From: Crystal Rivera [crivera@somachlaw.com]
Sent: Wednesday, September 29, 2010 3:45 PM
To: ILRP Comments
Cc: Pamela Creedon; Joe Karkoski; Adam Laputz; Tess Dunham; Dave Orth; William Thomas; Tim Johnson
Subject: COMMENTS on Draft PEIR for the LTILRP - Updated Signature Page
Attachments: 9-27-10 Comments DPEIR LTILRP.pdf; CommentLtr Corrected Signature Page.pdf

Dear Ms. Smith:

On September 27, 2010, I emailed you a comment letter (attached) on behalf of various agricultural organizations, coalitions, and water districts on the Draft PEIR for the LTILRP. One of the signatories, South San Joaquin Water Quality Coalition, was inadvertently omitted from the signature page. Attached is a corrected signature page, which includes South San Joaquin Water Quality Coalition. It would be appreciated if you would replace the original signature page with this corrected signature page for the September 27, 2010, comment letter we submitted. If you have any questions, please contact the undersigned. Thank you.

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September 27, 2010

Via email only - ILRPcomments@icfi.com

ILRP Comments
Ms. Megan Smith
IFC International
630 K Street, Suite 400
Sacramento, CA 95814

SUBJECT: Comments on the Draft Program Environmental Impact Report for the Central Valley Long-Term Irrigated Lands Regulatory Program (LTILRP)

Dear Ms. Smith:

The agricultural organizations, coalitions, and water districts identified below provide the following significant comments and concerns on the Draft Program Environmental Impact Report for the Central Valley Irrigated Lands Regulatory Program (Draft PEIR), the Draft Staff Report, the Recommended Program Alternative (RPA), and the Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program (Draft Economic Analysis). As requested, our comments are primarily organized by document and include recommended changes where appropriate.

I. Draft PEIR

Overall, we find the analysis in the Draft PEIR to be superficial, and inadequate to analyze the environmental impacts associated with the five alternatives as well as the RPA.

Our comments on the major areas of concern in the Draft PEIR are as follows.

A. The Draft PEIR Does Not Accurately Describe or Analyze the Proposed Project

The Draft PEIR analyzes five proposed alternatives. Central Valley Regional Water Quality Control Board (Central Valley Water Board) staff has combined elements of many of these alternatives to develop a sixth alternative, which staff is now recommending for approval, the RPA. De facto, the RPA has become the proposed project. However, the Draft PEIR does not analyze this project *at all*. While the elements of the RPA have been cherry-picked from the other alternatives, the Draft PEIR does not make any attempt to analyze the environmental impacts that would result if these elements were combined with each other, which is how they would be implemented if the RPA were selected as recommended by staff.

A draft environmental impact report (EIR) must include a general description of the proposed project's technical, economic, and environmental characteristics. (Guidelines for the Implementation of the California Environmental Quality Act[1] (Cal. Code Regs., tit. 14, § 15000 et seq.), hereafter State CEQA Guidelines, at § 15124(c).) The project description must be stable, accurate, and consistent throughout the EIR. "An accurate, stable, and finite project description is the *sine qua non* of an informative and legally sufficient EIR." (*County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 193.) "A curtailed or distorted project description may stultify the objectives of the [CEQA EIR] process. Only through an accurate view of the project may affected outsiders and public decision-makers balance the proposal's benefit against its environmental cost, consider mitigation measures, assess the advantage of terminating the proposal (i.e., the 'no project' alternative) and weigh other alternatives in the balance." (*Id.* at pp. 192-193.)

The Draft PEIR follows a National Environmental Policy Act (NEPA)-like approach. It does not identify any preferred alternative. Instead, it analyzes each of the alternatives in detail, and it claims that any one of them could be adopted as the proposed project at the conclusion of the environmental review process. Even if it is assumed that this approach fully complies with CEQA, the Draft PEIR fails because it makes no attempt whatsoever to analyze the environmental impacts associated with the RPA. Although individual elements of the RPA have been analyzed in the Draft PEIR, there is no evaluation of what would result when those elements are combined with each other, as they would be if the alternative were to be selected for implementation.

