Comments on the Final EIR/EIS

Cadiz Groundwater Storage Project
Cadiz and Fenner Valleys
San Bernardino County, California

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INTRODUCTION

I have made three written comments to the Draft EIR/EIS for the Cadiz Groundwater Storage Projects. The last of the comments was issued in August 2001, and was entitled: ***"Revised Comments: Cadiz Groundwater Storage Project—Cadiz and Fenner Valleys—San Bernadino County, California"***. In each of these comments we tried to point out the difficulties with the pumping of indigenous groundwater envisioned by the project.

In the earlier comments I made several points; I quote from our first report (December, 2000—this report is included in the Final EIR/EIS, v. III, G42):

1. ***the estimate of annual recharge used in the Draft EIR/EIS is an order of magnitude too high—it is probably only 5,000-6,000 ac-ft/yr;***
2. ***using a more realistic recharge rate there will be adverse impacts to the groundwater system and the environment; and***
3. ***that once development has proceeded for a period of several decades simply stopping the project, as implied in the Supplemental EIR/EIS, will not halt the adverse environmental impacts—in other words, the groundwater system once perturbed has sufficient persistence that adverse impacts will persist well beyond 100 years, even though the project is stopped after 50 year or earlier.***

These comments remain relevant; none has been adequately responded to in the Final EIR/EIS.

THE RECHARGE RATE

In the Final EIR/EIS a Management Plan that includes an extensive monitoring network was proposed; the Plan is intended to act as the "safety net" that will prevent harm to federal resources. Neither of these strategies addresses the basic issue of concern: ***the recharge rate of the aquifer***—the annual rate at which the groundwater supply is replenished from precipitation. The recharge rate is generally viewed as equivalent to the upper bound of sustainable groundwater development. The estimate of recharge is critical in any analysis of how a groundwater system will perform. If the estimated recharge is wrong, predictions of the aquifer's response, including injury to federally protected resources such as air quality, water supply and quality, springs and wildlife, will also be in error.

The design and implementation of the monitoring system appears to be an end run around this more fundamental issue. In commenting on our concerns the authors of the Final EIR/EIS stated:

> *"BLM and Metropolitan acknowledge that there are different opinions among experts regarding the amount of recharge. Due to these conflicting opinions, The Management Plan was developed as the basis for operating the project without adverse impacts to critical resources."*

This leaves open the issue of how much indigenous groundwater is to be extracted.

HOW MUCH INDIGENOUS GROUNDWATER WILL BE PUMPED

In the recently released Final EIR/EIS one of the stated objectives of the project is to

> *"Provide the maximum amount of indigenous groundwater consistent with the Management Plan*

However, nowhere in the document are projected or target levels of local groundwater extraction indicated. The Management Plan replaces the various scenarios of development envisioned in the Draft EIR/EIS, leaving totally open the question of how much of indigenous groundwater is to be pumped. This is problematic, to say the least, because it is impossible to assess the impact of the extraction of indigenous groundwater without some estimate of the amount and timing of the groundwater to be extracted.

PROBLEMS WITH THE PROPOSED MONITORING AND CONTROL

As mentioned above, the monitoring system is unlikely to be a reliable safeguard. It will be very difficult to accurately detect "early warning signals" of adverse impacts as they are likely to be masked by feedback from project operations and/or natural groundwater fluctuations. Clear, indisputable signs of an overdraft of native groundwater will not occur until the project has operated for some time, at which point it will be too late to prevent adverse impacts. Perturbing a groundwater system is like putting a freight train in motion; once it has started moving it will be difficult, if not impossible, to stop the system from responding to the overdraft.

