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June 4, 2010

Subject: San Joaquin River Group Authority Comments on the Central Valley Regional Water Quality Control Board Draft Report Entitled "*Salt Tolerance of Crops in the Lower San Joaquin River (Stanislaus to Merced River Reaches*" dated March 2010 (Study Report)

The report in well done but there are issues that must receive further analysis. The issues that the SJRGA feel are important are summarized here in the bullet points followed by a more extensive write up on each. The issues include:

- The Study Report needs to clarify the timing and cultural practices used for dry bean production in the Lower San Joaquin River to reflect present-day practices. Two issues are critical to this analysis:
    1. Dry-beans are not planted before the first weeks of May yet they are assumed to be planted as early as April 1st. The planting dates were verified by comments from the South Delta Water Agency during the 13 August SWRCB workshop on a similar analysis. Planting before this time could lead to crop loss due to low soil temperatures such as we experienced this year. Because of the return on bean production, replanting is not an option therefore growers use caution in choosing the planting dates. The modeling should be modified with these new planting dates.
    2. Need to verify and consider that present-day cultural practices include pre-irrigations, which minimize or eliminate any potential salinity impacts during germination and seedling emergence as well as greatly reduce salinity control throughout the growing season.

- A portion of the modeling is done with unrealistic assumptions regarding leaching. The study uses leaching fractions of 0.10 or less for modeling production of almonds and alfalfa. A leaching fraction of 0.10 or less is impossible to achieve without very sophisticated irrigation technology that is presently not available in the study area. This technology involves the use of low intensity, high frequency irrigation and these would invalidate the use of the present steady state models as they were developed for standard irrigation technology. Under high frequency, low intensity irrigation, water use patterns would be totally different than assumed in the 40-30-20-10 model or the exponential model.

- The modeling conducted as part of this study is being done with extreme conservatism in the assumptions used. These need to be corrected. Two assumptions illustrate this.
    1. Estimate of effective rainfall using soil evaporation rates that do not reflect reality during the winter period.
    2. Effective rainfall is assumed to be part of crop ET while in reality it also plays a major role in salinity control in any Mediterranean climate. This role of effective rainfall during the winter irrigation season has been left out of the report. This analysis needs to be conducted and the impact of winter rains on leaching and salt control needs to be fully evaluated.

- The present study report cites the need to conduct an analysis of water quality impacts from boron in the Lower San Joaquin River. The SJRGA feel this would be a complete waste of resources. The entire study area is known to be a boron enriched area from the soils being developed from the marine formations that line the western edge of this area. In addition, it is well know that boron sensitivity is most pronounced in orchard crops including apricots, walnuts and stone fruits. The entire Western Stanislaus County is being converted to orchard crops and Patterson is known as the apricot capital of the world. These two factors alone should provide sufficient evidence that such an analysis would be a waste of resources that could be used for more productive endeavors during budget short periods.

- The Study Report needs to take a closer look at actual leaching fractions (LF) in Western Stanislaus County. The tile drainage data presented in the Study Report shows that it may be 25% or higher and this is consistent with findings in the South Delta. Unfortunately the data upon which this conclusion is based is not a valid data set and the SJRGA is recommending the use of additional data that is in the Regional Board files. It is likely this new data will show an even higher leaching fraction as a result of present irrigation practices. If this is true, this high leaching fraction should be used in the analysis and modeling as it will likely be continued into the future. This is reinforced by the fact that the predominant surface flood and furrow irrigation practices are also likely to continue into the future as there is little room for improved efficiency from these irrigation methods.

- The study report is based on the 100%-yield potential defined by the 1977 Mass and Hoffman analysis that established crop tolerance curves for major crops. Unfortunately, the dry bean data used for this analysis is now over 50 years old and does not represent more salt tolerant varieties used today and is likely over conservative. It is recommended that the Study Report strongly advise against the continued use of these data and it recommend that a new curve be established for dry beans.

- Mandated water conservation by agricultural users will not likely change some of the basic water management practices being used for dry bean production. Production returns on dry beans will not allow the investment needed for improved irrigation practices therefore it is unlikely that there will be a reduction in the high leaching fractions being found on dry bean production today. If a water conservation modeling effort is undertaken, similar high leaching factions on dry bean production should be assumed.