Indeed, the Draft PEIR does not even include the RPA in its text. Rather, the RPA is presented only in the appendices. In *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, the Supreme Court reaffirmed that key pieces of the CEQA analyses cannot be buried in the appendices. Here, the *proposed project itself*—the RPA that staff is recommending that the Central Valley Water Board implement as the program—is presented *only* in the appendices. This is a blatant violation of *Vineyard*, and it results in serious errors in the environmental analysis.

Thus, the Draft PEIR suffers from both substantive and procedural flaws that are fatal.

B. The Cumulative Impacts of the Preferred Alternative Are Not Accurately Analyzed

As noted above, the RPA represents "a conglomeration of elements presented" in the five alternatives that are analyzed in the Draft PEIR, but the RPA was not itself analyzed in the Draft PEIR, and no attempt has been made to analyze the components of this program (as they would be applied) in conjunction with each other. Compounding this error, the Draft PEIR does not identify "any projects or programs adequately similar in nature, location, and type to result in a meaningful comparative analysis." "[A] cumulative impact consists of an

[1] California Environmental Quality Act, Public Resources Code section 21000 et seq. (hereafter CEQA).

impact which is created as a result of the combination of the project evaluated in the EIR together with *other projects* causing related impacts." (State CEQA Guidelines, § 15130(a)(1), emphasis added.)

In contravention of State CEQA Guidelines section 15130, the Draft PEIR employs neither a list nor a summary of plans and projections approach to the cumulative impacts analysis. In fact, the Draft PEIR does not identify a single program, policy, plan, or project to be included in the cumulative impacts analysis. Instead of analyzing the cumulative effects of the project together with other projects causing related impacts, the Draft PEIR blithely concludes that there are no other projects—and purports to analyze the cumulative impacts of the project, standing alone. This analysis cannot withstand scrutiny. Other programs and projects that have the potential to affect water quality in the program area include U.S. EPA's recent action banning pesticide application in certain areas, numerous pending National Pollutant Discharge Elimination System (NPDES) permits and other permit actions, and the Central Valley Water Board's own Groundwater Protection Strategy, which has been in development for several years. All of these similar pending programs and projects have the potential to create cumulative impacts on agricultural and other environmental resources, and, thus, require analysis along with the current project.

Moreover, even if it were deemed appropriate to disregard all the programs and projects that have the potential to contribute to cumulative impacts and consider the "cumulative impacts" of the program standing alone, *the Draft PEIR has not done this*. As explained above, the Draft PEIR does not analyze the impacts associated with the RPA; it makes no attempt to evaluate what effects will result if those program components are implemented in conjunction with each other. Thus, even if it were sufficient to limit the scope of the cumulative impacts analysis to the program alone, the Draft PEIR's approach leads to a failure to analyze—and a deliberate understating of—the project's cumulative impacts.

C. Alternative 1 Does Not Accurately Represent the "No Project" Scenario; Continuation of the Existing Irrigated Lands Program Would Be a Project Subject to CEQA, Not the "No Project" Condition

The Draft PEIR claims that Alternative 1 constitutes the "No Project" Alternative, which the Draft PEIR defines as "full implementation of the present program." This description of Alternative 1 is misleading and incorrect. In actuality, the Draft PEIR does not include a true "No Project" Alternative that represents what would happen absent any Central Valley Water Board action.