We are all the more concerned about the efficacy of the monitoring system. The final EIR/EIS defines what qualifies as an early warning sign. For the groundwater system the early warning signs are: 1) a one foot change in water level in one of the designated S-Series observation wells; and/or 2) a change in water quality of 25%. Should either of these conditions be met an analysis is made of whether the change constitutes a precursor to an adverse impact. In the analysis models will be used to project impacts into the future. Models have an inherent degree of uncertainty. In this instance certain key data such as the rate of recharge are highly uncertain. It is at this step that projecting future adverse impacts will be a matter of judgment on the part of the analysts. The analysts also will be subject to pressure because of the large up front investment in the project.

Adverse impacts are to be ameliorated by modifying the project operations including stopping the project, and/or recharging the groundwater system with Colorado River water (if it is available). Stopping the project may be a realistic last resort. Recharging the groundwater system with Colorado River water at a future time of scarce water supplies for human demands is implausible.

The Draft EIR/EIS suggested that perhaps as much as 2,000,000 acre-feet of indigenous groundwater would be extracted over the 50-year life of the project. In order to make our comments specific I did an analysis based upon a total withdrawal of 1,700,000 acre-feet of native groundwater during the life of the project. That analysis is presented in our earlier reports. In that analysis we showed that even though the project was stopped after

50 years significant changes in both water levels and water quality would continue to occur after the project was stopped. In other words, stopping the project does not stop adverse impacts; impacts occur as the perturbation caused by pumping migrates through the groundwater system.

In responding to the concerns we presented in two earlier reports the authors of the Final EIR/EIS stated *"the results of the simulation do not reflect the project as it will be implemented"*—a response that was repeated more than 10 times. Again we make the point—it is impossible to assess the impact of extracting local groundwater without some estimate of the timing and quantity of extraction. In an effort to estimate impacts we assumed a given development that was within the level of development indicated by the Draft EIR/EIS. By dismissing our analysis the authors of the Final EIR/EIS failed to acknowledge, let alone address, the important point that the perturbations of the groundwater system will migrate slowly, but inexorably through the system.

A SCENARIO OF DEVELOPMENT

The stated objectives of the project are (from the Final EIR/EIS):

1. *"provide delivery capability of up to 150,000 acre-feet of Colorado River water annually;*
2. *provide a storage capacity of up to 1.0 million acre-feet at any one time;*
3. *provide the maximum amount of indigenous groundwater for transfer consistent with The Management Plan; and*
4. *provide a recovery capability of stored or indigenous water at a rate of up to 150,000 acre-feet per year for delivery to the Metropolitan service area during dry years; and*
5. *enhance water quality in the delivery system."*

At the risk of being discounted once again, I am going to assume a scenario of storage and withdrawal that is consistent with both the Draft and Final EIR/EIS. I am assuming this scenario in order to illustrate how difficult, if not impossible, it will be to design and implement a monitoring and control scheme that will prevent adverse impacts. Lest there be some misunderstanding, let me stress the fact that even though the actual pattern of storage and withdrawal which plays out under the project may differ from the scenario I assume for illustrative purposes, it does not invalidate the point being made.

Groundwater Models

In our earlier comments I used groundwater models of both groundwater flow and salt transport to make our comments more concrete. I patterned the parameters for the groundwater flow model after the model used in the comment by Durbin (2000) on behalf of San Bernardino County. I will use the same flow and transport computer models used in my earlier analyses to make this analysis. The transport model is approximate in that it does not include the effects of varying groundwater density within the model.

To make the analysis specific I assume five equal periods of storage (5 years each); each storage period is followed by an equal period of pumping (5 years each). During the storage period I assume 100,000 acre-feet is stored annually. During the pumping period I assume 150,000 acre-feet of groundwater is pumped annually. The scenario of storage and pumping is illustrated in Figure 1.

