STATE OF CALIFORNIA

DOCKET 09-AFC-8		
DATE	JUN 16 2010	
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Energy Resources Conservation and Development Commission

In the Matter of:

APPLICATION FOR CERTIFICATION FOR THE GENESIS SOLAR ENERGY PROJECT DOCKET NO. 09-AFC-8

INTERVENOR CENTER FOR BIOLOGICAL DIVERSITY

Testimony of Tom Myers

Re: Impacts to Water Resources from the Proposed Genesis Solar Energy Project

Docket 09-AFC-8

Summary of Testimony

The proposed project will have a significant impact to water resources that have not been adequately addressed to date. The SA and Revised SA and the hydrology reports from the applicant's contractor vastly underestimate the impacts the proposed project will have on the groundwater balance and flow systems of Chuckwalla Valley and the nearby Colorado River. As an initial matter, the recharge to the basin is overstated by many times which leads to a significant overestimate of the perennial yield. Moreover, the discussion of the deep aquifer and the impacts of the proposed pumping of up to 1650 af/y on the shallow aquifer are based on unsubstantiated assumptions of the aquifer and inaccurate groundwater modeling. As a result, the identification and analysis of impacts of the proposed water use is inadequate.

The proposed project in itself as well as in conjunction with other cumulative projects would significantly impact groundwater resources and cause far larger drawdown of the aquifer than acknowledged in the SA and Revised SA.

Qualifications

My qualifications are provided on my Resume attached to this Testimony and as discussed below.

I have over 25 years of experience as a hydrogeologist, primarily in Nevada but also including California and the Mojave Desert. Approximately 16 of those years have been

as an independent consultant based in Nevada and working throughout the western United States, including the Great Basin and Mojave Desert of California.

I have a Ph.D and M.S. in Hydrology/Hydrogeology from the University of Nevada Reno. I have a B.S. in Civil Engineering from the University of Colorado. I have continuing education in various aspects of hydrogeology, including fractured rock analysis, groundwater monitoring, and environmental forensics from MidWest Geosciences and National Groundwater Association.

I have published articles on hydrological issues, including groundwater modeling, stochastic modeling, and river morphology in peer-reviewed scientific journals such as the *Journal of Hydrology* and presented papers/posters at professional meetings of hydrologists and water resource professionals.

I have provided expert testimony on hydrological issues and water resources in proceedings before the Nevada State Engineer, Nevada State Environmental Commission, and Billings Federal District Court.

Statement

The project applicant's Groundwater Resources Investigation (GWRI) and Supplement Groundwater Resources Investigation (SGWRI) are inaccurate. The Discussion of Water Resources in the Staff Assessment (SA) and Revised SA are also incomplete and inaccurate. This statement is a review of those documents and is organized into three broad categories: Water Balance, Groundwater Model, and Impact on the Colorado River, along with a References section.

Water Balance

The GWRI discusses various aspects of the water balance and perennial yield for Chuckwalla Valley. With the exception of discharge, the GWRI grossly overestimates all of the water balance components, as explained in the following comments.

- Water balance is a simple concept in that inflow equals outflow. In groundwater hydrology, it is common to consider water balance at steady state or for predevelopment conditions. In this case for predevelopment conditions, recharge plus interbasin inflow equals discharge through evapotranspiration (ET) and springs plus interbasin outflow.
- 2) The GWRI (at 34) estimates discharge to evapotranspiration (ET) at Palen Lake to be approximately 350 af/y. The discharge is mostly through exfiltration. This estimate is reasonable.
- 3) The GWRI (at 31) estimates interbasin outflow to Palo Verde Valley to be approximately 400 af/y. This estimate also appears reasonable although it is not possible to examine the original reference. Rather, considering the cross-section from the GWRI, Figure 4, the flow passes a trapezoidal area about 1500 foot thick at its thickest point and about six miles wide for an area about 35,000,000 ft² or

818 acres. From GWRI, Figure 10, the gradient is about 0.0008 ft/ft. Using Darcy's Law, the conductivity is about 1.7 ft/d, a reasonable value.