"The 'no project' analysis shall discuss the existing conditions at the time the notice of preparation is published, . . . as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services." (State CEQA Guidelines, § 15126.6(e)(2).) When the existing conditions include implementation of a program or rule that will expire

unless some affirmative action is taken, the "No Project" scenario must consider the expiration of that program or rule and its associated ramifications. (See, e.g., *Sherwin-Williams Co. v. S. Coast Air Quality Management Dist.* (2001) 86 Cal.App.4th 1258, 1280 [SCAQMD properly defined the "No Project" scenario as "not adopting the proposed amendments to Rule 1113, but instead allowing the expiration of the current product variances for some of the coating categories, and maintaining the current version of Rule 1113 as amended by a 1990 court order"].) In contrast, when an agency must act affirmatively to extend an existing program or rule, that itself is a project that must be analyzed under CEQA. (*Sunset Sky Ranch Pilots Assn. v. County of Sacramento* (2009) 47 Cal.4th 902, 909 [county's decision not to renew a conditional use permit that was expiring is not a project under CEQA, but the renewal of the permit would be].)

Here, the "No Project" Alternative should reflect the expiration of the existing waiver program on June 30, 2011. (See *Coalition Group Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*, Order No. R5-2006-0053, at p. 17 (2006 Conditional Waiver). Pursuant to Water Code section 13269, the 2006 Conditional Waiver remains in place only if it is affirmatively renewed by the Central Valley Water Board. (Wat. Code, § 13269(b)(1).)

The lack of an accurate "No Project" Alternative constitutes a fatal flaw for the Draft PEIR. The "No Project" Alternative is a mandatory component of an EIR. The purpose of this requirement is "to allow decisionmakers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project." (State CEQA Guidelines, § 15126.6(e)(1).) In this case, no such comparison is possible because the "No Project" Alternative is fundamentally inaccurate.

D. The Draft PEIR Misrepresents the Baseline Conditions, So the Entire Environmental Analysis Is Tainted

The Environmental Setting fails to describe accurately the existing environmental conditions, even at a programmatic level. "Knowledge of the regional setting [of the project] is critical to the assessment of environmental impacts . . . . The EIR must demonstrate that the significant environmental impacts of the proposed project were adequately investigated and discussed and it must permit the significant effects of the project to be considered in the full environmental context." (State CEQA Guidelines, § 15125(c).) Toward that end, the Draft PEIR "must include a description of the physical environmental conditions in the vicinity of the project, . . . from both a local and a regional perspective. This environmental setting will normally constitute the baseline physical conditions by which a Lead Agency determines whether an impact is significant." (*Id.* at § 15125(a).)

First, the "Existing Setting" chapter is, by its own admission, incomplete. For example, the description of the existing conditions related to surface water makes no mention whatsoever of the amount of surface water currently being diverted or the amount being used for irrigation by participants in the Irrigated Lands Program. Likewise, there is no indication

of how much water is returned to stream systems after agricultural use, and how much of that water is derived originally from groundwater basins or surface water sources. Absent this information about the existing physical conditions, it is not possible to determine whether the proposed new regulatory program will cause significant impacts on water supplies, stream systems, or the fish, wildlife and plants dependent on those systems.

The Draft PEIR attempts to overcome the gaps in the "Existing Setting" chapter by adding a discussion of environmental setting to each of the impact analyses. This is confusing to the reader because these supplemental discussions of the "existing setting" are not entirely consistent with the description provided in the "Existing Setting" chapter. Moreover, even the supplemental discussions in the impact analyses are improperly truncated. For example, in the Vegetation and Wildlife Section (section 5.7), the agricultural lands environmental setting consists of three paragraphs for over 7 million acres of agricultural land in the Central Valley. Considering the diversity and value of varying vegetation and wildlife throughout the Central Valley, a three paragraph summary in no way can establish the existing environmental setting.

To the extent the Draft PEIR relies on the "No Program" Alternative to represent the existing baseline conditions, this is improper in this case. As explained above, the "No Program" Alternative misstates what will occur absent any Central Valley Water Board action. Because neither this nor any of the other attempts in the Draft PEIR to describe the environmental setting is legally adequate, the Draft PEIR lacks any accurate baseline against which to judge the environmental impacts of the proposed program.

