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June 7, 2012

State Water Resources Control Board
Division of Water Rights
Attention: Patricia Fernandez
P.O. Box 2000
Sacramento, CA 95821-2000

Dear Ms Fernandez,

I am attaching my completed peer review comments of the report titled "Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives."

It's been a pleasure working with your organization.

Sincerely,

Frank A. Ward
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Las Cruces, NM USA 88011

Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives

Peer Review Comments by

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June, 2012

Attachment 2: Listing of Economic Conclusions or Assumptions Subject to Review

Economic Conclusions or Assumptions Regarding the Analysis Approach in the Draft Agricultural Economics Report

1. **Use of the Statewide Agricultural Production (SWAP) model was based on sound economic knowledge, methods, and practices.**

Yes. The agricultural economics report provides estimates of the potential effects to agricultural production and related sectors of the Lower San Joaquin River (LSJR) watershed economy from estimated changes in allowable surface water diversions that may be needed to achieve potential LSJR flow alternatives.

The analysis in the agricultural economics report followed three major steps:

- *The LSJR flow alternatives' effects on allowable surface water diversions were estimated relative to baseline conditions using a Water Supply Effects model.*
- *Baseline flow conditions were assumed to be the conditions that existed in the LSJR watshed in 2009.*
- *The Impact Analysis for Planning (IMPLAN), a regional economic model, was used to estimate the total economic and jobs effects resulting from changes in allowable surface water diversion on agricultural production on all connected sectors of the regional economy.*

The analysis in the agricultural economics report estimates the potential effects to agricultural production and related sectors of the LSJR watershed economy from estimated changes in allowable surface water diversions needed to meet deliveries for achieving the LSJR flow alternatives.

There are three LSJR flow alternatives, each consisting of a specified percentage of unimpaired flow deliveries required on the Stanislaus, Tuolumne, and Merced Rivers. For a particular alternative, each tributary must meet the specified percentage of its own unimpaired flow at its confluence with the LSJR during the months of February through June. The percentage unimpaired flow requirements are 20%, 40%, and 60% respectively for each LSJR flow alternative. Flows must not drop below specified levels on each tributary, and together must maintain a minimum flow on the San Joaquin River (SJR) at Vernalis.

In general, as the percent of unimpaired flow requirements increase, the average difference in diversions for a particular alternative relative to baseline conditions

increase. A greater agricultural diversion reduction would be needed to accommodate an increase in unimpaired flow.

The Statewide Agricultural Production (SWAP) model was used to estimate the agricultural production, crop acreage, and crop revenue associated with the surface water diversions potentially needed under baseline conditions and for the LSJR flow alternatives. SWAP is an agricultural production model that simulates the decisions of farmers at a regional level based on principles of economic optimization. The model is based on the assumption that farmers maximize profit subject to resource, technical, and market constraints. The model simulates farm decisions that selects those crops, water use patterns, and irrigation technology that maximize profit subject to these constraints. The model accounts for land and water availability constraints for a given set of input and output prices, and calibrates exactly to observed yearly values of land, labor, and water use for each region.

For this analysis, SWAP was calibrated to the Department of Water Resources (DWR) estimates of land use and applied water for water year 2005. This water year was the most recent normal year in terms of water availability and crop prices. These data are presented in Table X-7 of the report.

River flows shown in section X.3 of the report titled "Surface Water Diversion Estimates" were used as inputs to the SWAP model to estimate agricultural production and revenues associated with varying water delivery requirements for the SJR at Vernalis. For each water year, SWAP uses a Positive Mathematical Programming (PMP) methodology to calculate the cropping patterns that maximize on-farm profit from annual allowable surface water diversions.

For several reasons, this reviewer believes that the use of the SWAP model with the described assumptions and approach is based on sound economic knowledge, methods, and practices:

- *PMP has become a widely-accepted method for analyzing water demand and for conducting policy analysis. It is viewed as the state-of-the art method for models that represent agricultural production.*

- *Changes to the amount of allowed surface water diversions have the potential to affect water available for crop irrigation and therefore have the potential to affect farm income and production. The estimates of the surface water diversions reductions that are input to the model are used in the SWAP model to estimate farm production and revenues for each of the LSJR flow alternatives.*

- *The report described the use of PMP to predict impacts to production and*

revenue from changed surface water flow requirements delivered to the San Joaquin River near Virnalis by three tributaries of that river.