- Both steady-state and transient models are available for use in development of a water quality objective. The SJRGA supports the development of a transient model for South Delta conditions but in its absence the Study Report should recommend the use of the exponential model over the 40-30-20-10 model. The 40-30-20-10 model does not represent the present state of knowledge regarding crop water uptake and would only compound the shortcomings in the analysis since the only crop tolerance data available is over 50 years old.

Background Information on Dry Bean Production[1]:
Bean production in western Stanislaus and San Joaquin Counties continues to decline as it is no longer considered a diet staple. Beans are now grown as a rotational crop with processing tomatoes and specialized crops such as onions, carrots and peppers. The reason is that beans are a legume and are considered a soil builder by releasing nitrogen into the soil. In addition, the present furrow irrigation practices used for bean production have a very low efficiency and therefore accomplish a strong salt leaching prior to rotating back to processing tomatoes or other higher value crops. These factors are often a stronger consideration than the monetary return from the bean crop.

Dry beans are rarely planted before early May. Harvest normally occurs from late August to late September. This was verified by Mr. Alex Hildebrand of the South Delta Water Agency (SDWA) during the 13 August 2009 SWRCB Workshop on the South Delta Crop Tolerance Report. All dry beans are furrow irrigated and pre-irrigated one week or less prior to planting. Pre-irrigations are done to ensure 1) a high moisture seedbed, 2) deeper profile moisture, and 3) a low-salinity seeding bed. Pre-irrigations are not done with sprinklers as it is not cost effective. Crop water use[2] ranges from 1.5 – 2 acre-feet/acre depending upon yearly weather conditions[3]. Water applications however are much higher and range up to 4 ac ft/acre. The high water use results from all bean production being done with furrows and the need to pre-irrigate. The use of furrows results in the need to run water for extended periods of time in order to get adequate deep percolation in the mid-furrow zone and this results in serious over applications at the head and tail end of the furrow network. This high water use results in a very low irrigation efficiency compared to other cropping systems in the same area.

Unrealistic Leaching Assumptions:
A portion of the modeling is being done with unrealistic assumptions regarding leaching. Similar to the Hoffman Report, the present study uses leaching fractions of 0.10 or less for modeling production of almonds and alfalfa. A leaching fraction of 0.10 or less is impossible to achieve without very sophisticated irrigation technology that is presently not available in the study area. It has been shown in research that such low leaching fractions can be achieved but only with low intensity, high frequency irrigation technology. Such a system would require that water be available constantly and on-demand. Such a system does not exist in the Lower San Joaquin River area except for some groundwater pumping operations. If they are using groundwater, there is no need for San Joaquin River water.

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[1] Personal Communications with Bean Growers in Western Stanislaus and San Joaquin Counties
[2] California Department of Water Resources, Bulletin 113
[3] University of Nebraska Extension Bulletin, Crop Water use by Growth Stage – Dry Beans

Even if this technology was available in the study area, such low intensity, high frequency irrigation would invalidate the use of the present steady state models as they were developed for standard irrigation technology and the water use patterns would be totally different than assumed in the 40-30-20-10 model[4] or the exponential model[5]. This would require development and validation of a new model and time and resources do not permit such an undertaking nor would the present irrigation practices warrant such an effort.

The analysis that was conducted by the Hoffman Study was to take the short-term water deficits that occur frequently in the summer months and extrapolate this to the entire season to see what the impact would be of a worse case scenario. The use of these low leaching fractions in the Hoffman Report was simply to model a worse case scenario and was not meant for use in developing water quality objectives for protection of irrigated agriculture. The assumptions that had to be made in the Hoffman analysis was that such a leaching fraction would be maintained for the entire irrigation and rainfall season. This is simply unrealistic. The Hoffman Report modeled this scenario is see what short-term water stress would do if it were extended over the entire irrigation season. The intent was simply to see the worst case collapse of the water supply system, not what is intended for irrigation management. Salinity buildup is done over a season or several seasons, not during short-term deficit irrigations. Short-term deficit irrigation is being utilized extensively in the San Joaquin Valley very successfully but it is not being applied to the entire irrigation season.

The SJRGA recommends that the report be amended to reflect that this analysis, if left in the report, is only to demonstrate the worse case scenario and not to be utilized in developing water quality objectives.