- 4) The estimate for interbasin inflow from Pinto and Orocopia Valley, at 3500 af/y, is very high. To be correct there must be that much recharge in those valleys. Considering the discussion below on recharge for Chuckwalla Valley, such an estimate appears to be very high. Also, the width of the boundary with Chuckwalla Valley, shown on GWRI Figure 6, appears to be less than the boundary with Palo Verde Valley which had been estimated to have just a little more than one-tenth of the estimated inflow from Pinto Valley.
- 5) Pumping is not part of the pre-development, steady state discharge. It should not be included in the GWRI Table 3-5.
- 6) Ignoring the pumpage (discussed in the GWRI (at 26-30)), the natural discharge from the valley appears to be approximately 750 af/y.
- 7) Recharge and interbasin inflow therefore must balance the steady state discharge.

The GWRI has a long discussion on recharge trying to justify an estimate that exceeds the natural discharge by ten times or more. For many reasons, the estimate of recharge is incorrect.

- 8) The in-basin recharge estimate is grossly too high, based on a comparison with other methods used in the southwest and based on a detailed consideration or understanding of the principles of recharge.
- 9) The applicant cites favorably the Maxey-Eakin method as an empirical method used in arid basins throughout the Southwest (GWRI, at 23). The report fails to note that application of the method in the Chuckwalla Valley would yield an estimated recharge equal to zero. This is because the Maxey-Eakin method established a recharge efficiency coefficient equal to zero for precipitation zones less than 8 inches/year (in/y) (Avon and Durbin, 1994, at 100). (I used Avon and Durbin (1994) to reference the Maxey-Eakin method because it best describes the methodology and assesses its accuracy.)
- 10) The GWRI criticizes the Maxey-Eakin recharge methodology citing to Lerner et al (1990); the reference list does not include the citation for this reference so the basis of the criticism cannot be assessed.
- 11) Avon and Durbin (1994, at 109) estimated new coefficients, finding that for basins with precipitation less than 8 inches the coefficients would be 1.1%; the GWRI does not mention this. Thus, Avon and Durbin's coefficient for areas with less than 8 in/y precipitation implicitly acknowledges that recharge will occur in any basin because there will be wetter years with runoff that does infiltrate into the fans causing recharge. If 1.1% applies to the Chuckwalla basin, the recharge would be about 3465 af/y, or about 1/3rd the value estimated in the GWRI (at 24).
- 12) Another methodology used in the Southwest and developed by the US Geological Survey is the Anderson method (Anderson, 1995) which also limits recharge to basins which have average precipitation in excess of eight inches (*Id.*, at A16).
- 13) The GWRI references a US Geological Survey study to claim that basinwide recharge rates, for arid Southwestern basins, vary from 3 to 7% of the basinwide precipitation (GWRI, at 23). The citation is to USGS (2007), which is a

collection of multiple professional papers describing site-specific studies at seven sites ranging from northern Nevada to southeastern Arizona to southern California. They do not specify which paper within that collection summarizes recharge and provides the reported range.

- 14) The USGS recharge sites described in Constantz et al (2007) differ substantially from Chuckwalla Valley in that they have significantly higher elevation and would have significantly less potential ET (PET) than does the Chuckwalla Valley. The Mojave River site faces north and the Amargosa River site is both higher and significantly further north. Both would lead to lower PET than in Chuckwalla Valley. More PET would increase the amount of exfiltration of the infiltrated runoff, thereby decreasing the amount of alluvial fan infiltration which actually becomes recharge.
- 15) The Mojave River and Amargosa River sites (Constantz et al 2007) are closest in climate and geology to the Chuckwalla Valley. The altitude of the two gages is 1003 and 1234 m amsl (3290 and 4048 ft, respectively), which exceeds the elevation of the lower end of Chuckwalla Valley by from 3000 to 3800 feet. Both of these USGS study watersheds have significantly higher elevation areas which likely have much higher precipitation than does the higher elevations in the Chuckwalla Valley.
- 16) Waste water and irrigation return flow is not part of the steady state recharge.

