GROUNDWATER RESOURCES ASSOCIATION
OF CALIFORNIA

November 22, 2010

Ms. Mary Scruggs
California Department of Water Resources
901 P Street
Sacramento, CA 95814

Subject: GRA Comments on Draft CASGEM Procedures for Monitoring Entity Reporting and DWR Groundwater Elevation Monitoring Guidelines

Dear Ms. Scruggs,

Submitted herewith for consideration by the Department of Water Resources (DWR) are comments on the subject draft documents from the Groundwater Resources Association of California (GRA). These comments were prepared by GRA's Technical Committee which is comprised of a volunteer team of groundwater professionals from public and private sector entities. GRA understands the challenge that DWR staff is undertaking with its charge of implementing provisions of SBx7-6. We trust that the enclosed comments will assist DWR in preparing final versions of the two documents.

I would also like to take this opportunity to offer the services of GRA's Technical Committee to assist or advise DWR staff in its preparation and review of future groundwater-related documents. GRA's broad membership constitutes a wealth of technical and institutional knowledge of state-wide and local groundwater environments that DWR may find of value as it evaluates documents submitted in response to SBx7-6. If there is an opportunity or need where GRA may be of assistance, please do not hesitate to contact me or Kathy Snelson, our Executive Director.

Sincerely,

William Pipes
President

enclosures

915 L Street, Suite 1000
Sacramento, CA 95814
(916) 446-3626 / (916) 442-0382 (fax)
www.grac.org.

Groundwater Resources Association of California Comments on the California Statewide Groundwater Elevation Monitoring (CASGEM) Program Procedures for Monitoring Entity Reporting (October 2010 draft)

November 19, 2010

General Comments

Comment #1

The language in the Procedures for Monitoring Entity Reporting (PMER) pertaining to eligibility for water grants or loans administered by the state is vague. The PMER states in its introduction:

> *If no local entities volunteer to monitor groundwater elevations in a basin or part of a basin, DWR may be required to develop a monitoring program for that part. If DWR takes over monitoring of a basin, certain entities in the basin may not be eligible for water grants or loans administered by the state.*

While this statement is technically correct, it may lead to a lot of "What if?" inquiries from local entities. A similarly vague statement is made on page 14 "Data Gaps". The PMER should reflect the same clarity as SBx7-6, which states:

> *10933.7. (a) If the department is required to perform groundwater monitoring functions pursuant to Section 10933.5, the county and the entities described in subdivisions (a) to (d), inclusive, of Section 10927 shall not be eligible for a water grant or loan awarded or administered by the state.*
>
> *(b) Notwithstanding subdivision (a), the department shall determine that an entity described in subdivision (a) is eligible for a water grant or loan under the circumstances described in subdivision (a) if the entity has submitted to the department for approval documentation demonstrating that its entire service area qualifies as a disadvantaged community.*

In other words, if the California Department of Water Resources (DWR) is required to perform groundwater monitoring functions, is it DWR's understanding that *all* of the existing entities in that area that may assume responsibility for monitoring functions will not be eligible for a water grant or loan awarded or administered by the state unless such entities can demonstrate that their entire service area qualifies as a disadvantaged community?

DWR should provide unequivocal clarity on who will retain eligibility for a water grant or loan awarded or administered by the state in any foreseeable scenario. For example, if a monitoring entity assumes responsibility for a portion of a basin that is within its area

of authority (i.e., the remainder of the basin lies outside of its area of authority), will DWR expressly affirm that this satisfies the intended requirement to be eligible for a water grant or loan?

Comment #2

DWR should clarify its understanding of the intended goals of CASGEM and how DWR intends to use the water elevation data. The PMER (p. 4, 1st paragraph) states, "The new law directs that groundwater elevations in all basins and subbasins in California be regularly and systematically monitored, preferably by local entities, with the goal of demonstrating seasonal and long-term trends in groundwater elevations." Demonstrating seasonal and long-term trends in groundwater elevations may provide some indication of a basin's condition, but can DWR provide detail on any additional objectives that it expects to achieve from CASGEM? Such information would be helpful for a monitoring entity in designing its monitoring network.