Winter Rainfall Assumptions Used in the Crop Models are Extremely Conservative:
The discussion of effective rainfall needs to be reconsidered and requires a major modification to include a discussion of effective rainfall during the winter season. The discussion on pages 45-48 needs to be reconsidered. This discussion assumes, as shown in Figure 3.11 on page 48 that a steady rate of soil evaporation occurs during the winter period. If this were true, then any fallow land would be completely dry by mid to late spring. This is not the case in California however. The soil very quickly forms a natural barrier to evaporation by creating at the surface a dry layer that little or no water can cross. This is a natural process known to farmers and soils scientists for years.

The formation of a barrier to evaporation can be illustrated in dry-land farming practices in California. Dry-land farmers do not plant each year. Rather they lay the land fallow for one year to allow soil moisture to build up for the crop the next year. This moisture is used for germination and initial plant growth in the fall prior to the winter rains. The same technique is utilized in the wheat fields of the Dakotas. Under the scenario assumed in the report these dryland areas would quickly become deserts.

From Figure 3.11 and Table 3.6, it is clear that a significant amount of effective rainfall occurs in the winter season (>10 inches). This is not only effective in meeting ET demand as is assumed in the modeling in the report but from the literature it is shown that winter rainfall is very effective in leaching salts from the profile[6]. In some cases in Mediterranean climates as little as 4-6 inches of effective rainfall can desalinize an entire root zone to a depth of 3-5 feet. In the case of the Lower San Joaquin river area, an effective rainfall of greater than 10 inches will be very effective in leaching salt from the soil profile. In addition, the Mediterranean climate rainfall patterns are especially effective in salinity control in the upper portion of the profile[7] where seedlings would be most affected. This same characteristic was seen in the Imperial Valley in leaching salt during reclamation[8], especially if the application rate could be intermittent and the application rate kept below the soil infiltration rate[9]. This is a characteristic that is similar to the rainfall patterns in the San Joaquin Valley.

The reliability of winter rainfall in salinity control in the San Joaquin River Basin is illustrated in Figure 3.11 where it shows that winter rains rarely are less than the assumed soil evaporation rate which in itself is extremely conservative. Thus winter rains are a reliable source of salinity control, not just meeting crop ET. This can be illustrated by the practice worldwide in water short areas where irrigation is used after harvest to ensure that the soil profile is wet prior to the winter rains. This allows the winter rains to leach to a greater depth and winter rain is not

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[4] Assumptions as described in Ayers and Westcot, 1985
[5] Hoffman, G. J. and M. Th. Van Genuchten. 1983.
[6] Stylianou, Y. and Orphanos, P.I. 1970 Irrigation of Shamouti Oranges with Saline Water. Technical Bulletin No 6, Cyprus Agricultural Research Institute, Nicosia (as shown in Ayers and Westcot, 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper #29 (revised))
[7] Aziz, M.H.A. Crop Water Requirements and Water Quality: Salinity Control in Kuwait. (as shown in Ayers and Westcot, 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper #29 (revised))
[8] Hoffman, G.J. et al. 1980. Guidelines for Reclamation of Salt-Affected Soils. Proceedings of the Inter-American Salinity and Water Management Technology Conference. Juarez, Mexico, Dec 1980. Pages 49-64.
[9] Oster, J.D., Willardson, L.S. and Hoffman, G.J. 1972. Sprinkling and Ponding Techniques for Reclaiming Saline Soils. Transactions ASCE 15(6): 1115-1117.

taken up as part of the needed soil moisture. With the present irrigation practices in the San Joaquin River Basin, it is likely that the soil profile is strongly wetted prior to the winter rains thus making them extremely efficient in leaching salts from the previous irrigation season.

There is No Need for an Independent Analysis of Boron Impacts:
The present study report cites the need to conduct an analysis of water quality impacts from boron in the Lower San Joaquin River (pages 5, 9, and 118). The SJRGA feel this would be a complete waste of resources. The entire study area is known to be a boron enriched area as are all the soils on the Western side of the San Joaquin and Sacramento Valleys from north of Colusa south to Bakersfield were derived from former marine formations present in the California Coastal Range. The soils from the Western portion of Stanislaus County were developed from the marine formations that lie in the Coastal Range that lines the western edge of this area. Farmers in these areas have been dealing with boron in the soils since initial irrigation development started. The groundwater is also known to be enriched in boron as a result of runoff from the streams exiting the Coastal Range and deep percolation of irrigation water through boron enriched soils. The Regional Board has done extensive work on the quality of the streams exiting the Coastal Range and this analysis is available in the Regional Board files.

