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Game Issues/ Analysis.

I am very encouraged by progress to date. However, want to make the game more realistic (perhaps less optimistic) and to deal with emerging issues.

Choices in 93 were an artifact of salmon conditions in that year. If they had been healthier, we wouldn't have cut so much

Biologists did not appear to deal with the cost of their operations in deciding on cuts. Big 1993 cuts cost perhaps $40 million during a period when EWA could have been picking up water (not spending it). Were the fish saved worth $40 million? For that cost, we could have purchased 10 – 20,000 acres of Delta habitat. The issue is clouded by low populations in that year (first wet year after a long drought). Nevertheless, we would ideally include other targets for money within the game. For example, we might buy Delta islands, picking up the following benefits: habitat, reduced TOC loading, reduced Island entrainment, and EWA water (via reduced ET). If these benefits are great enough, the EWA might even find it desirable to sell water in order to buy more land. I realize that this notion is controversial, however (Delta interests will be afraid of major land-use shifts and enviros will be afraid that the EWA will have too great an incentive to sell water). Therefore, the EWA should probably be considered, for now, just on its ability to manage water. All other opportunities are simply a bonus.

Collateral/ debt. The year 1993 came out all right, despite the creation of an enormous EWA debt in San Luis going into the growing season. Basically, the debt was paid off with some groundwater pumping (120 kaf), some extra Delta pumping (?), some south of Delta purchases (100 kaf), and by moving 235 kaf of storage and purchases from north of the Delta to SLR. We even had a few additional tools we could have thrown at the problem. We might have asked for demand shifting from MWD to allow delayed payback. We might have shifted water from Shasta and Oroville etc. into San Luis during July and August (thus moving the debt upstream). We might have relaxed additional environmental standards (assuming we had the authority to do so) to generate more export water.

Nevertheless, I am sure that the Projects would be very nervous about allowing this kind of a hole to be created in San Luis Reservoir, based upon mere commitments by the EWA to deliver water by the end of August. What would have happened if the spot purchase had fallen through or someone had protested shifting the EWA water from north of Delta to SLR? What if Kern or Santa Clara had refused the EWA access to groundwater pumping? If things were to go badly, the EWA's payback of SLR water might have been delayed past the SLR lowpoint, in which case contractors would have received reduced deliveries right at the end of the growing season. Thus, I believe, the value of collateral must be discounted to account for possibility that it cannot be delivered in a timely fashion. If the market is unreliable (as is the case now), then a commitment by the EWA to purchase and deliver water by a date certain must be heavily discounted. If the regulatory hoops required to move water from north of Delta to the export areas create uncertainty, then water owned by the EWA upstream must be discounted. This is not to say that EWA should only be allowed to act if it has water sitting in surface storage south of the Delta, only that this entire construct depends upon assuring the contractors that operations of the EWA will not put them at risk.

This implies that we need to take a second look at the reliability and feasibility of the various EWA tools. The game should be modified to reflect the actual constraints which may govern the various tools. For example:

- Markets.
  - Will a spot market exist that will allow the EWA to purchase water virtually instantaneously? Such markets exist in other resource areas (power, oil, etc.), but are not reliable yet for water in California.
  - What regulatory process will the EWA need to go through for purchased water? Will the process be efficient enough to allow use of the water within a few months of purchase?
  - Can upstream purchases be delivered in a short-term pulse (as was done in July of 1993)? Or must they be delivered over a longer period (e.g., via reduced diversions by local agricultural districts).
  - If spot markets are unreliable, and the regulatory process time consuming and uncertain for annual purchases, then we may need to think about longer-term water purchases by the EWA. We could lease water for 10 –20 years or even purchase a water right. Then, we would need to do the environmental documentation up front, but would thereafter be able to rely heavily upon this water. The water would also represent better collateral for the Projects.
- Demand Shifting
  - We are assuming that arrangements to shift demands with MWD will be available every year, provided that we decide we want to shift demands by some date (June 1?). This too is questionable, unless we negotiate a multi-year agreement with MWD in advance.
- Groundwater deposits/ extractions
  - We have generally assumed that capacity always exists within the EWA groundwater basins to deposit water into the ground and to extract it from the ground. The only exception was in the March game when we assumed that Kern would not allow the EWA access to groundwater extraction during dry and critical years. Again, we need to determine what is feasible. The reliability of the groundwater for the EWA and as collateral for the Projects probably depends, once again, upon the development of a multiyear agreement defining EWA access to groundwater and assuring that access.
- Relaxations.

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- We have assumed that the EWA may grant relaxations to the E/I ratio and to the in-Delta AFRP requirements. Moreover, the relaxations can be granted virtually instantaneously. This is an optimistic assumption. First of all, it implies a degree of unified decisionmaking that does not now exist. My experience has been that the No Name group (the analog within the Ops Group) has frequently had problems when it needed to make decisions quickly, simply because of the number of people who needed to sign off and because of the different responsibilities of the participating agencies. The need for rapid analysis and decisionmaking has major implications for the institutional structure of the EWA. However, assuming that the EWA has the correct institutional structure to make decisions quickly, there is likely to be another layer of regulatory oversight. If the EWA desires to relax the E/I, will it need the pre approval of the SWRCB? If it wishes to relax an AFRP requirement, will it need the pre approval of DOI?