Comment #3

On page 9, the last sentence states that a monitoring entity needs to demonstrate that it has the "capability to take over the DWR monitoring network" in the monitoring entity's area. This requirement was not presented in the workshops as having to be met by a monitoring entity. What was conveyed in the workshops is that a monitoring entity (or the measurement collection agencies) must demonstrate the capability to take over monitoring wells in DWR's network if those wells are a part of the monitoring entity's monitoring network, should DWR discontinue monitoring those wells. Please clarify what is the actual intent.

Comment #4

On page 15, the 1st paragraph states, "When proposing monitoring locations and frequencies, Monitoring Entities should justify why they are sufficient to represent static groundwater level conditions across the basin (e.g., enough points to draw accurate contour maps and enough frequency to develop accurate hydrographs for seasonal and long-term variability)."

The above example misuses terminology. *Accuracy* provides an indication of the proximity of a measurement to the true value of the measured variable. More data points (in space and in time) will result in more detail presented in contour maps and hydrographs, respectively, but this has no inherent bearing on the accuracy of collected data or the validity of results. We suggest the term "accuracy" be replaced with "representative."

The above language from page 15 could be interpreted to suggest that DWR may expect contour maps to be submitted by the monitoring entity. While a monitoring entity may choose to prepare contour maps for its own purposes, SBx7-6 does not indicate

the preparation of groundwater elevation contour maps as a responsibility of monitoring entities. This distinction should be clarified in the PEMR.

Comment #5

On page 15, the 1st paragraph states, "Note that public water supply wells as defined by the California Department of Public Health (DPH) should not be used for monitoring in this program because of the confidentiality requirement of DPH to not disclose the location of these wells. Thus, unless there is an agreement between DWR and DPH to the contrary, public supply wells should not be used in the CASGEM program."

In November 2009, the SWRCB made possible access to public water supply well groundwater quality data through a new GeoTracker feature. This was done through the use of modified location coordinates to slightly decrease the precision of the well location. The feature resulted in being able to relate historical groundwater quality data to locations in a basin to evaluate groundwater quality conditions and trends. To the extent that groundwater levels from public supply wells have been collected and used by local entities, their use should not be discouraged for the reason as conveyed on page 15.

Comment #6

P. 16, 2nd paragraph: The PMER should acknowledge that local basin conditions and management goals may dictate significant differences in monitoring guidelines than those provided in DWR's Groundwater Elevation Monitoring Guidelines, Draft, October 29, 2010.

Comment #7

Page 19, "Groundwater Level Information" requires the submittal of an "accuracy" to accompany depth-to-water measurements. To provide clear guidance to monitoring entities, DWR should provide definitions of concepts of accuracy, precision, and resolution and then revisit the reporting requirements. The whole document should be reviewed for the correct application of this terminology.

While many manufacturers provide technical specifications for their instruments, including calibrated accuracies derived from highly controlled laboratory experimentation, such accuracies often bear little relation to actual accuracies achieved by the end user. The calibrated accuracy of an instrument can be used in combination with individual measurements (performed by individual end users) to calculate an estimated uncertainty inherent in the measurements (i.e., measurement value ± uncertainty interval) to specify the range within which one thinks the true value of the measured variable falls with a specified degree of confidence for individual end users. This can be time consuming. Also, many monitoring entities will not have the expertise to do this.

It should be recognized that measurements will be affected by undetected systematic errors in many cases. For example, depth-to-water readings in wells that are out-of-plumb will yield measurements that systematically overstate the true depth to water, and in many cases this error source will dwarf the measurement uncertainty introduced by the calibrated accuracy of an instrument or skill of the end user. However, although inaccuracies introduced by systematic errors can potentially be large, even such a "biased" data set can be of value as it will show seasonal and long-term water level variability.