In addition, on a more practical level for irrigation management and potential for boron impact, it is well know that boron sensitivity is most pronounced in orchard crops including apricots, walnuts and stone fruits. The entire Western Stanislaus County is being converted to orchard crops and Patterson is known as the "Apricot Capital of the World". This factor alone should provide sufficient evidence that a problem does not exist and such an analysis would be a waste of resources that could be used for more productive endeavors during budget short periods.

Actual Leaching Fraction May be Higher than Assumed:
The Study Report looks at actual leaching fractions (page 63-66) utilizing a series of small tile drainage systems within the western portion of Stanislaus County (Table 3.10). Using this data, the Study Report rightfully concludes that the median leaching fraction exceeds 20%. Unfortunately there are two factors that need to be reconsidered in this analysis.

1. The quality of the water used to calculate the leaching fraction for this series of small tile drains is nothing like the water quality that has been used for production. The report on page 5 states that "it is assumed that the areas being studied are using San Joaquin River water". The water quality of the San Joaquin River for a twenty year period is defined in Table 2.0 on page 8 and this quality should be utilized to determine the leaching fraction in Table 3.10, not the values given in the table at present.

2. It would have been useful if the Study Report had access to the data from a larger data set for the drainage system directly within the area where the majority of the dry bean production occurs. Such data is available. The present Table 3.10 is a mix of both surface and tile drainage systems. As such, the median values would not be reflective of leaching fractions as calculated in the report. There is a better set of data available in a report entitled "Quality of Agricultural Drainage Discharging to the San Joaquin River from the Western Portion of Stanislaus County, California, April 1985 to October 1988, dated April 1989[10]."

   In the report cited above, there is water quality data for 20 tile drainage systems in Western Stanislaus County which could be used for the calculation. See Table 4 on page 8 of the report cited above for a summary of the data. The data is presented in the appendices. We have attached a copy of the pages critical to this analysis. This represents 127 samples that would give a more robust analysis of the data. If you include the data from Table 3.10 which are not included in the report cited above, this would give you 145 water quality samples from which to draw a median and mean value.

   The sites in your table 3.10 which correspond to the sites shown in the April 1989 report are as follows with the April 1989 report site numbers shown in parenthesis:

   D3 (STC008)
   D5 (STC007)
   D6 (STC006)
   D8 (STC032)
   D9 (STC002)
   D13 (STC038)
   D16 (STC005)

[10] Quality of Agricultural Drainage Discharging to the San Joaquin River from the Western Portion of Stanislaus County, California, April 1985 to October 1988 dated April 1989. Report by the Central Valley Regional Water Quality Control Board

D18 (STC004)
D19 (STC003)

The following sites in the April 1989 report can be considered tile drainage systems with little or no influence from surface water return flows:

STC002 through STC007
STC009 through STC011
STC032 through STC033
STC035
STC038 through STC039
STC041
STC046
STC049
STC055

The April 1989 data set is especially strong in that it contains an extensive record of three tile drainage systems (STC005, STC009, and STC010) which drain extensive acreage each and thus represent a summary or averaging of the practices in the Western Stanislaus County area.

Present Crop Tolerance Curves for Dry Beans May Be Overly Conservative Due to the Data Base Being Used:

The present modeling in the study report is based upon the salt sensitivity of dry beans. This is based primarily on the Mass and Hoffman, 1977[11] threshold limit (100% yield) that is shown in Figure 3.6 on page 31 of the Study Report. As stated in the Hoffman Study Report, this threshold was established using only 5 data points and as shown in Figure 3.6, three of these data points had an experimental design that was set up with the lowest salinity level significantly below the threshold limit and the remaining two show that a 100%-yield level was obtained at a higher salinity level than the threshold value. Because the original experimental design was not set up to establish the threshold value, it has become necessary to extrapolate between these two extremes. This introduces a significant error as the next nearest data point upon which to develop a slope to the relative yield line is with a yield less than 50%. The SJRGA finds it unfortunate that there are no data points in between these two relative yield levels upon which to refine the threshold point and slope of the line. The Hoffman Study Report also points out several other deficiencies in the data base that make the threshold value very conservative. One of the most important is that the studies are over 50 years old and the varieties used in the testing are no longer in existence[12]. Because of this, the SJRGA strongly supports additional testing to determine the actual tolerance of beans varieties being grown in the Lower San Joaquin River Basin and the experiments conducted under growing conditions of the western slope of Stanislaus County where beans are primarily grown.