- Delta storage.

  - Water quality concerns continue to be raised about Delta storage, if these concerns turn out to be valid, the EWA may be more constrained in its use of Delta storage (though I believe this problem can be worked out as discussed below).

A related issue is the reliability of market water.

For purposes of the game, we assumed that spot purchases can be made on a dime and that we can be assured

Reliance on transfers.

In 1993, EWA used up much of the transfer capacity. Additional capacity existed in August, but taxes would have been about 35%. Need to look at other years.

EWA appeared to be hampered significantly in efforts to protect ecosystem by regulations – very ironic. Delta storage could not be filled on several occasions, despite opportunities and low impacts. Keep in mind that Delta Wetlands rules were developed on the assumption that the project was to develop project yield. In this game, the Bacon complex is designed for the sole benefit of the environment. Bacon pumping is not a dead loss to the environment, but a complete gain. This should shift the balance in favor of more relaxed regulations or at least the ability to relax

Similarly, afrp regulations may hinder correct decisionmaking. July pumping was constrained, despite major benefits to water quality and minimal environmental impacts because of afrp. Bio's were unwilling to relax. Cannot necessarily fault bios in this game, since their responsibility is to the fish, not wq. Still, could have built up EWA storage and improved export water quality with, apparently, minimal harm to ecosystem.

Russ Brown's model appears to show that DWRSIM overstates possible exports. When flows fluctuate rapidly, opportunities decrease for two reasons: (1) DWRSIM averages inflows, allowing spikes to be spread over the entire month and (2) the E/I ratio is based upon a 14 day average inflow and cannot follow rapid increases in inflow. In 1993, Russ Brown's model showed a 1 maf difference in total exports. This helps to resolve the paradox noted by Spreck that historical diversions are much lower than future projected diversions. It also increases the importance of E/I relaxations and peaking capacity represented by the Delta islands

With all the Delta islands, peaking capacity (for about 1 month) rises to 21 kcfs, of which 4 kcfs is under the control of the EWA. We did not use this capacity during the last game because of the drought, because the first year after the drought reservoirs were filling, and because fish were particularly sensitive after the drought. In more normal circumstances, this capacity will be very valuable.

The game represents one possible way to think about "the value" of environmental operations. For example, with a limited budget, would the EWA spend money on reclamation at $1,000/af to generate zero impact water, or would it rather pull water at low impact periods (causing some harm) for use during high impact periods. If so, then the damage caused by the increased exports is less than $1,000 per acre-foot of water pumped. On the other hand, in the game, we found that people were willing to buy $100/af water rather than export more water above a certain level (that is, we exported some more, but also bought water). Therefore, the marginal impact of new pumping was thought higher than $100/af. Etc. We could study this effect by changing the price of water and observing changes in behavior.

If the Delta storage forebay is a wq problem, we have a number of possible responses:

- Seal the islands
- Dig out the peat (easier on victoria). This has the added benefit of increasing storage potential, increasing the depth of storage, and providing fill.
- Reduce the residence time on Bacon Island. We could generally evacuate this island very quickly after filling, either moving the water into Victoria, or moving it south of Delta.
- Deliver water only into the DMC, coupled with an O'Neal bypass. This would greatly reduce TOC problems during periods of demand for DMC water (a few urban DMC users would need to be shifted over to the SWP canal) and should reduce mass salinity loading for ag as well. However, water would still go into SLR during winter months.

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- The water could be delivered to Mendota pool and released into the SJR during the salmon outmigration period to boost flows and to increase Delta outflow (or to be backed into upstream storage for the EWA). (This is like Alex Hildebrand's recirculation approach, but without rediversion at the bottom). This would, incidentally, reduce the need for the EWA to purchase water on the SJR for flows. (unless there were specific tributary needs.). This is especially important if we have overestimated market water availability or underestimated the price. I guess, some of the TOC would get back into the Projects, but the water would be diluted, particularly during the VAMP period (with limited exports and closure of Old River). We could even think about an in lieu arrangement in which we supply the water in return for credit from the exchange contractors (thus allowing us to get some of the water back in the export area).
- A similar idea would be to use this water to make deposits into the Gravelly Ford groundwater site, again via the DMC. The TOC problem disappears, and we get long-term storage.
- When operating as a flow-through, confine the water to a sealed channel.

The EWA appears to provide net water supply benefits to the Projects in two ways: though this statement still needs to be confirmed.