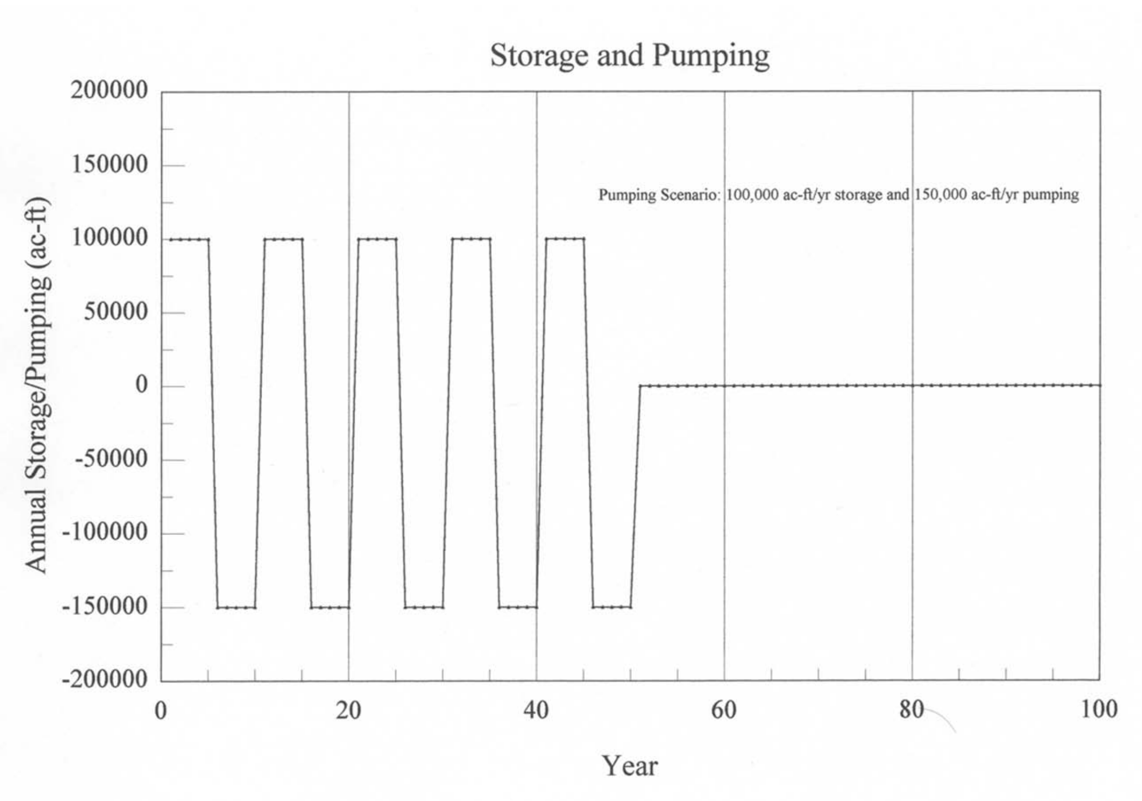

Figure 1. Scenario of annual pumping and storage.

During the 50-year life of the project, as envisioned in the Figure 1 scenario, the operations result in:

Stored Water	2,500,000 acre-feet
Pumped Water	2,500,000 acre-feet of stored Colorado River Water
	1,250,000 acre-feet of indigenous groundwater

These quantities are within both the stated objectives of the Final EIR/EIS for the project and the amount of local groundwater that the Draft EIR/EIS indicated would be pumped. (The Draft EIR/EIS suggested 2,000,000 acre-feet, or more, of local groundwater might be pumped.)

Change in Water Quality

One of the criteria that trigger an analysis of adverse impact is a change in water quality in one of the S-Series observation wells of more than 25%. I want to examine the simulated water quality in observation well SCE 5. Well SCE 5 is an existing well situated between the proposed project storage ponds and Bristol Lake Playa (see Figure 2).