Control of cultural practices is significantly different from the greenhouse to field conditions. Throughout the Study Report it is assumed that a 100% yield of a bean crop can be obtained based upon some maximum yield that was obtained under controlled experimental conditions where salinity was the only factor limiting yield. In reality under field cultural practices, other factors such as pests, soil conditions, weather, irrigation timing, and water tables may limit yield even with an excellent quality water supply. Two of the greatest limiting factors in Western Stanislaus County Soils would be high soil boron and fluctuating water tables. As a result, it may not be realistic to assume a 100%-yield potential due to uncontrolled factors that are encountered under field production and a lower level should be assumed.

As the Study Report points out, the present bean production in Western Stanislaus County is on soils that are derived from Marine sediments from the Coastal Range. These and similar soils that developed in other areas of the west side of the San Joaquin Valley are known to be high in salts and boron. The Study Report looked at the present salinity levels in the water supply and concluded that there is a threat to production. This conclusion fails to consider that the soils where bean production occurs are high in natural boron and may be limiting bean yield to a greater degree than salinity. A review by Mass, 1984[13] showed that several types of beans, including lima beans, which make up a portion of the dry bean production in Western Stanislaus County, were sensitive to boron and that yield losses resulted when soil boron levels were in the range of those found in the soils derived from the Coastal Range.

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[11] Maas, E.V. and G.J. Hoffman. 1977. Crop Salt tolerance – Current Assessment. Journal of Irrigation and Drainage Division, ASCE 103 (IR2): 115-134.
[12] Personal Communications with former grower representatives for the California Bean Growers Association.
[13] Maas, E.V., 1984. Salt Tolerance of Plants. In Handbook of Plant Science in Agriculture. B.R. Christie (ed). CRC Press, Boca Raton, Florida.

The continued presence of boron is demonstrated by monitoring of tile drains that have been in continuous operation for over 30 years. These tile drains are located in areas where dry bean production predominates and show a median boron level of 1.5 mg/l. The tile drain data supporting this conclusion is the Regional Board report [14] which is discussed in the previous section and made an attachment to these comments. Because of the continued presence of boron in Western Stanislaus County soils where dry bean production predominates, an analysis needs to be conducted to determine if the soil boron levels have the potential to limit bean yields to less than the presently assumed 100%, even in the presence of excellent quality water.

Water Management Practices for Dry Bean Production Will Not Change as Water Conservation Measures are Introduced:
One of the factors of that will need to consider in reviewing the water quality objectives for Lower San Joaquin River is the State mandate for increased water conservation by both urban and agricultural users.

Mandated water conservation needs <u>will not</u> likely change the water management practices for dry bean production. The present production returns on dry beans will not allow the level of investment needed for improved irrigation practices. As dry beans are planted for various reasons, including soil fertility improvement, it is unlikely that farmers will switch to a higher income cropping pattern.

It is unlikely that water conservation will significantly change the leaching fraction. The primary reason is the continued need to pre-irrigate and the continued use of furrow irrigation. In water conservation efforts, the first and easiest water losses to control are those of surface water runoff. As these are a big component of the irrigation practices in Western Stanislaus County, they are likely to be the first to be controlled. This will leave deep percolation in the same range as it is now, in the range of 20-25%. This is the leaching fraction that should be assumed in future modeling when water conservation is assumed to occur.