E. The Draft PEIR Fails to Evaluate the Program's Reasonably Foreseeable Direct and Indirect Effects on the Environment

"In evaluating the significance of the environmental effect of a project, the lead agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project." (State CEQA Guidelines, § 15064(d).) "An indirect physical change in the environment is a physical change in the environment which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect physical change in the environment." (*Id.* at § 15064(d)(2).)

The Draft PEIR fails to achieve this charge. For example, the Draft PEIR acknowledges that, under the alternatives analyzed, the higher cost of irrigation would result in less water being used and some land going out of agricultural production. However, the Draft PEIR's analysis stops there. It does not consider what impacts will be caused by the reasonably foreseeable result of less irrigation, such as less water returning to stream systems and diminished flows at certain times of year, and less irrigation water reducing the amount of groundwater recharge that would otherwise occur, particularly in the San Joaquin Valley where many of the surface water delivery systems were built with the intent to increase local groundwater basin recharge. In many groundwater basins within the Central Valley, flood

irrigation is responsible for a significant portion of the groundwater recharge to those basins. Numerous entities rely on that recharged groundwater to meet their water supply needs, including urban agencies, private domestic users, industry and agriculture. Less irrigation could result in significant environmental impacts, and a discussion of those potential impacts is completely absent from the Draft PEIR. In addition to direct groundwater impacts, discharge to waterways from the groundwater basin could also decrease, potentially resulting in reduced flows that may constitute a direct change in the environment. This possibility is also not analyzed by the Draft PEIR. Finally, it is reasonably foreseeable that reduced irrigation could have other indirect environmental impacts. Reduced groundwater availability may require the installation of dedicated recharge basins or injection wells, or force third parties who rely on groundwater recharge to procure alternative supplies in the absence of the previously available groundwater. Such reasonably foreseeable consequences are not considered in the Draft PEIR, rendering the analysis wholly deficient.

In addition to the potential reduction in irrigated acreage, changes in irrigation practices, and specifically the use of pressurized systems, can have a whole host of environmental impacts that were not considered in the Draft PEIR. For example, the Draft PEIR indicates that field preparation activities would not substantially increase as a result of changes in management practices. (See Table 5-5-1.) In reality, the installation of pressurized systems would result in a significant increase in fieldwork which includes but is not limited to the construction of pumping facilities, filtering equipment, and trenching and laying of pipes. These changes could have direct impacts on air quality and other environmental impacts not discussed in the Draft PEIR. In addition, pressurized systems require additional energy to operate, which would similarly result in potential impacts to air quality and energy resources. The failure of the Draft PEIR to include these foreseeable direct and indirect environmental impacts renders it fatally flawed.

Similarly, the Draft PEIR acknowledges that the program will result in the conversion of agricultural lands to other uses, but it fails to analyze the reasonably foreseeable impacts associated with that conversion, such as increased valley temperatures (see Climate Change comments, *infra*), and conflicts with existing land use regulations and zoning (see Land Use comments, *infra*). All of these direct and indirect impacts resulting from the implementation of the program must be analyzed in the Draft PEIR.

F. The Draft PEIR Grossly Understates the Program's Potential Impacts on Land Use

A draft EIR must "discuss any inconsistencies between the proposed project and applicable general plans and regional plans," including habitat conservation plans and natural communities conservation plans. (State CEQA Guidelines, § 15125(d).) While the Draft PEIR acknowledges the requirement to evaluate its consistency with General Plans and Habitat Conservation Plans (HCPs), it makes no attempt to analyze these impacts even in a qualitative manner. Its characterization as a programmatic document does not wholly excuse

undertaking the required environmental analysis. The Draft PEIR should evaluate the extent to which adopted General Plans within the program area designate agricultural land uses that would be undermined by the increased irrigation costs imposed by the program and the resulting loss of agriculture. Likewise, the Draft PEIR must discuss whether and how adopted HCPs in the program area rely on agricultural land uses and how the increased irrigation costs imposed by the program, and the resulting loss of agriculture, would affect those plans.