- *The PMP approach presents several advantages over the alternatives: (1) It does not need large datasets; (2) it accounts for farm adjustments to a range of surface water diversion changes; and, (3) by comparing a base case with current diversions and a policy scenario with alternative diversions, the PMP approach economically quantifies changes in revenue, cropping patterns and applied water per unit area (p. X13).*

- *Table X-8 of the report shows impacts on acreage by crop for 82 years' historical water supplies and also for three alternative river flow requirements. There are three alternative downstream river flow delivery requirements for each of the three tributaries. These alternatives are 20%, 40%, and 60% of native inflows. Results make good economic sense. They make sense because as water becomes less available, crops most affected are rice, pasture, and field crops, followed by corn. These crops are affected most because they are high water-use annual crops with low economic (income) values per acre. In some years of severe drought, pasture and field crops are nearly eliminated from production, especially in the 40% and 60% downstream flow delivery alternatives. By contrast, water-saving crops such as truck crops as well as high valued crops such as vines showed a much smaller adjustment to meet a required diversion reduction.*

2. **Use of version 3 of the Impact Analysis for Planning (IMPLAN) model was based on sound economic knowledge, methods, and practices.**

This reviewer is aware of the long history and widespread use and credibility of IMPLAN by US federal and state agencies. I am also told that current versions of the IMPLAN software are easy to use and interpret. The IMPLAN results look plausible and even reasonable. However, I do not have enough expertise to review the IMPLAN model runs in detail.

3. **The LSJR flow alternatives have the potential to affect the amount of allowable surface water diversions from within the LSJR watershed. The economic analysis assumes that construction or installation of alternative water supplies would not be implemented in response to changes in estimated allowable surface water deliveries. Staff believes this is a conservative assumption.**

This reviewer believes that it is a conservative approach to assume that construction or installation of alternative water supplies would not be implemented. It is conservative because direct economic losses to LSJR watershed irrigators from a requirement to meet

higher than baseline LSJR flow alternatives will be larger without access to alternative supplies than with them.

The study also estimated that in wet years irrigators will see positive economic impacts when 20% LSJR flow requirements need to be delivered because actual irrigation diversion could be higher than needed to produce 20% LSJR flow requirements in those wet years. Under those special conditions, making the assumption of no alternative water sources reduces the economic gains associated with the lower 20% LSJR flow targets compared to the gains if substitute water sources were used.

More generally, a lack of access to alternative water sources increases the economic losses when there are shortages and reduces the economic gains when there are surpluses. So, in this sense, assumptions made about no access to alternative sources are conservative.

4. **Reasonableness of other assumptions.**

Other reasonable assumptions beyond those identified above were used in the analysis. Some of these include:

- *Irrigation farmers attempt to maximize profits with their available land, labor, and water resources in the face of resource, technical, and market constraints based on information to which they have access. This includes information on crop prices, costs of production, crop water use requirements, and crop yields by crop.*

- *Prices, costs, yields, and crop-water use are important determinants of on-farm profits. Impacts on potential profitability also influence on-farm adjustments to downstream delivery requirements that affect allowed agricultural water diversions.*

- *Irrigators will adapt to changes in allowed irrigation diversions through on-farm adjustments in water use, choice of irrigation technology, and land in production by crop.*

- *A time series of 82 annual estimates of crop acreages and revenue was used to estimate effects on both acreage and revenue from changes in allowed diversions. These are the changes in diversions that would be required by 20%, 40%, and 60% of native SJR watershed inflows required for delivery to the San Joaquin mainstem at Vernalis.*

This reviewer believes these assumptions and others described in the report are valid and are consistent with those used in similar properly conducted economic analyses.