Need to Recommend the Use of the Exponential Model:
Several models are available for analysis of crop tolerance data. The original models were steady-state and based on the 40-30-20-10 pattern of water uptake which was assumed in the 1970s to be approximately correct. Based on the modeling skill level at that time this was a valid assumption as other errors in the modeling exceeded the error introduced by using the 40-30-20-10 water uptake pattern. Since that time however, it has been shown that the water uptake pattern is weighted stronger to the upper portion of the rootzone. Therefore the exponential model was developed with an updated water uptake pattern. As this model better reflects the present state of knowledge, it seems reasonable that it should be used in the Study Report's analysis. Using the 40-30-20-10 model would place the analysis in the same light as the data limitations on the crop tolerance curves; completely out of date. The Study Report should recommend the use of the exponential model and we would support that recommendation.

The obvious choice is the use of a transient state model over the steady-state model. The shortcoming however is that the data for such a model is not presently available and the model has not been verified for Western Stanislaus County conditions. Because of this, the SJRGA recommends that the Study Report recommend that efforts be made to develop a transient model and verify the amount and quality of data needed to make such a model valid. The SJRGA also recommends that the Study Report recommend that an Exponential Steady-State Model be used in the interim as it best imitates field conditions.

The following are detailed comments on the report:

COMMENT Page 1, Paragraph 1, final sentence: Neither Turlock or Modesto IDs have any rights to the San Joaquin River and would not be using water from the SJR. They should be removed from the sentence.

COMMENT Page 1, Paragraph 3, fourth sentence: It is unclear what dairies and feedlots mean. Does this include the dairy milk barns and corrals or the reuse areas as well? This should be explained as the reuse areas could be significant areas.

COMMENT Page 1, Paragraph 3, fifth sentence: Normally river descriptions are from upstream to downstream. Suggest the two river names be reversed here and throughout the document.

COMMENT Page 2, Paragraph 2, second, third and fourth sentences: It is unclear what the inconsistencies were. When is the boron analysis scheduled and what will it include? Will it be done on a separate track from this

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[14] Quality of Agricultural Drainage Discharging to the San Joaquin River from the Western Portion of Stanislaus County, California, April 1985 to October 1988 dated April 1989. Report by the Central Valley Regional Water Quality Control Board

effort? This same comment applies to Page 9, Paragraph 2. Also see our comments above on there not being a need for a boron analysis.

COMMENT Page 5, Paragraph 1, final sentence: This sentence should be referenced as (Ayers and Westcot, 1985).

COMMENT Page 5, Paragraph 3, second sentence: The words "of units" should be taken out.

COMMENT Page 5, Paragraph 3, final sentence: The units of millimho per centimeter are not outdated. The units of dS/m are being used to be consistent with the international SI units.

COMMENT: Page 5, Final Paragraph describes a figure on water quality for a series of years. It would be more helpful if this analysis was conducted by water year types to see whether the water quality differences shown are related to the water year type. This would require a larger data set than used here.

COMMENT: Page 6, Second Paragraph, first sentence. Recommend that you strike the words "on soil sodicity".

COMMENT: Page 8. It would be helpful if a similar presentation could be done based on water year types as the cropping pattern likely also varies by water year type.

COMMENT: Page 10, Final Paragraph. Suggest that you break this into two separate paragraphs as they are two distinctly different thoughts. The break should occur after the third sentence.

COMMENT: Page 17, Third Paragraph. There is no reason to spend additional time on developing the information for San Joaquin County as it makes up less than 2% of the total area.

COMMENT: Page 18, Final Paragraph. The discussion shows an 8% decline in moderately sensitive crops and an 8% increase in moderately tolerant crops in 2000. In looking at the data in the table, you need to be careful in making too many interpretations from only two surveys. In 2000, the tomato processing plants were shifting to overseas and there was a serious reduction in tomato production. This may account for the changes in cropping patterns when only looking at two distinct years. The tomato production has since recovered in California. It may have been more helpful to look at the crop production figures complied by the individual water districts as these are done annually. To keep the amount of effort in perspective, the SJRGA recommends this be done for the three crops analyzed in this report.

COMMENT: Page 26, First Full Paragraph. This same comment applies here. This decision may be based on economics, water supply availability and a variety of other factors none of which may be related to water quality. This is the short comings of using a survey that was only conducted once every ten years.

COMMENT: Page 28, First Full Paragraph and Figure 3.5b on page 31. The reduction in dry beans could be related to tomato prices, water availability or a number of factors. It is doubtful that it was related to water quality as bean production like many field crops in the Westside is cyclic and primarily based on economics, not water quality. Again this is the difficulty of using two surveys which were often conducted ten years apart.