- First, there is the interaction between diversions and X2. My impression is that the EWA has tended to clip off high Delta outflows through increased diversions, and to increase Delta outflows at lower flow levels. Because the relationship between Delta outflow and the movement of X2 downstream is logarithmic, improvements in Delta outflow at low outflows have a much greater positive effect on X2 than reductions in outflow at high outflows. This could mean that the EWA is helping, on average, to meet the X2 standards through its operations. If so, then either the EWA should get credits for this water, or it needs to be added to estimates of improved project yield. Of course, if the opposite is true and the EWA is making compliance with X2 more difficult, then the EWA must compensate the Projects.
- Second, there is the issue of the San Luis low point. As I understand it, in most years, the Projects attempt to operate SLR such that minimum storage (in August) is greater than some specified amount. This carryover storage will constrain Project deliveries. **The existence of EWA water in San Luis in the late summer allows the Projects to deliver water below their previous low point.** Another way of putting it is that the EWA is providing the dead storage in San Luis, or that the Projects are borrowing EWA storage in San Luis. Now, the Projects will not necessarily gain water supply out of this maneuver. If San Luis doesn't fill and the EWA doesn't have storage in San Luis the next summer, the projects would have to reduce deliveries and would be right back where they started. But when SLR fills, the Projects will have increased their deliveries. Again, I am not demanding that the EWA must get credit, but I do feel that we should acknowledge the increased yield and estimate how large it will be. Conceivably, a similar phenomenon could take place in other reservoirs (e.g., if EWA has water stored in Shasta, the water might count toward the 1.9 maf carryover target), though this is less likely.

We should explore the possibility of "reverse" demand shifting, in which MWD or other state or federal contractor takes water from the EWA ahead of its normal contractual schedule, and returns that water to the EWA later via reduced deliveries from the state or federal projects. In other words, can the EWA temporarily access empty storage controlled by local or regional water agencies? The main benefit would be to allow the EWA to avoid losing water that would otherwise "spill" when San Luis fills up. It may be that when San Luis fills, most local and regional storage is likewise full, but there may be some opportunities for finding empty storage in some years. If the Colorado or Owens Valley Aqueducts have surplus capacity, we could even back water into Mono Lake or the Colorado Reservoirs.

We continue to have some difficulty in integrating Webb Tract into the game. I think that there is general agreement that Webb is part of the baseline w/r EWA operations, even though it is being operated by hand in the game. However, some questions remain about how it fits. Here are the questions, and my tentative answers:

- If the EWA stops the Projects from pumping into Webb, how is the debt carried and how is it paid off? The basic rule is that the EWA cannot do harm to the Projects. Therefore, the EWA must assure that any benefits that would have been generated by the water in Webb are retained by the Projects (it owes these benefits to the Projects). If Webb can fill the next month, then EWA's debt is extinguished. If Webb could have released its water for export, then EWA is on the hook to compensate for that water (the debt is transferred to San Luis).
- Can

Most of us originally believed that the EWA would expend a disproportionate amount of resources in dry years, while accumulating resources during wet years. This was not the case during the last game for 1991-1993. We actually accumulated assets during the dry years and spent them during the wet years. Why? Most of the environmental actions taken during this game were export reductions during sensitive periods. Since exports were very low during 1991 and 1992, the cost of reducing exports was low. Meanwhile, the EWA had a few opportunities to divert water and was able to buy some cheap water. During 1993, the stakes rose by an order of magnitude. The EWA was able to divert more water for itself, but was also forced to spend enormous amounts of water and money to bring down exports from 15 kcfs to a level considered safe by the biologists. The year 1993 may have been an anomoly in that historical stocks were very low so that the biologists felt compelled to protect fish despite relatively low fish densities at the pumps. Nevertheless, it raises fundamental questions about EWA priorities and the distribution of property:

- If environmental protection is mainly a matter of reducing already low export levels in dry years at low cost, but dramatically reducing spring export levels in wetter years (at high cost), then the mismatch in needs between EWA and the Projects provides an opportunity to restructure EWA assets and strategies. For example, EWA might strike a deal with the Projects to supply dry year water to the Projects. In return, the Projects would deliver double or triple that amount of water to EWA in

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below normal, above normal, and wet years. In this way, EWA can effectively transfer unneeded dry year assets to the wetter years when they are most needed.

- Alternatively, if dry years really are the problem, then we need to emphasize strategies that transfer wet year assets to the dry years. That means storing up water and building up financial reserves during wet years for use in dry years. Pursuit of this strategy would mean:

  - Accepting somewhat greater levels of take during wet years under the assumption that higher flows will more than compensate for additional take. In this way, we can spend less and accumulate more water.
  - Using more money and more water to enhance flows during dry years
  - Develop as much storage as possible so that storage can be held from wet years to dry years. Long-term storage assets currently are limited to 400 kaf of groundwater storage and 50 kaf of surface storage – not enough to do all that much during a long-term drought. This is probably all that we can look forward to in Stage 1. However, the need for more EWA storage might be incoporated into later stages.
  - Develop risk management strategies. For example: Enter a future's market (if one existed). In this type of market, the EWA would buy an option for water to be delivered the next year at an agreed price (before we know what kind of year it will be). The cost of the option and the cost of the water in the option would incorporate the risks, as seen by the seller. Then, if next year is wet, the option need not be exercised (and the EWA is only out the option cost). If the next year is dry, then EWA can exercise its option at a bargain price and the seller is on the book to provide the water at a loss. This is basically what is in the current game. However, the cost of the options and the cost to invoke the options may be too low to protect the seller. We need to look into this in more detail. This type of future market exists in practically all arenas <u>other</u> than water. It would be a valuable tool for the EWA and for other water users as well.

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