5. **The level of effort used in analyzing the potential economic effects to agriculture covers a reasonable range of economic factors and considerations.**

This reviewer believes that the effort presented in the analysis covers a reasonable range of economic factors and considerations. Although I do not know the cost of conducting this analysis, I can see that a large number of economic factors and considerations was included in a comparatively short report of 35 pages. Some of the most important factors addressed in the report include:

- *The SWAP model accounts for existing farm income, total land in production by crop, crop yields, total water use, and water use per acre.*
- *SWAP accounts for changes in irrigation diversions allowed and impacts on irrigated agriculture from the requirement that 20%, 40%, and 60% of unimpaired surface water supplies in the Stanislaus, Tuolumne, and Merced Rivers delivered to the San Joaquin River near Vernalis.*
- *The PMP approach represents a major improvement over existing methods for measuring farm adjustments to changes in water diversion limits. Alternative approaches either require large datasets, are not based on income maximizing behavioral responses to water use requirements, or permit only a limited range of on-farm adjustments.*
- *The PMP approach is also an improvement over the DWR California Agriculture (CALAG) and DWR Net Crop Revenue Models (NCRMs). Neither of those existing models account for as wide a range of on-farm adjustments to changes in irrigation diversion limits.*
- *The data present irrigation activity for 82 historical years of water supply. The PMP model predicts activity for a base and three alternative downstream delivery requirements for each of those 82 years.*

6. **The results of the analysis are valid.**

The Draft Agricultural Economics Report contains conclusions regarding the agricultural economic effects of meeting the alternative flow requirements for the San Joaquin River near Vernalis. Table X-9 of the report displays predicted changes in gross revenues and crop production that would be associated with the various flow alternatives. Estimates

of changes in the total value of sector output from baseline conditions ranged from an increase of approximately 0.3 percent to a decrease of about 3.0 percent (figure X-20). This reviewer believes that the results shown in the figure are valid estimates of the effects of the proposed flow alternatives for on-farm gross revenue and on agricultural production in the LSJR watershed.

- *Figure X-21 shows a larger reduction in agricultural net revenue as the percentage of required LSJR flow alternatives increase. Larger reductions in agricultural revenues are also shown in dry years than in wet years. Both these results make good sense and indicate that the results are valid.*

- *Figure X-23 shows that the incremental farm revenue loss becomes larger in the face of increased average annual diversion reduction from 0.5 million acre feet to 1.1 million acre feet per year. At a 0.5 million acre foot diversion reduction, incremental revenue losses are about $140 per acre foot. However, at 1.1 million acre feet, incremental revenue losses increase to about $240 per acre foot. Both these results make good sense, and provide another indication that results of the analysis are valid.*

7. Other Issues

Additionally, reviewers are not limited to addressing only the specific issues presented above, and are asked to contemplate the following "Big Picture" questions:

- **In reading the Draft Agricultural Economics Report, are there any additional agriculture related economic issues that should be a part of the report's analysis that are not described above? Effects of the LSJR flow alternatives on other non-agriculture related sectors of the economy will be addressed elsewhere in the SED.**

The report presents the most important agricultural impacts associated with changes in allowable diversions from three tributaries to the San Joaquin River. The report estimates impacts to production and to on-farm revenues. In the future, it would be desired to have model predictions about impacts on (1) deficit irrigation and (2) groundwater pumping from aquifers associated with alternative allowable surface diversions from the three tributaries. Nevertheless, estimating those impacts is beyond the scope of any empirical model in operation today of which I am aware.

- **Taken as a whole, is the report's analysis based upon sound economic knowledge, methods, and practices?**

Yes. This reviewer believes that the analysis is based on sound economic knowledge, methods, and practices. There are several reasons for this.

- *The PMP approach allows many kinds of adjustments to water supply shortages brought about by increased diversion reductions. These adjustments, include adjustments to cropping patterns, water use, and land use (page X-14). Accounting for these kinds of adjustments require a much more comprehensive model than has been developed by any other empirical model of which I am aware.*

- *Results are based on agricultural adjustments that would be required by downstream flow deliveries equal to 20, 40, and 60 percent of native inflows for three tributaries to the SJR.*

- *SWAP model results are calibrated to match historical conditions for crop acreage, crop production, crop yields, costs of production, crop prices, and farm income for a base year of 2005.*