COMMENT: Page 34, Fourth Paragraph, final sentence. It is unclear what this sentence means. A sodic soil is not likely to impact water quality as the only way sodium would leave the sodic soils is by reclamation with a calcium source and the sodium would then go to groundwater, not to surface water. This sentence should be stricken from the report.

COMMENT: Page 40, Figure 3.8. Although not prominent, this figure is very illustrative. What it says is that present irrigation and leaching practices along with present water quality are good enough to allow moderately sensitive crops to be grown extensively on saline soils in the LSJR area. This should be a strong indicator that present water quality is not impacting yields or these crops would not be grown on saline lands which would only complicate a water quality problem.

COMMENT: Page 50, Second Paragraph, Second Sentence. The second sentence implies that wheat and barley are irrigated by furrow. This is not true; it is flood or basin irrigation. Have you ever tried to harvest wheat or barley with a combine in a furrow irrigated field? The bumps and jarring would destroy a combine and at close to $1 million each, I don't think they would risk this equipment to furrows.

COMMENT: Page 51, Final Paragraph. The word "Chlorine" is used twice in the paragraph and it should be "chloride".

COMMENT: Page 52, First Full Paragraph. We are unsure what this paragraph is suppose to say and recommend that it be eliminated from the report.

COMMENT: Page 67, Last Line in the Third Paragraph and the First Line in the Fourth Paragraph. These two sentences read exactly the same. Should one come out?

COMMENT: Page 73, Second Paragraph, Third Sentence. It implies that not having the 5% estimated salt dissolution in the model is a negative. In fact it is not. If you assume a 5% estimated salt dissolution, you can also figure approximately the same level of salt extracted by the plant (crop) that is also not accounted for in a steady state model. Both of these would likely cancel each other out.

COMMENT: Page 74, Third Paragraph. This assumes that the first cutting of alfalfa occurs by March 13th. This needs to be confirmed with the growers in the area as this seems very early for this growing area. An early date like this may be applicable to the Southern San Joaquin Valley, but not here. It is unlikely also that any irrigations would take place prior to the middle of March as the ground is still wet from the winter and putting on additional irrigation water at this time would delay the soil warming up from the winter period and this is most important to an alfalfa grower.

COMMENT: Page 74, Fourth Paragraph. The dates for almond production need to be confirmed with growers on the Westside of the San Joaquin River. An almond tree begins to shut down with the onset of short days and colder night time temperatures. The largest change in night time lows occurs in October and it could be assumed that little crop growth or water use would occur after October 15th. It is also unlikely that an almond grower would irrigate his trees prior to the first two weeks of April. Because of winter rains and cold soil temperatures, irrigating prior to this time may cause root oxygen stress that could cause fruit drop or fruit delay due to the cold soil temperatures. It takes a wet soil much longer to warm up than one that is dryer. While you can define the growing season (and it does vary from year-to-year), you need to focus the steady-state modeling on the irrigation season which will normally not start until April 1st and will likely end by October 15th even though growth will be occurring outside that period. The irrigation period is when San Joaquin River water may be used.

COMMENT: Page 89, First Paragraph, Line 10: Westcott should be "Westcot".

COMMENT: Page 96, Alfalfa Write-up. The analysis shows that at no time would a yield loss occur at .15 LF even under the most extreme conditions and EC levels near 2.0 dS/m. This is consistent with the production practices in the Imperial Valley of California where similar conditions exist and no yield losses occur. There is extensive discussion however about high evaporative demand and not being able to get enough water into the soil to meet both ET and LF. This does occur during short periods in the hottest summer periods but stored soil water normally meets all crop demands during this period. The impact of salinity is <u>not short-term</u>; it is a buildup of salts over a season or several seasons. This does not occur in the San Joaquin Valley due to soil conditions and irrigation practices.

The alternative LFs of .07 and.10 are unreasonable and unachievable with present technology and irrigation practices in the San Joaquin Valley. LF is likely to be closer to .20 and should have been included in the modeling effort results presented in Table 6.1. We recommend that the .20 LF model results be presented in Chapter 6 as a large portion of the alfalfa is grown on or near the high water table lands in the LSJR area. Table 3.10 shows that these lands are well drained and likely to have LF closer to .20 than to .07.