MEMORANDUM

To: ESHMC
Fr: B. Contor
Date: 17 October 2006

Re: Scenario discussion 29 September 2006

This memo is to summarize the ESHMC discussions on 29 September 2006 regarding a new scenario to replace the Base Case scenario. It summarizes the discussion and areas of agreement. The list is impressive; we accomplished a great deal. Please respond if any part of this summary does not match your understanding of our discussions and conclusions. The memo also highlights some additional considerations by IWRRI.

1) Modeling procedure. A number of ideas on the procedure for constructing the scenario were discussed at the meeting. This memo does not address modeling procedure, but points out some factors that will be important when we do consider it:

   Input data are vital. Long-term results will be driven entirely by the magnitude of the water budget and short-term results will be driven almost entirely by starting heads. While this point is obvious, it has not been stressed enough and cannot be stressed too much. The aggregate spring discharge and reach gains predicted in the long run *will be* the average of the water budget presented to the model simulation. In the short run, the aggregate spring discharge and reach gains *will be* determined by starting heads. The difference between short-run and long-run results will be governed by the difference between the recent water budget (implicit in starting heads) and the average simulation water budget. The trajectory between current and long-term results will be governed by the spatial distribution of recharge (and S/T, which will not be changed in the scenario). The water budget and starting heads *will determine* the outcome of the simulation.

   The other hydrologic fact that cannot be emphasized too much is that the while data drive the simulated effects, *actual* effects will be determined by *future hydrologic conditions* which are unknown and unknowable.

2) White board images. File "WhiteBoard20060929.zip" is a zip file of digital photos of the white-board notes from our discussion (available on the IWRRI website at http://www.if.uidaho.edu/~johnson/ifiwrri/projects.html). The photos are generally poor quality.

3) Title of the scenario: Current Water-use Practices.

4) What the scenario is: Simulation of aquifer conditions in response to current water-use and management practices over a representative hydrologic sequence.

5) Time horizon: The Water Resource Board needs to understand the expected aquifer condition in three different time-horizon contexts:
    1) What is going to happen in the next few years (if current practices continue)?
    2) What is going to happen in the long run (if current practices continue)?
    3) How long will it take various management activities to show a beneficial effect upon spring discharges and reach gains?

    We (the full group) generally agreed that the third question was not part of this scenario, but should be addressed through specific superposition scenarios addressing particular management options. We also generally agreed that the scenario should address the second question. Our discussion went back and forth on the merits and practicality of addressing question one. Upon further consideration, IWRRI sees merit in only addressing question two, as discussed below.

    Before we began recording on the white board, we discussed the possibility that this scenario should also attempt to represent possible future changes, i.e. reductions in surface-water diversion volume or incidental recharge. We decided *not* to address future changes in this scenario, as reflected by the title and statement of purpose.

6) Presentation of results: We agreed that it is unwise to present a single result that may be misinterpreted as a prediction of future conditions. The long-term result (purpose two) should be represented in a probabilistic form such as a box-and-whisker plot, an expected mean with upper and lower bounds, or an estimated shape of a probability distribution. We generally agreed not to present a trace of progression towards the long-term result, to avoid the results being misinterpreted as a prediction. There was brief discussion (but no agreement) on the concept of reporting a number of years to meet a given fraction of the final result (i.e. XX years to 95% of final).

    Our discussion of the short-term presentation (if we attempt goal one) tended towards representation of a trace of the expected mean value for the next five or ten years, bounded by upper and lower traces. The "high" and "low" limits are to represent the bounds of variation expected over a time series of a normal hydrologic regime.

    It was suggested that the representation of a continuous series of wetter-than-normal or dryer-than-normal conditions would produce extreme, diverging representations that overstate the range of the expected results of continuing current practice. We also discussed the importance of communicating that the limits represent expected hydrologic variability and not model uncertainty or confidence limits. However, these last two points did not receive full discussion and may not represent full consensus. Since the meeting, IWRRI has considered that the simultaneous presentation of (and differentiation between) hydrologic variability and model uncertainty may be almost impossible.

7) Representation of hydrologic sequence: We agreed that the representation of the

hydrologic sequence needed to have the following characteristics:

a) A long enough series that the mean and variability are representative.
b) Enough data points that meaningful statistics can be derived.
c) Has a correct representation of serial correlation.

In addition, we agreed that if the first purpose (short-term simulation) is to be achieved, the starting heads for the simulation need to be representative of today's aquifer condition. We agreed that we can start with ending-calibration-period heads and use simulated data for the period April 2002 through the present to achieve approximately correct starting heads. We did not discuss the details of building the synthetic data set but agreed that it appears that HDR, Principia Mathematica and IWRRI have independently been successful in constructing synthetic post-2001 data. It was suggested that model runs could be used to adjust the synthetic data set so that current predictions are close to current observations.

We rejected the idea of interpolating current water-level observations to obtain a starting-head array, and we rejected the idea of using current water-level observations to scale the starting-head array from the calibration period. We did not discuss the hydrologic fact that if starting heads are correctly represented, all prior hydrologic impacts are implicitly integrated into the modeling scenario.