Given the difficulty for monitoring entities to evaluate the uncertainty in individual measurements and their inability to state actual accuracies, it may suffice to establish minimum data quality objectives. Recognizing the objectives of the monitoring effort, monitoring entities could be asked to specify (from predefined choices) a best estimate for an interval around individual measurements within which the entity thinks the true value of the measured variable falls (e.g., ±0.1, 0.5, 1, or >1 ft). Their estimate should be based on calibrated instrumentation accuracy and experience regarding individual wells and field personnel.

Comment #8

p. 19, 1st paragraph states, "All required and requested groundwater level data shall be submitted electronically to DWR's online system." DWR states that several methods will be available for submitting data, including data file upload for batch entry. This is a critical element that must be included in the data transmission process. The DWR Online system should allow the required data elements to be uploaded in bulk format, such as a spreadsheet file or a .CSV file, to allow those monitoring agencies that utilize database systems to efficiently transmit large volumes of data instead of manually entering data into a fill-in-the-form interface. Therefore, DWR should develop electronic data transmittal (EDT) alternatives and data standards to permit bulk data transfer and assist monitoring entities to plan data handling to accommodate reporting to DWR.

Specific Comments

The following specific comments are editorial in nature with the primary focus to suggest restructuring and reformatting the PMER to more clearly and concisely state the requirements of each component of the monitoring plans to be submitted by monitoring entities.

1. P. 4, last paragraph: Spell out Association of California Water Agencies (ACWA) the first time.

2. P. 14, first paragraph: Modify first sentence as follows:

   "Monitoring Entities, verified by DWR, will each develop a Monitoring Plan that includes the following sections: Entity Information, Monitoring Sites and Timing, Field Methods, and Data Reporting."

3. P. 14, first paragraph, second sentence: Modify "summer 2011" to "[specific date], 2011."

4. P. 14, inset table: Modify "summer 2011" to "[specific date], 2011."

5. P. 14, inset table: Insert as first bullet: "Entity Information"

6. P. 14, inset table: Insert "Describe Data Gaps" as the last sub-bullet under the Monitoring Sites and Timing bullet.

7. P. 14: Move the Entity Information section on p. 17 to p. 14 as the first section below the introductory paragraph. The header font for Entity Information should be upper and lower case caps – consistent with other key monitoring plan components.

8. P. 14: Move the Data Gaps section to the last sub-section of Monitoring Sites and Timing after Well Information. The header font for Data Gaps should be consistent with other sub-sections.

9. P. 15, Monitoring Sites and Timing section: Replace bullets with a complete listing of all required and recommended sites and timing information:

    a. Description and rationale of well network design
    b. Map and GIS shapefile with monitoring well locations, Bulletin 118 groundwater basin boundary, and boundary of proposed monitoring area
    c. Table of selected wells (details listed under Well Information section)
    d. Table of proposed (future) wells to be included in the Monitoring Plan and a schedule for when these wells will be constructed and added to the Monitoring Plan
    e. Table of frequency and timing of water level measurements and rationale to explain how this frequency and timing will measure seasonal high and low elevations
    f. Description of Data Gaps, including nature of and reason for each data gap

    Move the entire Well Information section on pp. 17-18 beneath this listing.

    Move Data Gaps section on p. 15 beneath the Well Information sub-section.

10. P. 16, Field Methods section: Modify last sentence in the first paragraph to say, "Each Monitoring Plan will include a section on Field Methods which will describe the following basic requirements:"

11. P. 16, Data Reporting section: Insert sentence at the end of the paragraph: "Each Monitoring Plan will include a statement confirming that it will adhere to the electronic data reporting requirements of this section or will contain an explanation if the Monitoring Entity is unable to use the standard reporting form(s) or provide the necessary groundwater elevation data elements."

12. P. 17: Delete first sentence and bullets and insert entire Groundwater Elevation Information sub-section on p. 19 here.

13. Well Information sub-section:

    The well designation and naming protocol are unclear. Are the sub-bullets suggestions or required components of a well designation? These components should be described as suggested ways of developing a unique local well designation, but the local entity should be allowed to utilize its own well names provided that they are unique to that Monitoring Plan.