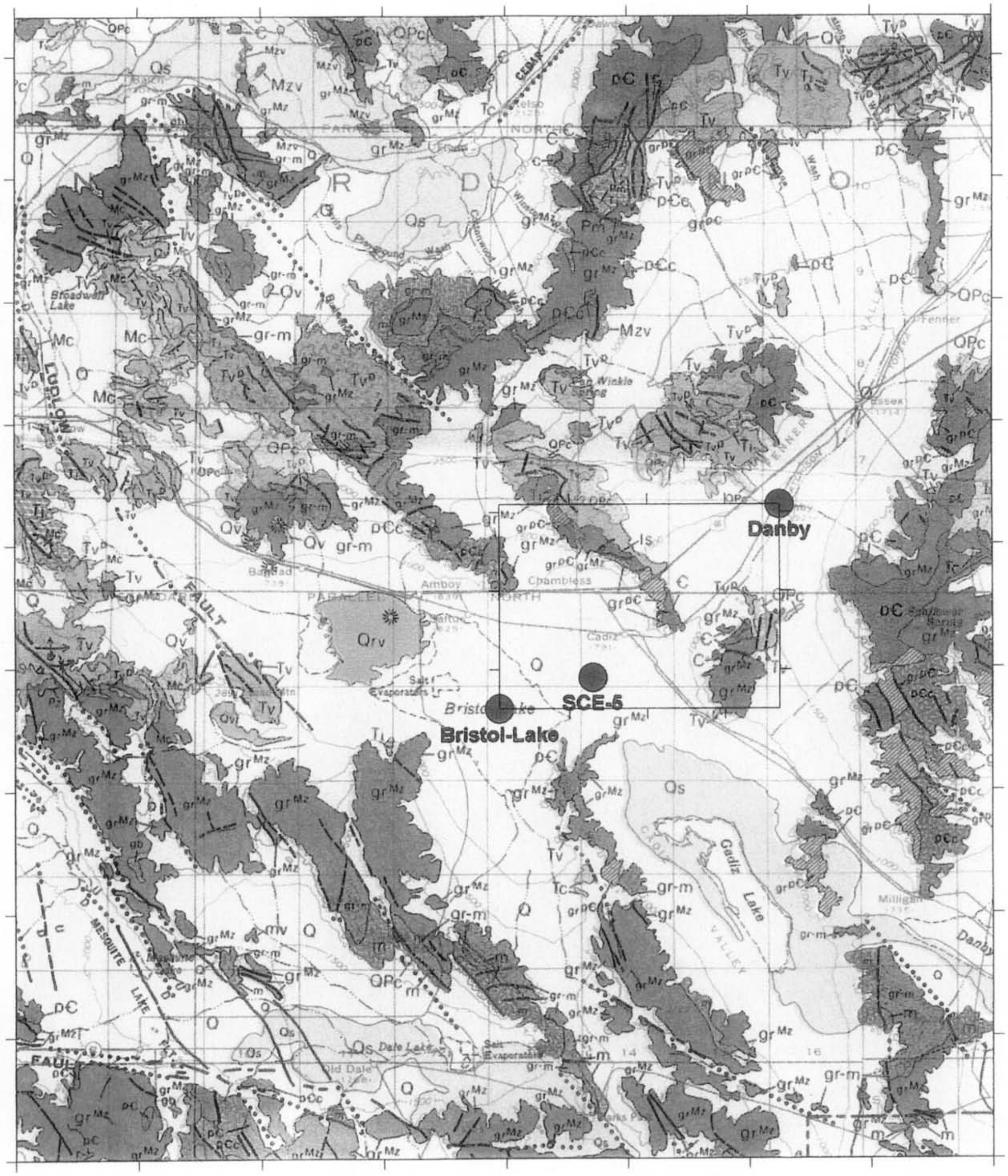

Figure 2. Location map of observations wells.

Figure 3 is a plot of the simulated water quality in the SCE 5 observation well. Under our assumed scenario of development the total dissolved solids (TDS) of the water increases by more than 25%, the criterion for triggering action, in year 45. In our simulation we stop pumping indigenous groundwater after year 45, and we simulate totally stopping the project after year 50. Nevertheless, the quality of water continues to deteriorate for the next 50 years after stopping the project—out to year 100, as far as the simulation was carried. The TDS exceeds 1000 mg/l in year 62. The increase in total dissolved solids is an indication that the salt water associated with Bristol Lake Playa is moving toward the area of pumping; it continues to move even though the project stops.