At the meeting we concluded that in order to meet the first purpose, the simulation would need to incorporate multiple traces of possible future hydrologic conditions in order to define the upper and lower bounds. After discussion of ways to build synthetic data sets that contained the appropriate mean, variability and serial correlation, we agreed at the meeting to use actual historical records to establish the "representative hydrologic sequence." Again, it is important to remember that the actual future effects will depend on future hydrologic conditions, which we cannot know.

8) Current water-use and management: This discussion came at the end of the meeting and the items listed on the white board may not represent full agreement. Also, some members had to leave before this part of the meeting. With those qualifiers, we tentatively concluded the following:

a) Extract model inputs from the most recent years of the calibration data (May 1992 - April 2002) based on the index from the historic hydrologic series. The starting year was selected based on the moratorium on new ground-water development.
b) When data are extracted from the calibration data set, use all budget components from the same year in order to capture correlation between components.
c) Whenever possible, use more recent data in preference to a year from earlier in the candidate period, in order to capture the most recent practices and technology.

We also discussed the idea of using pairs or triplets of years in order to better capture serial correlation, and briefly discussed the effects of carryover storage. At one point

we wrote on the board that some components of the water budget might be eligible for negotiated modification. Those of us still in attendance agreed this was *not* a good idea but the white-board photos were taken before this was crossed off the list.

Other comments and suggestions that were made in passing did not receive full discussion nor get written on the board. One of these is that the constructed data series must be examined to make sure that it indeed has the correct mean, variability and serial correlation. Another is that we must remember that the period from which we are extracting data includes two dry periods and only one wet period, so it should be expected that years extracted from the period will not be uniformly represented in the constructed time series. We also discussed the fact that 1997 perhaps should be excluded from selection because diversion volume may have been distorted by flood damage to diversion and delivery infrastructure. We did not discuss the possibility that with only a few years to choose from, we may not find a year representative of a particular hydrologic condition suggested by the historical time series. We invite discussion of all these issues.

There was limited discussion at the meeting of the importance of reservoir carryover in determining surface-water diversions. After the meeting, IWRRI concluded that there are several developments that may have changed the utilization of storage water, invalidating the use of the long-term record of carryover storage as an indicator: 1) Changes that may have occurred in reach gains; 2) The 427,000 acre-foot agreement and the Nez Perce agreement; 3) Changes in irrigation technology and canal maintenance; 4) Operation of power plants; 5) Operation of the rental pool; 6) Managed recharge. IDWR has pointed out that these same factors may have changed the serial-correlation characteristics of diversions and incidental recharge, casting doubt on our ability to construct a series that incorporates variability appropriate to current practices.

IWRRI is in the process of investigating available hydrologic indices and historical diversions by irrigation entity. IWRRI is concerned that the candidate ten years of calibration-period data may not contain enough choices to allow construction of a long-term input data set that simultaneously represents the observed historical hydrologic variability *and* gives the appropriate mean recharge value needed to avoid biasing the results. This supports the idea of addressing only question two in the scenario, and focusing on the expected long-term mean result. If this is true, the understanding of expected long-term and short-term variability will need to come from a qualitative understanding of past observations over many hydrologic cycles.

Combined with this concern over the short period of data representing current practices is a concern over our inability to predict future hydrologic conditions, a concern over the hazard of biasing scenario results with a water budget that has an incorrect long-term average, and the difficulty of constructing representative synthetic data sets. IWRRI proposes that we consider whether we are better off constructing a simpler but more robust scenario, which may produce fewer but more reliable results. We cannot stress enough that future hydrologic conditions will be the single biggest

driver of actual effects. At best, this scenario will be a rudimentary estimate of expectations. A simple scenario may be more likely to be correct, and still may capture all the knowledge that the data actually are able to provide.

9) Corrections. At the meeting IWRRI asserted that the trend on surface-water diversions (since the 1980s) was not statistically significant, and that there was no apparent trend in North Side Canal Company diversions since the 1980s. The trend analysis that was not statistically significant was an analysis of 1980-2000 data, designed to omit the influence of the recent drought. With the drought year 2001 included, the trend is significant. The canal-company diversion plot with no trend for the calibration period was not the North Side canal as stated, but the Twin Falls Canal.

10) Summary of details to be worked out: IWRRI agreed to assemble a list of details that still need to be worked out. A tentative first cut is:

    a. How do we include representation of probability or variability in our results?
    b. What limits of variability do we use (one or two standard deviations, 20% and 80% exceedence, other)?
    c. Do we attempt to represent both short-term (question one) and long-term (question two) results?
    d. How do we present long-term results?
    e. How do we present short-term results?
    f. How do we construct synthetic data for May 2002-present?
    g. Do we adjust the synthetic data based on comparison of model results to current observations? Do we adjust component-by-component, or scale the water budget globally?
    h. Which hydrologic sequence(s) do we use as indicators?
    i. How do we construct an index from the hydrologic data series?
    j. How do we use the hydrologic index to extract data from the calibration data set?
    k. Do we exclude the 1997 data?
    l. What do we do if the 1992-2001 period doesn't include a full suite of conditions appropriate to our index?
    m. How do we ensure that the data set provides the correct long-term average recharge (will not bias results)?
    n. The required input data must simultaneously reflect the impact of current practices and expected long-term hydrologic conditions. How confident are we that we can actually achieve this?