    What if a state well number has not been assigned to a well?

    Reference point elevation should clearly state that this is the point from which the depth to water level measurements are taken.

Groundwater Resources Association of California Comments on the Department of Water Resources Groundwater Elevation Monitoring Guidelines (October 2010 draft)

November 19, 2010

The Groundwater Elevation Monitoring Guidelines (GEMG) pertain to DWR's monitoring in the event that a local agency does not step forward. Local agencies are not required to follow these procedures, per the PMER at P. 16 ¶2: "the DWR guidelines are for internal use in the event that the Department is required to perform groundwater monitoring functions pursuant to Section 10933.5 and are not binding on any other agency." Therefore, the following comments on the GEMG pertain only to how DWR would execute water level monitoring in parts of the state where no local entity steps forward to do the monitoring.

Comment #1

P. 1, Introduction, 3rd paragraph: The document states, "DWR will report findings of the CASGEM program to the Governor and the Legislature by January 1, 2012 and thereafter in years ending in 5 and 0." This is not consistent with SBx7-6, 12924. (b), which states:

> *The department shall report its findings to the Governor and the Legislature not later than January 1, 2012, and thereafter in years ending in 5* ***or*** *0.* (**bold underline** added for emphasis)

Is DWR intending to clarify the intent of the legislation by ensuring the department will report its findings in 5-year intervals?

Comment #2

P. 1, Selection of Monitoring Wells for Monitoring Plans: As mentioned in the CASGEM workshops, wells selected for the monitoring plans should not only have known well construction information but also be designated as monitoring a specific aquifer as well. Knowledge of the hydrogeology of the basin is important, coupled with well construction data, in order to select wells which will provide groundwater level data specific to a known aquifer. Selection of wells should be aquifer specific and wells with known well construction which are screened across more than one aquifer should not be candidates for selection. Therefore, monitoring wells which are screened in a single aquifer are recommended, if possible, over production wells, which in some cases may be screened across multiple aquifers.

Comment #3

P. 1, Selection of Monitoring Wells for Monitoring Plans: The document states "monitoring wells near rivers or aquifer storage and recovery projects should be avoided due to the potential for rapidly fluctuating water levels and engineered groundwater systems". Perturbations to a groundwater system from streams or wells provide useful information to reveal system dynamics.

This section should begin with a statement of the purpose for collecting groundwater level data. Without stating a purpose, none of the listed criteria inform the monitoring network design process. The PMER states that water levels should be collected with "the goal of demonstrating seasonal and long-term trends in groundwater elevations," but for what purpose? The answer to this question will define the allowable tolerance in measurement accuracy, well spacing, and measurement frequency for a given area. One statistical process that may be used to aid in determining what wells to measure is principal component analysis (Taylor and Alley, 2001)[1]. This process will provide an understanding of the relationship between water elevations at different wells, the variability in water elevations and may lead to data collection reduction as some wells' water levels may be mostly representative of other wells' water levels.

This section provides little useful guidance regarding the choice of an appropriate well network density. Referenced previous work is described without needed detail, large density ranges are quoted without qualitative evaluation, objectives of previous studies are not always disclosed, and frames of reference are lacking (e.g., knowledge of the amount of groundwater pumpage in a particular county is not helpful without the knowledge of the size of the county).

This section could be improved if substantial additional detail were given on previous work efforts, their objectives, and findings. The discussion would need to be linked to CASGEM Program objectives and provide straight forward guidance to DWR staff. In addition, DWR staff will need to rely on the experience and good judgment of their staff members on a case-by-case basis.

Seasonal effects are not controlled only by precipitation and runoff; dam releases and other controls on sources of recharge can be just as relevant. Therefore, inclusion of wells near streams should be a goal for designing a monitoring network. Similarly, understanding the sinks in a groundwater system and the degree to which the system is stressed during periods of intensive pumping are also important.