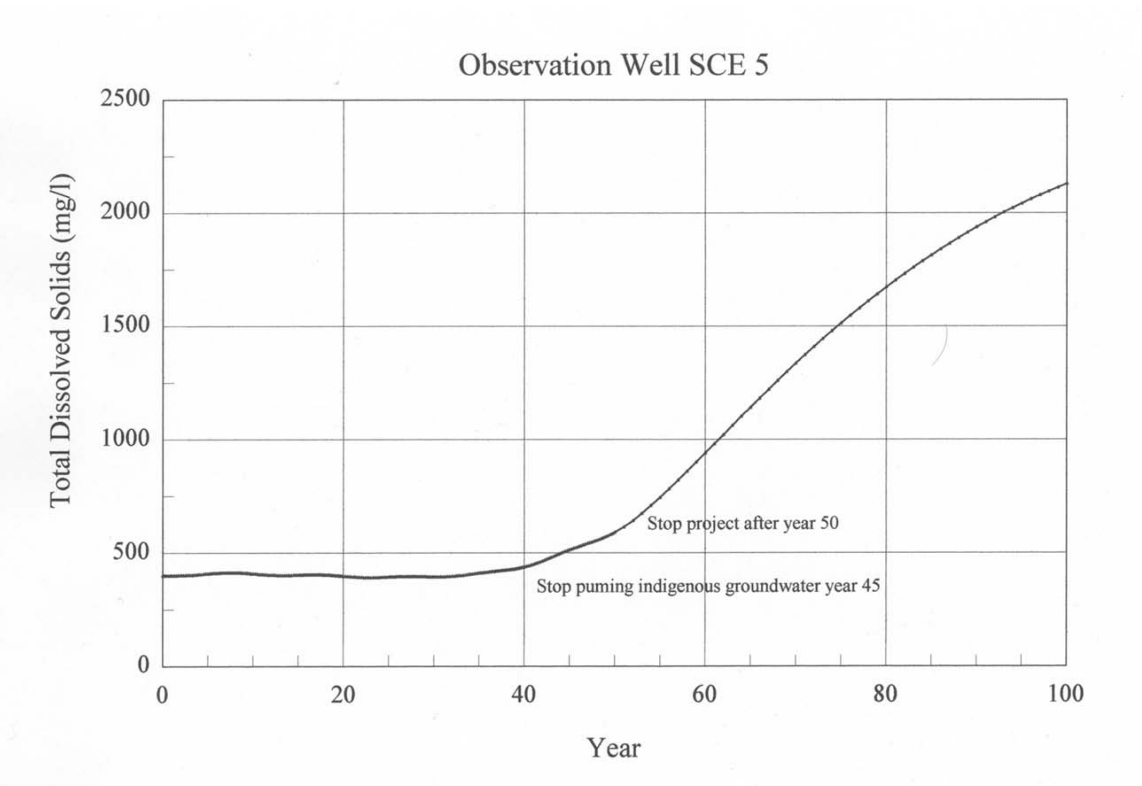

Figure 3. Simulated change in TDS in well SCE 5.

The simulated increase in total dissolved solids violates the water quality standards adopted by the State of California. The Basin Plan adopted by the California Regional Quality Control Board for the region has as its goal to maintain the existing water quality of all nondegraded groundwater basins. The State of California Department of Health Services has identified a secondary water quality standard of 1000 mg/l for TDS in drinking water.

The movement of salty water could be reversed by recharging water at the recharge facility. However, it would take a quantity of recharge approaching the magnitude of the total amount of local groundwater extracted in the 45 years of pumping (approximately 1 million acre-feet) to reverse the situation. This amount of recharge is outside the realm of feasibility.

