HYDROSPHERE
Resource Consultants

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RE: Comments on ESHMC Meeting in Twin Falls

Dear Paul and Donna:

Thanks for putting on a very good meeting in Twin Falls on the 12th and 13th. I thought there was productive discussion in several important areas and it was helpful to get (nearly) everyone working on the model enhancement in the same room for a while. I hope I didn't miss anything crucial by leaving at 3:30 on Wednesday.

I've been through my notes and recollections of the meeting to try to synthesize my thoughts on the direction of the work and the discussions that took place. This letter is an attempt to document those and convey them to you.

Overall, I think things are headed in the right direction. There are some high-level issues that came up that suggest the need for more top-down policy guidance from the Department. I also have some comments on more specific details of approaches and assumptions later in this letter.

High-Level Issues

The high-level issues generally relate to the question of how the model will be used. The revised model grid would appear to allow for more detailed representation of the aquifer in areas close to the river, and the idea of doing calibration on a two-week time step for the final year would further support detailed representation of stream-aquifer interactions. While these are, I think, good things, they raise the specter of using the model for short-term administrative decisions. I think the Director has indicated that this is not his intent,

even if the model appears to have the capability (which I think it will not). Nevertheless, the pressures will be there to use the tool for that purpose

If the tool will be used for short-term administration (which I don't think is a good idea), it would have to be run in a transient mode and it would become even more important that it be accurate in an absolute sense. For example, initial conditions (heads, spring flows) would need to match actual real-time values. Bob Sutter has said to me several times that small model errors are not that important, because all the analyses will address *differences* between model scenarios and that such errors will thus "wash out." I think this "correlated error" reasoning becomes less valid as the model is used for shorter-term, site specific analysis. I also have concerns that the data to do short-term calibration is not really going to be there in the quality that is needed.

My own view is that short-term administration of individual wells can best be supported by detailed analysis of those wells and their relationships to specific spring discharges...something that needs to be done outside of the model enhancement effort. I understand that some studies are planned or underway in this regard. If the Department chooses to go this route to address more immediate impact problems, those studies will need to be expanded and made more comprehensive (for instance, what I have seen so far does not appear to support segregation of pumping effects from those of surface irrigation activities).

If the Department truly does not intend to use the model for short-term administration, then I think the effort associated with doing two-week time-step calibration should be foregone and the resources reallocated to other areas of the project.

The question of prospective model use also seems to implicate the parameter estimation process. John Doherty several times said, "it depends on how you want to use the model" when asked questions about the calibration approach. From a conjunctive management perspective, I think it is critically important that the calibration place great emphasis on assuring that stream-aquifer interactions are represented correctly, both in terms of location and extent. Achieving minimal error in predicting aquifer water levels may suggest that the model is sufficiently accurate, but doesn't directly address this critical management need.

I think it will also be important to characterize uncertainty associated with model predictions. John Doherty pretty effectively demonstrated that calibrated parameters will not necessarily be unique. Coupling this with the effects of uncertainty in ET estimates, seepage estimates, etc., leads me to believe that truly characterizing overall model uncertainty would require some sort of Monte Carlo approach. In lieu of this, I think it will be necessary, at a minimum, to systematically explore and document the sensitivity of model results to the ranges of values that important inputs could take.

Specific Issues

On more specific issues, most of my comments relate either directly or indirectly to the development of the water budgets for each time step of the calibration (i.e., the model

inputs). I've tried to put these comments in a logical order below...an order that doesn't necessarily reflect relative importance.

Because irrigated acreage is such an important driver of water use, getting good acreage estimates for each year is crucial. Two discussion topics from the meeting bear directly on this: 1) how to distribute acreage changes over time given that only a few "snapshots" are available, and 2) how to segregate irrigated acreage by water source and application method. With respect to the former, I would suggest estimating acreage between "snapshots" using a combination of interpolation and judgement, the latter informed as much as possible by reference to secondary and anecdotal information (e.g., canal company interviews, real estate records, annual agricultural survey data, equipment sales, etc.).

Categorizing irrigated acreage by water source (surface or ground) and application method (gravity or sprinkler) will be fundamental to making appropriate assumptions about pumping, consumptive use and recharge. This is a tough issue and one that wasn't discussed much at the meeting due to John Lindgren's absence. The "pristineness" discussion danced around the edges of this problem when we talked about the use of Potential Evapotranspiration (PET) estimates as surrogates of pumping. This approach assumes that all crops are fully watered and growing at their maximum potential, and that pumping is 100% efficient in delivering water to the crop root zone. Neither of these are good assumptions, in my view. If groundwater is applied via surface distribution methods (as it often is when used as a supplemental supply) it will inevitably contribute to deep percolation and, except perhaps in very dry years, to tail-water runoff. There will be inevitable evaporative losses from sprinkler application and possible contributions to deep percolation as well, depending on application rates and soil types.

Another key component of the water budgets relates to precipitation. It sounded to me as if the basic precipitation data used would be annual, albeit with a relatively high degree of spatial resolution. This annual precipitation will need to be subdivided into two time periods and further subdivided into components reflecting crop consumptive use, non-beneficial consumptive use, runoff and recharge. Since precipitation form (rain or snow) and intensity are so important in this second subdivision, it is difficult for me to see how it can be done without referring to daily climatic records. Perhaps an empirical model could be developed from detailed analysis of a few sites, and then extended to the whole area.

It was unclear from the discussion at the meeting how the individual half-year water budgets will be balanced. As a general rule, I favor distributing the residual among the various terms based on the uncertainty associated with each term. Alternatives include distribution based on magnitude of each term or assignment to a single term (which implies all other terms are 100% accurate). The uncertainty associated with various water budget terms will generally not be known explicitly, and professional judgement will be required on this one.

Bob Sutter's short description of his approach to estimating reach gains raised some concerns in my mind, some of which may be based simply on not understanding

completely what he proposed to do. It sounded as if he was going to rely on the basic calculation approach used for the DWR's planning model, with some adjustments to get finer spatial resolution. I couldn't tell from his description whether this water balance approach would be consistent (conceptually, spatially and temporally) with the water budget calculations done to generate model inputs. I think it is important that they be reviewed for such consistency to avoid overlooking or double-counting water. I was also concerned that his approach was going to lump some important aquifer discharge in with return flows from surface water irrigation. His approach seems to make an assumption that all gains occurring within some period (6 months, if I recall correctly) of irrigation are return flows coming back to the river from surface drains or from subsurface flow *not* related to the aquifer.

I think the data showing substantial short-term variability in aquifer levels in response to irrigation make this assumption questionable and potentially inconsistent with the recharge assumptions made for the model cell water budgets. I would suggest instead that immediate return flows from irrigation be based on measurement and analysis of drains and groundwater levels in specific canal systems and that the model be reflective of the recharge and subsurface returns associated with these systems.

I was dismayed to hear from Annette (?) from the USGS that error in land surface elevation at observation wells may be as large as annual variability in observed water levels. This does not portend well for calibration of the model against observed water levels and highlights another reason to emphasize river/aquifer interactions in the calibration process. Is there a way to get a handle on these land elevations to learn the extent of the problem and whether it is systematic or random?

I hope these comments are helpful. As I said earlier, I think things are generally on the right track from the big picture perspective and I commend you both for keeping things organized and moving. I'm happy to discuss any of my comments with you in more detail.

Sincerely,
Hydrosphere Resource Consultants, Inc.

by: _____
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Cc: Jeff Fereday
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