The overall groundwater budget discussion mixes development stresses and natural fluxes, as if they should balance (GWRI, at 34, 35). When development occurs, the new discharge initially causes groundwater to be released from storage. As the water table or potentiometric surface lowers, the new discharge begins to capture natural discharge from some area. In this case, it appears the basin is currently being pumped at rates exceeding the perennial yield, as noted below.

- 17) The GWRI cites a perennial yield estimate of 12,200 af/y, based on Hanson (1992). This reference is a letter, not a peer-reviewed or even agency-reviewed analysis of the amount of water available from the basin. It should not be considered authoritative and should not be relied upon when considering water availability.
- 18) The GWRI does not estimate perennial yield, but provides a groundwater balance table to suggest that the amount of water available is of the order of the Hanson perennial yield.
- 19) The groundwater budget table (GWRI, Table 3-5 at 35) shows substantial pumpage most is in western Chuckwalla Valley. The 1992 groundwater contour map (GWRI, at Figure 11) does not include this area around Desert Center. The hydrographs presented for western Chuckwalla Valley do not continue into the 21st century, the time period for which most of the reported pumping has occurred. Therefore, there is no estimate of the drawdown which must be occurring. At no point does the GWRI consider this flux from storage to the water balance. It would be part of a current water balance for the valley, but the GWRI does not present such a water balance.

- 20) Using the Avon and Durbin (1994) Maxey-Eakin coefficient estimate and accepting for the sake of argument the 3500 af/y inflow from Pinto and Oracopia Valley, the total natural inflow to the valley would be 6965 af/y. Subtracting the 350 af/y ET discharge at Palen Lake, the interbasin flow to Palo Verde Valley would be 6615 af/y, which would require a conductivity of 28 ft/d, based on the cross-section for flow to Palo Verde Valley described in comment 3. This is much higher than any average that could be obtained using conductivity values in the GWRI. It is therefore reasonable to conclude that overall inflow to the basin is overestimated and that natural discharge is underestimated.
- 21) If an average of the inflow and outflow estimates is used, the flux through the valley would be an average of 6965 af/y and 750 af/y, as derived above in comments 2, 3, and 20, or about 3850 af/y. Note that this would require a discharge to Palo Verde Valley of 3500 af/y which would require conductivity equal to 14.8 ft/d, still a very high value. Based on this estimate, the project would pump, and consumptively use, about 41% of the natural flux through the basin.
- 22) Based on the estimate of 3850 af/y as pre-development flux through Chuckwalla Valley, the perennial yield is currently exceeded by the existing pumping near Desert Center and the prison. There is no water available in the Chuckwalla Valley based on the concept of perennial yield for the basin based on the average from comment 21 and the pumping estimates in the GWRI (at Table 3-5).

The summary of the water budget for the valley is as follows. The valley is arid with little in-basin recharge and interbasin flow passing through from upgradient to the Colorado River floodplain. The estimated fluxes that can be considered predevelopment values presented in the GWRI do not balance. The estimated inflow from Pinto/Oracopia Valleys is about three times the estimated ET discharge and interbasin flow to Palo Verde Valley; add any of the in-basin recharge estimates from the GWRI and the natural inflow to the basin far exceeds the natural discharge – a situation that cannot be correct, which demonstrates the GWRI contains errors that were not considered within the document.