[1] Charles J. and William M. Alley, 2001, Ground-Water-Level Monitoring and the Importance of Long-Term Water-Level Data, U.S. Geological Circular 1217.

Comment #4

P. 2-7: The section on optimal well spacing for a water level measurement network is confused by the introduction of studies on optimal spacing for water quality sampling wells. The objectives of water quality sampling programs and water level measurement programs may be very different within the same groundwater basin. The GEMG would be improved if the discussion was confined to water level measurement considerations.

Comment #5

P. 3, last paragraph: The term "accuracy" is misused here. An increased number of wells used to create a groundwater elevation contour map does not increase its accuracy, it increases the level of resolution.

To provide clear guidance to DWR staff (and also monitoring entities who are encouraged to use this document), DWR should provide definitions of concepts of accuracy, precision, and resolution. The whole document should be reviewed for the correct application of this terminology.

If Figures 1a and 1b are retained in the final document, they should be discussed in more detail. Presently, with the information given in the document, the lowest density well networks appear adequate to attain CASGEM Program objectives.

Comment #6

P. 4, paragraphs 1 and 2: DWR should reconsider its recommended minimum water-level measurement frequencies with respect to the CASGEM Program objectives. Hourly or even daily measurements are not needed to describe seasonal and long-term groundwater level trends.

Table 3: Frequencies for both unconfined and confined aquifer types are identical and could, therefore, be combined.

Comment #7

P. 10, Figure 3: This figure is effective at conveying the idea of how factors should guide measurement frequency, but only in a relative sense, which complicates translation to application. It would be more helpful if the specific guidelines provided by Table 3 were incorporated into Figure 3 by hanging a scale on each factor range. For example, withdrawal as a percentage of storage, flow rates in ft/day, and depth in feet (in some aquifers, 30 feet is considered shallow and 80 feet is deep; in others, aquifers deeper than 300 feet are considered deep).

Comment #8

P. 12, 4th paragraph: The guidance discusses four different ways reference point elevations can be determined. The accuracy of the four methods is discussed; however, the required accuracy for CASGEM should be stated based on the program's goals as a basis for determining the minimum adequate accuracy required for efficient successful data collection. The potential exists that different reference point methods may be employed in one monitoring area or from different monitoring entities' areas (See figure below) leading to relative error in comparing water elevations, as is done with contour maps.

Scenario B.
One basin, several
Monitoring Entities
collecting and
submitting data

Error of water elevation is comprised of error from both the depth to water measurement and error in the reference point elevation. Reference point elevation error is a function of the method for its determination as discussed in the guidelines. However, in areas with historic or current subsidence the change in land surface elevation since the reference point elevation was determined will be an additional source of error. Therefore, all land surface and reference point elevations should be recorded with the date of the determination and special procedures should be used for areas with historic or current subsidence to update elevations and reconcile historic calculated water elevations, if possible.

Comment #9

P. 18, 1st paragraph: Monitoring well caps are mentioned, but no guidance is given on whether monitoring well caps should be vented or air-tight. Air-tight caps may cause air above the water to become compressed when water level rises, or to create a vacuum as water levels drop. Consequently, caps may pop off under pressure, and water levels rise quickly once air in the well equilibrates with atmospheric, or levels may drop quickly as air rushes into the well. The procedures should issue specific guidance on well caps.

Comment #10

P. 18-20, Guidelines for Measuring Water Levels: This discussion pertains only to wells in which water levels are lower than the top of the well casing; artesian wells are not addressed. The only mention of artesian wells in the whole document is in the context of selecting pressure transducers on Page 26. At the top of Page 12, the reader is referred to USGS NFM to read more about flowing wells because those methods are "not needed in most basins". This is a major omission; flowing wells occur at least seasonally in many California groundwater basins.