The Management Plan proposes that a set of observation wells be drilled between well SCE 5 and Bristol Lake Playa. I have simulated the changes in water quality at a well 1 mile west of SCE 5, closer to the Bristol Lake Playa. Figure 4 is a simulated plot of TDS in this hypothetical well. The criterion for triggering action, a change in water quality of more than 25%, is met approximately in year 20. I simulated stopping the extraction of indigenous groundwater after year 20; from that time through year 50 only storage and extraction of Colorado River water is simulated.

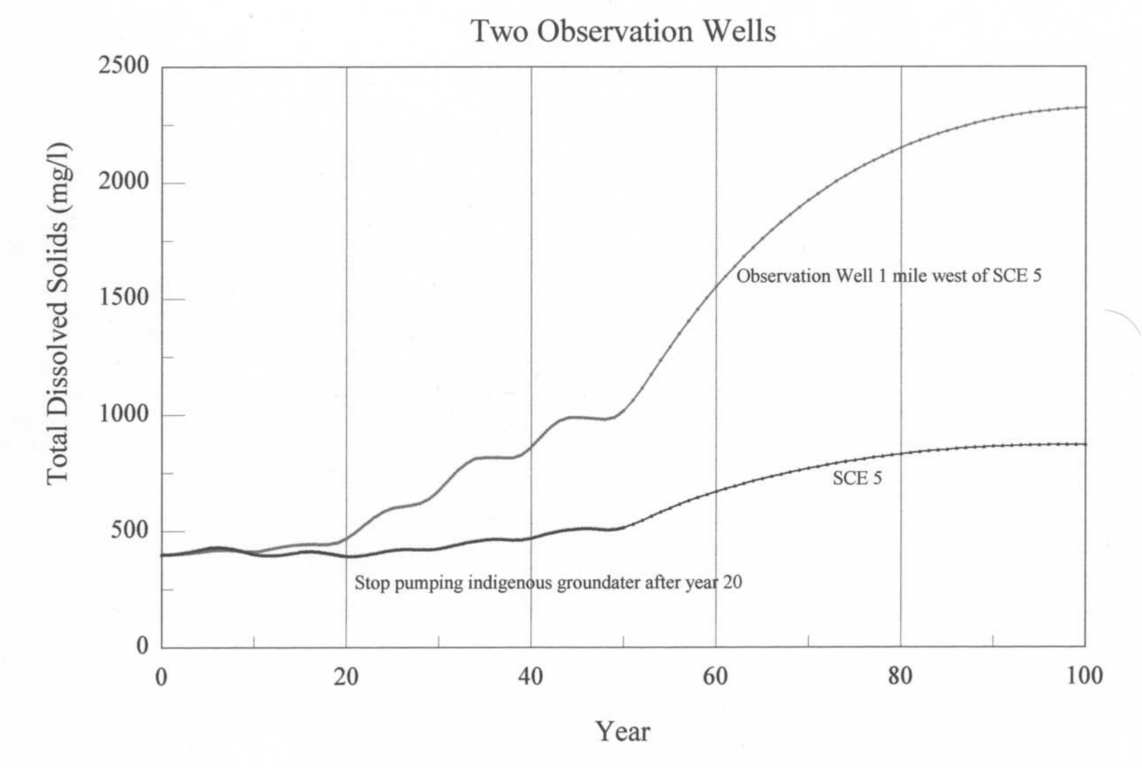

Figure 4. Simulated TDS in two observation wells near Bristol Lake Playa.

Again, stopping the pumping of indigenous groundwater does not stop the degradation in water quality. At this location the deterioration continues to year 100. The TDS at year 100 exceeds 2000 mg/l. This scenario also increases the TDS level at well SCE 5 to approximately 800 mg/l.

The two scenarios illustrate the impracticality of the proposed monitoring and control system.

Changes in Groundwater Levels

I would like to illustrate the kind of slow response in a groundwater system that in many ways resembles momentum in the system. The slow response leads to the fact that a perturbation in the system caused by pumping will take a long period to work its way through the system. I will use our same scenario of development (Figure 1) to illustrate the point.