Comments 21 and 22 lay out an argument for a perennial yield that is much less than the 12,000 af/y discussed in the GWRI and referenced by the SA. Using an average flux through the valley based on the pre-development estimates of recharge and discharge, the proposed pumping is about 41% of the perennial yield or flux through the basin. Current pumpage exceeds this natural flux by more than two times. Adding the project to the existing demands of 10,475 af/y (GWRI, Table 3-5), more than 12,000 af/y would be removed from the basin annually. This is about 3.1 times a reasonable perennial yield estimate of 3850 af/y.

Groundwater Model

The applicant's groundwater model is insufficient to predict the impacts of this project. It is poorly designed and calibrated. The following comments are specific to its development and use.

- 23) The authors call the model impact modeling (GWRI, at 44) which means they are only considering drawdown from pumping and not trying to implement the conceptual flow model of the valley. The model considers neither recharge nor discharge. The model does not account for the heterogeneous aquifers in the basin.
- 24) There is no justification for the number of layers chosen for the model. The model assumes each layer extends continuously over the entire model domain which ignores the heterogeneity present in the basin. Every layer with low conductivity is assumed to provide an unbroken barrier across the entire domain, again without justifying data.
- 25) The supplemental GWRI also indicates the layers are not continuous. "The general sequence of sediments described above appears substantially similar to other closely logged borings in the eastern Chuckwalla Valley; however, the **depths of specific coarse grained units cannot be widely correlated** based on the available data. Based on this observation and the results of the pumping test of units in the middle Bouse Formation, described below, **coarse grained units in this part of the basin appear to be of relatively limited lateral continuity**" (SGWRI, at 4).
- 26) If the coarse grained unit are of "limited lateral continuity", as indicated in the quote in the previous bullet, it is absolutely unjustified to model the coarse units as continuous layers, as was done in the model.
- 27) If the depths of the units cannot be "widely correlated", also as noted in bullet 25, dividing the domain into a dozen layers with valleywide continuity is absolutely unjustified.
- 28) The geophysical log provided for well OBS-2 does not justify the layering or assigned/calibrated conductivity values at the well, except, possibly the confining clay layer observed 260 to 280 ft bgs. However, the model simulates that clay in layers 3 and 4, which are 39 feet thick (GWRI, at Figure 21), not the 20 feet observed on the log.
- 29) All layers below the clay, in the model, have horizontal conductivity high enough to yield sufficient water to the proposed well (Kh≥0.1 ft/d), but the assigned vertical conductivity is very low, leading to a high vertical anisotropy and a tendency for the model to prevent vertical flow.
- 30) The geophysical log shows substantial poorly graded sand between 360 and 410 ft bgs. This zone should have the highest conductivity, based on gradation, but spans part of layers 7 and 8 with Kh=3 ft/d. Deeper layers which show more clay interbedded with the sand have higher conductivity, near 15 ft/d. The proposed pumping would be constructed in these lower layers. The model layers do not match nor are justified by the geophysical log; the high horizontal and low vertical conductivity values for layers that do not correspond with the geophysical log, could limit the drawdown so that most is limited to deeper layers.
- 31) The model simulates clay in layers 3 and 4. Because of its extremely low vertical conductivity, it controls the drawdown in overlying layers. The model assumes that the clay layer separating the Bouse formation from the overlying alluvium extends over the entire model domain. This assumption is absolutely without justification because the report provides no supporting data to show it is

continuous throughout the valley. The model results depend on this unfounded assumption.

The model calibration was based on a seven-day pump test completed for near the proposed project location. The GWRI presents a substantial amount of sensitivity analysis, which apparently is an attempt to substitute for a decent flow model of the basin and to adequately calibrate/validate it. The following comments demonstrate the problems with the calibration and sensitivity analysis and explain why it is no substitute for an accurate model.

