related science activities."

NGWA and GWPC may have useful documents that could help us answer this question about the impact of having insufficient data for decision making, or questions about the value of the data.

Question – we've been talking about groundwater level monitoring, but not groundwater flow. Can you talk about that for a minute? Answer – monitoring levels is somewhat analogous to stage-only, in that you don't know the flow. We can't stick an ADCP (acoustic Doppler current profiler) or a flow meter down the well to find out the discharge; we have to use many other techniques. Our preferred approach to this dilemma is to create a groundwater flow model.

ACTION – If people on this call can provide info about the other documents that have been mentioned (by NGWA, GWPC, and others), we can circle back to this question at a later meeting.

Note: at the end of this meeting minutes document are comments by one workgroup member that may be useful for our future discussion of the issues discussed during this meeting.

Presentation by Jerad Bales on USGS Federal Appropriations and FTE:

The presentation is available here: http://acwi.gov/monitoring-challenges_wkg/minutes/ACWI_budget_presentation-2012-01.pdf

Question – How do you distinguish between research and non-research? Answer – definitions are provided by the Office of Management and Budget (OMB). (Those definitions are shown below.)

Information on current and past USGS budgets is available at www.usgs.gov/budget

Information about the USGS organizational structure is available at www.usgs.gov/aboutus

Question – What do you mean by "assessment"? Answer – That definition also is provided by OMB. In looking at the data, I'm surprised that GWRP doesn't include more assessment.

Question – What percentage of the total program is monitoring and assessments? Answer – not sure, but we'll provide that information in the meeting minutes. (Answer – In 2012, 51.5% of funds appropriated directly to USGS Water Mission Area line items were categorized as monitoring and assessments.)

ACTION – We will provide that information in the meeting minutes. We'll also look for the definitions that OMB uses for research versus monitoring and assessment, and we'll include that in the notes. (Status – done.)

Item inserted after the meeting – definitions according to OMB Memorandum-05-03, 12/16/2004:

> A scientific assessment is an evaluation of a body of scientific or technical knowledge that typically synthesizes multiple factual inputs, data, models, assumptions, and/or applies best professional judgment to bridge uncertainties in the available information.
>
> Conduct of research and development (R&D): Research and development (R&D) activities comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.
>
> Include:
> - Administrative expenses for R&D.
>
> Exclude:
> - Physical assets for R&D such as R&D equipment and facilities...
> - Routine product testing, quality control, mapping, collection of general-purpose statistics, experimental production, routine monitoring and evaluation of an operational program, and the training of scientific and technical personnel.
>
> Definitions of basic and applied research and development are provided below...
>
> Basic research is defined as systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.
>
> Applied research is defined as systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.
>
> Development is defined as systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

> Research and development facilities: Amounts for the construction and rehabilitation of research and development facilities. Includes the acquisition, design, and construction of, or major repairs or alterations to, all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the Government or by a private organization, and regardless of where title to the property may rest. Includes the international space station and such fixed facilities as reactors, wind tunnels, and particle accelerators.

Question -- If there's a way of coming up with an estimate of R&D funding that USGS is comfortable with (regardless of OMB definitions), that would probably be useful. Answer – We'll try to do that, but I'm not sure that any number we come up with is going to make us comfortable.

Question – your FTE chart showed people associated with the water programs; I'm assuming that because people are doing multiple tasks, it's hard to figure out who is doing surface water work versus groundwater work. Answer – that is correct. Our programs can tell you how many people they fund, but you have to remember that more than half our money is reimbursable, so it's a less clean split for those people, since they're also working on multiple projects. There's also the question of how to count the FTE who are working on data management and data accessibility.

Discussion of Next Steps:

We will need to move Part V of our agenda to a different meeting. Are there any more questions for Bill Cunningham regarding his groundwater presentation?

Additional Q&A:

Question – how does USGS handle data sharing? Do cooperators come to USGS, or does USGS actively seek that kind of information? Answer – It can be either, depending on the Director of each individual water science center and the needs of that office. There is a cost associated with that; in order to be accepted as furnished record, the WSC director has to assure that those data meet the same quality standards that USGS uses for its own data. The NWGWM is a different model; that's why we provide the data, along with metadata that shows where the data originated.

Question – in terms of basic data collection that is done in conjunction with research (such as individual modeling projects), how are those characterized in the groundwater arena? Answer – we have monitoring activities going on, and those are directly tied to a modeling effort. The value of our monitoring networks is really in the long-term nature of those networks. Our modeling efforts are much shorter term, so it's hard to compare the two.

Question – what is responsible for the drop in funds in Cunningham slide #11? Answer – the reduction on the USGS side of this is probably not by USGS choice. But we would need to poll the water science centers to figure out exactly what caused this change. Question – so there wasn't a programmatic policy decision that caused this decrease? Answer – no there was not. We've been emphasizing groundwater monitoring networks a great deal in the past few years, so it's not a programmatic decision by the USGS.

Question – On Cunningham slide 13, there's a large trough between 1999 and 2006. What caused that? Answer – my impression was that it was due to a shrinkage in non-Federal cooperators for groundwater-

level monitoring within the Cooperative Water Program. We started including furnished records in here during that timeframe. There may also be an effect here that was caused by the large 1999/2000 budget realignment that moved funds out of all USGS programs in order to centralize Enterprise Information and other bureau-wide activities.

Wrap-up:

Next meeting will be Feb 11 and will focus on water quality networks.

There is already a list of background documents on water quality up on the website (http://acwi.gov/monitoring-challenges_wkg/index.html) under the "Background Documents" link.

Additional thoughts provided by workgroup members after the meeting:

- Persuasive examples – please consider adding the following:
    - "Be sure to include examples from East Coast areas, because even in so-called 'water-rich' areas there is a critical need for sufficient monitoring."
    - "… also, a shining example is 'hydrofracking,' because of the lacking of baseline groundwater level data in many areas in combination with the extreme level of scrutiny now…."

- In regard to "groundwater flow," there are some points that may need to be added (or enhanced) in the meeting minutes, if you feel that they would help with addressing our overall charge:
    - "The ACWI Subcommittee on Ground Water early on considered including 'pumped volume' data collection as part of the NGWMN but quickly dropped this as being too difficult and complicated to tackle as part of the initial implementation efforts"…
    - …."Modeling is an essential activity for assessing groundwater flow and storage, for providing basic information needed for appropriate groundwater resource management and protection, and long-term, consistent groundwater level monitoring is essential for conducting sufficiently accurate modeling"…..
    - …."Groundwater and surface waters are often strongly linked, and in such situations the streamflow monitoring is almost always a very critical data-source for groundwater flow model calibration; thus, there are compelling reasons for ensuring the continuation of BOTH surface water AND also groundwater monitoring in such situations (again noting that 70% of surface water flow is from groundwater base flow)."