In this case we will examine the simulated water level changes for an observation well near Danby (see Figure 2 for the location). Danby is situated up the Fenner Valley approximately 12 miles to the north of the area of project operations. Danby is north of the Granite Mountains, east of the Clipper Mountains, and west of the Old Woman Mountains. Springs in these mountains are of concern to the wildlife in the area. Water level changes at Danby could be an indicator for changes in springflow in the adjoining mountain ranges. Danby is one of the areas designated in The Management Plan for a set of the S-Series observation wells.

Figure 5 is the simulated plot of the water level change in the well at Danby. In this instance the change in water level only exceeds the trigger criterion of a 1-foot change in approximately year 54; the project was stopped after year 50. However this is only the beginning of the change; the water level continues to steadily decline to year 100.

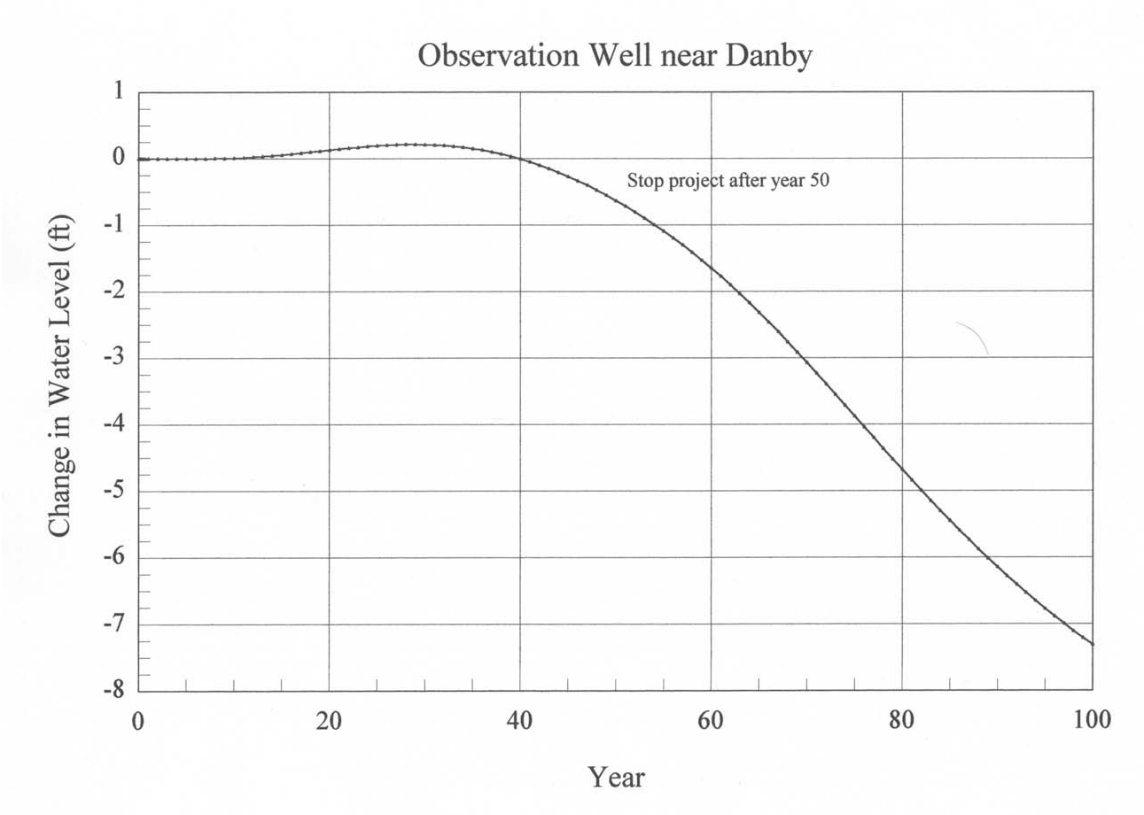

Figure 5. Simulated drawdown in an observation well near Danby.