- 32) The calibration effectively considers groundwater level responses measured during a 7-day pump test at one point in the valley. The **calibration is for essentially a single point** when the model is of a large basin.
- 33) The calibration pump test pumped at 87 gpm but the project will pump at 1000 gpm. The pump test does not stress the aquifer sufficiently to assess how it would perform with pump rates closer to that required for this project.
- 34) The pump test well was screened between 350 and 550 feet bgs (lithologic log for TW-1 in GWRI App 2), but the proposed pumping well will be screened from 800 to 1800 ft bgs. Thus, the calibration data available for this project is for pumping an aquifer layer not targeted for pumping for this project.
- 35) Fluctuations in the observed data for OBS #2_270 and Transducer #2_315 indicate that **barometric pressure may have affected the values**. The report does not indicate whether barometric pressure adjustments were made. Because the level changes for these wells were less than 1.5 feet, the variability induced by not considering pressure changes could have biased the calibration.
- 36) The calibration sensitivity analysis (GWRI, at Tables 4-4, 4-5) shows that the results depend on the chosen vertical conductivity in the clay layer. Drawdown in the layer 3 and layer 5 observation wells was roughly 2.5 to 3 times higher for a one order of magnitude increase in clay layer vertical conductivity. Although the absolute values are small, the drawdown in the unconfined well OBS-1 is 36 times greater for the same increase in clay layer vertical conductivity. The model depends on the (supposedly) calibrated vertical conductivity to limit drawdown in the unconfined alluvial layer.
- 37) The validation model runs using the prison wells (GWRI, at 52) do not prove the model's ability to predict drawdown. A three-day validation does not compare with a 33-year simulation period. After just three days, the simulated drawdown varies from observed by from 15 to 25% this is not reasonably close based on the sensitivity analyses completed in the GWRI they suggest the transmissivity is off by a factor of 10, at least. The residuals in the validation are that the simulation underestimated the drawdown (GWRI, App 8, figures for WP-38 and -39)

The GWRI presents drawdown estimates for specific locations, a map of drawdown, and predicted changes in boundary flows. Because the model is based on so little data and lots of unwarranted assumptions, there is little confidence in the results. The sensitivity analyses actually demonstrate the lack of confidence in the predictions and the boundary

flows show that the impacts even with the "calibrated" data are significant. The following comments demonstrate the uncertainty in the predictions and the certainty that impacts are significant.

- 38) The magnitude of boundary flow changes is estimated with the model to be about 20% of the pumping rate after just 33 years (GWRI, Table 4-9). Even if pumping ceases at 33 years, the changes in boundary flow will continue to increase as drawdown recovers. This magnitude of change shows that this project will have a major effect on the water balance of the Chuckwalla Valley and significantly change flows to and from adjoin basins, such as the Palo Verde Valley (the Colorado River floodplain aquifer).
- 39) The GWRI (at 64) inappropriately calls this decrease in flow to Palo Verde Valley "insignificant" without considering the water budget of that valley. The decrease in flow is about 80% of the predicted 400 af/y flow to Palo Verde Valley (GWRI, at 31). This is most definitely significant. See also the discussion on water budget above.
- 40) Increasing the vertical conductivity in the clay layers 3-6 tripled the drawdown in the water table aquifer. The magnitude of the changes remains small which demonstrates the importance of the clay layering in the model to the results presented in the GWRI. The assumed clay layer in the model is necessary to "protect" surface aquifers and prevent deep pumping from drawing salty water into the deeper layers.
- 41) Decreasing the horizontal conductivity in the pumping layer to one tenth the "calibrated" value increased drawdown at the pumping well from about 10 to 70 feet. By itself, this is a huge difference in drawdown. However, this change increased the drawdown in the water table by more than six times, over twice as much as lowering the vertical conductivity, because the increased drawdown at the well increased the gradient drawing flow from the water table layer.
- 42) The GWRI completely fails to consider the effects of different drawdown by layer because it does not report the changes in flux among layers; because the project seeks to prevent drawing salty near-surface water into the deeper layers, the report should have honestly presented this important aspect of the sensitivity analysis.