Comment #11

P. 18, (1) Steel Tape Method: The guidance states, "A graduated steel tape is commonly accurate to 0.01 foot." The tape itself is neither accurate nor inaccurate; it's graduated. The combination of the instrument and its user determine the accuracy of the measurement. The precision and accuracy of the technician and tool should be established by taking seven or more independent replicate measurements and determining the standard deviation and the percent error from the true value established by a second and more accurate means such as a pressure transducer. The same comment applies to the electric sounding tape method.

Comment #12

P. 18, (1) Steel Tape Method: The guidance states, "with the obstructions found in production wells it is best to only report water levels to the nearest 0.1 foot." This equates to a reduction in the *resolution* of the measurement, not to a reduction in its *accuracy*. Also, it is unclear why measurements in production wells should categorically be reported using a reduced resolution. Rationale for this guidance should be given.

In addition, the method for measuring the water level when oil in the well described on pages 19 and 20 can be improved via use of water reacting paste (e.g. Kolor Kut brand) to determine the thickness of the oil. Using the density of oil, the true water elevation can be calculated. Assuming oil density is ~0.85 then every foot of oil will alter the true water elevation by 0.15 feet.

Comment #13

P. 22, (2) Electric Sounding Tape Method: The guidance states, "If the water in the well has very low specific conductance, the tape may not give an accurate reading." This is a good point, but it would be more useful if the range of specific conductance at which the leading brands of electric sounders begin to display inaccurate reads was provided.

Comment #14

P. 22, (2) Electric Sounding Tape Method: The method for calibrating electric sounding tapes suggests an unrealistic accuracy threshold (± 0.02 ft) that appears to neglect the inter-technician variability and error bars for technician accuracy. A more realistic threshold is ±0.05 ft, but that value should be established by the monitoring technician through replicate measurements. DWR's guidance should direct each monitoring team on how to establish the accuracy threshold for the combinations of technician and instruments.

Comment #15

P. 26, 2nd paragraph: The guidance states, "Thus, if a non-vented pressure transducer is used, a barometric pressure transducer will also be needed at the well." This

statement should be revised to note that the barometric pressure transducer need not be located at the subject well; it can be miles away and still provide relevant barometric data usable for correction of non-vented transducer data. It may be possible to avoid acquiring and deploying a barometric transducer by relying on NOAA data, local airport data, university data, or other sources. However, some appreciation for the variation of pressure across the monitored region must be incorporated into selection of barometric data sources for correcting non-vented pressure transducers.

Comment #16

P. 26: The first bullet point states, "No correction is required for angled wells, as pressure transducers only measure vertical water levels." Although it is correct that the pressure reading of the sensor is not influenced by the angle of the well, the depth-to-water measurement needed to calculate the water surface elevation is influenced by the angle of the well.

Comment #17

P. 27, Figure 5: The physical location where the transducer cable is fastened to the well casing or anywhere else (e.g., a crane 50 feet above ground surface) is irrelevant to the determination of the water level elevation. Therefore, the concept of a hanging depth, as indicated in this figure, is irrelevant and should be removed. Relevant measurements are the depth to water (from the RP) and a simultaneous reading from the transducer, the sum of which determines the elevation of the transducer. Subsequent transducer measurements (without manual depth-to-water readings) are then related to the transducer elevation to calculate water level elevations. Table 7 should also be appropriately modified.

Comment #18

P. 30, 4th numbered point: We recommend sending the instrumentation to the manufacturer for re-calibration if drift is suspected. Field calibration cannot substitute for the controlled conditions in a laboratory.

Comment #19

P. 31, Glossary of Terms: The given definition for Specific Conductance is incorrect. The specific conductance is the electrical conductivity normalized to a temperature of 25 °C. We suggest correction and adding a definition for Electrical Conductivity of water:

Electrical conductivity is a measure of the ability of water to conduct electricity and, therefore, a measure of the water's ionic activity and content. The higher the concentration of ionic (dissolved) constituents, the higher the conductivity. Conductivity of the same water changes as its temperature changes. This can have a confounding effect on attempts to compare this feature across different waters, or seasonal changes

in this parameter for a particular body of water. Normalization of the electrical conductivity eliminates this problem (see Specific Conductance).