The point of this illustration is that it takes more than 50 years for the change in water level to exceed 1 foot, but the decline continues to more than 7 feet in 100 years even though the project was totally stopped. If we wanted to avoid the decline in water level at Danby we would have to halt the project, or at least halt the extraction of indigenous groundwater, long before the water-level change there reached 1 foot. One could imagine adverse impacts to springs in the nearby mountains long after the project was stopped.

A SUSTAINABLE PROJECT

Many of the objections to the Cadiz Project are based upon the analysis that the project as proposed will mine a large quantity of indigenous groundwater. Given our current understanding of the groundwater system in the area, only a project that pumped a smaller quantity of local groundwater while storing Colorado River water could be sustainable indefinitely.

As suggested above, there is disagreement among the experts about the recharge to the Cadiz/Fenner valley aquifers. The current estimates range from a low value of 2,000 ac-ft/yr to a high value of 30,000 ac-ft/yr. However, most of the estimates clearly favor the lower range of values. Currentl y the Cadiz Company is pumping 5,000 to 6,000 ac-ft/yr for irrigation. The current agricultural pumping has, or will capture the natural discharge that probably occurred as evaporation from the dry lakes under virgin conditions. The agricultural pumping has been going on for more than a decade and appears to have little or no significant adverse impacts.

A Cadiz Project in which the quantity of groundwater pumped currently for irrigation is acquired by the project, and not exceeded, is probably sustainable. This would entail pumping for the project instead of for agriculture—the irrigation by the Cadiz Company would have to cease.

Accordingly, I recommend a sustainable Cadiz Project in which the total pumping of native groundwater from the Cadiz/Fenner Valleys be restricted to an average of 5,000 ac-ft/yr.

CONCLUSIONS AND RECOMMENDATION

From my analyses I have reached the following conclusions:

1. Recharge to the Valley aquifers is of the order of 5,000 ac-ft/yr, not 50,000 ac-ft/yr as suggested in the Draft EIR/EIS.

2. Water table groundwater systems respond slowly to perturbations. Once perturbed, impacts occur at long times into the future. This poses a challenge for monitoring and control. The delayed reaction of the groundwater system combined with the fact that the subtle indications of overdraft tend to be masked or easily confused with fluctuations due to other causes will profoundly undermine the early warning system that has been proposed.

3. The control measure to ameliorate adverse impacts is to modify the project operations. For practical reasons the most feasible modification of operations is to stop extracting indigenous groundwater. Recharging Colorado River water with the purpose of mitigating adverse impacts, as suggested in the Management Plan, is probably infeasible—the water will be needed to meet human demands at that time. Our simulations show that after the project has operated for several decades stopping the extraction of local groundwater will not mitigate adverse impacts. Again, water table groundwater systems respond slowly to perturbations; perturbations migrate slowly but inexorably through the system. Impacts occur at long periods into the future.

4. Models are useful tools in the monitoring. The Management Plan envisions using models to assess long-term impacts. However, future predictions made using models carry a degree of uncertainty inherent in the analysis. Given 1) the fact that a model analysis indicates an unwanted future adverse impact, and 2) the uncertainty inherent in the analysis, the question arises ***will such an analysis be sufficiently persuasive to modify or halt the mining of native groundwater—especially given the substantial amount of public funds invested up front in the project?***

5. The Cadiz Project could probably be sustainable if one limited the magnitude of pumping of native groundwater to approximately the current rate of pumping by the Cadiz Company—5,000 ac-ft/yr. In a sustainable mode the project would acquire the irrigation pumping of the Cadiz Company—irrigation in the area would cease. This rate of pumping of native groundwater is equal to 250,000 ac-ft over the 50-year life of the project. ***It is my recommendation that the project be made sustainable by restricting the pumping of native groundwater to an average rate of 5,000 ac-ft/yr.***