An accurate full groundwater model of the project is needed. There appears to be sufficient well and pumping data available in Chuckwalla Valley, and presented in the appendices of the GWRI, to develop a proper groundwater model using justifiable assumptions. Considering the magnitude of the proposed pumping with the flux in the water balance for the valley, a full groundwater model is the only way to estimate the long-term impacts of the project.

Impact on the Colorado River

The Chuckwalla Valley is tributary to the Colorado River, which means that all of the flux from the valley will eventually reach the river. It also means that all of the pumpage will eventually be lost to the Colorado River. This is basic water balance analysis.

However, it will take a long time and the management of the Colorado River is generally based on consideration of more finite time frames.

The GWRI applied Leake et al (2008) and found that the proposed pumping will occur in an area where just 1% of the pumping will be depleted from the Colorado River after 100 years. They are wrong. The one percent value would have been based on the lower transmissivity estimate by Leake et al (2008); this estimate is inaccurate because based on flow and cross-section values discussed in comment 3, the transmissivity is about $15,750 \text{ ft}^2/\text{d}$ (although through the valley it would be variable). This is between the values used by Leake et al (2008), which suggests the depletion from the Colorado River from the proposed pumping would be between 1 and 10%.

Conclusions

I would like to summarize my conclusions as follows:

Current pumping in Chuckwalla Valley far exceeds the perennial yield, which has been estimated in the past and it the GWRI to be much higher than it should have been estimated. This project would make the pumping in the valley exceed a more reasonable perennial yield estimated by more than three times. The groundwater model used by the applicant is insufficient for analyzing the impacts and is biased, through clay layering in the model, to underestimate the drawdown. All of the water withdrawn for this project will eventually deplete flows in the Colorado River because the only interbasin discharge from Chuckwalla Valley is to Palo Verde Valley, an alluvial valley in significant connection with the Colorado River.

References

Exhibit 800:	Anderson, T.W., 1995. Summary of the Southwest Alluvial Basins, Regional Aquifer-System Analysis, South-Central Arizona and Parts of Adjacent States. U.S. Geological Survey Professional Paper 1406-A.	
Exhibit 801:	Avon, L., and T. J. Durbin, 1994. Evaluation of the Maxey-Eakin method for estimating recharge to ground-water basins in Nevada. Water Resources Bulletin 30(1):99-109.	
Exhibit 802:	 Constantz, J., K.S. Adams, and D.A. Stonestrom, 2007. Ground-Water Recharge in the Arid and Semiarid Southwestern United States – Chapter C. U.S. Geological Survey Professional Paper 1703C. 	
Exhibit 803:	Leake, S.A., Greer W., Watt, D., and Weghorst, P., 2008, Use of superposition models to simulate possible depletion of Colorado River water by ground-water withdrawal: U.S. Geological Survey Scientific Investigations Report 2008-5189, 25 p.	

Declaration of Tom Myers

Re: Impacts to Water Resources from the Proposed Genesis Solar Energy Project

Docket 09-AFC-8

I, Tom Myers, declare as follows:

- 1) I am currently a Hydrologic Consultant and have held this position for 16 years.
- My relevant professional qualifications and experience are set forth in the attached resume and the testimony above and are incorporated herein by reference.
- 3) I prepared the testimony attached hereto and incorporated herein by reference, relating to the impacts of the proposed project on water resources.
- 4) I prepared the testimony above and incorporated herein by reference relating to the proposed Genesis Solar Energy Project in Riverside County, California.
- 5) It is my professional opinion that the testimony above is true and accurate with respect to the issues that is addressed.
- 6) I am personally familiar with the facts and conclusions described within the testimony above and if called as a witness, I could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: June 16, 2010

Signed:

At: Reno, NV



BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA 1516 NINTH STREET, SACRAMENTO, CA 95814 1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION FOR THE GENESIS SOLAR ENERGY PROJECT

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PROOF OF SERVICE (Revised 6/7/10)

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DECLARATION OF SERVICE

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I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

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