Even more egregiously, the Draft PEIR utterly fails to analyze the program's land use impacts. The Draft PEIR acknowledges that agricultural lands are a resource that must be analyzed under CEQA, and it also admits that many jurisdictions have adopted land use plans, regulations, and zoning ordinances to protect agricultural uses. Yet the Draft PEIR completely fails to analyze, even at a programmatic level, whether the program will conflict with any of these land use plans, regulations, or zoning ordinances. Again, the Draft PEIR's status as a programmatic document is not an excuse to omit *any* discussion of these potentially severe impacts—which is the faulty path taken by the Draft PEIR.

G. The Draft PEIR's Conclusions Regarding Global Warming Are Not Supported by Substantial Evidence

The conclusions drawn in an EIR must be supported by substantial evidence. The Draft PEIR's climate change analysis fails to meet this standard, as it relies on argument and speculation rather than the best available evidence. While this is an evolving area of science, and there may not be much evidence available, the lead agency must use the best evidence available to it to inform its analysis. If there is any substantial evidence to support the Draft PEIR's conclusion that irrigating agricultural lands causes climate change—which seems doubtful—the Draft PEIR does not contain or cite it.

Here, the best available evidence is a 2007 study, which indicates that agricultural irrigation practices in the Sacramento/San Joaquin Valley cause the mean temperature in summer months to drop, even as greenhouse gas emissions drive temperatures upward. (Irrigation cooling effect: Regional climate forcing by land-use change, Geophysical Research Letters, Vol. 34, L03703 (Feb. 7, 2007) (Enclosure 1).) As noted by Professor Lara Kueppers, one of the authors of the study, "activities related to agriculture, forestry and development do matter to the climate." As Professor Kueppers states, "If we don't consider what we're doing to the area by urbanizing, which removes farmland that has a cooling effect, we could very well end up with a much hotter Central Valley." (See http://www.ucmerced.edu/news_articles/02082007_professor_s_research_shows.asp.) This evidence suggests that any program such as the LTILRP, which the Draft PEIR concedes will have the effect of removing some land from irrigation, will cause increased climate change impacts in the Central Valley. While it may not be possible to precisely quantify those impacts at this time, they must be disclosed, at least at a qualitative level.

In addition, the Draft PEIR fails to account for the effects of new management practices on energy demand, which would in turn affect air quality, greenhouse gas emissions and ultimately climate change. As noted in our comments regarding the Draft PEIR's failure to adequately assess the true impact of the LTILRP on the environment, the installation of pressurized systems would result in a significant increase in construction activities in the short term and increased energy consumption in the long term, both of which could contribute to an increase in greenhouse gas emissions. This increase could have a direct impact on climate change, yet it was not discussed or analyzed in the Draft PEIR, even in a qualitative fashion.

H. The Draft PEIR Arbitrarily Imposes Mitigation Measures That May Not Be Legally Imposed

Mitigation measures that cannot be legally imposed need not be proposed or analyzed. (State CEQA Guidelines, § 15126.4(a)(5).) The "Mitigation and Improvement Measures" for vegetation and wildlife resources identified in section 5.7.6 (p. 5.7-50) propose mitigation measures that would require avoidance of sensitive biological resources, additional CEQA review if such resources cannot be avoided, and would force agricultural landowners to conduct a delineation of affected wetlands "prior to implementing any management practice that will result in the permanent loss of wetlands." In delineating wetlands, the mitigation requires it to be conducted in accordance with current U.S. Army Corps of Engineer (Corps) methods. The mitigation measures proposed here cannot be legally imposed in all cases.

First, we question the requirement to undertake additional CEQA review when an adverse effect on a sensitive biological resource cannot be avoided. While we agree that impacts to such sensitive areas should be avoided, we are concerned that, as proposed, the mitigation measure imposes a new CEQA requirement on agricultural landowners and operators when no discretionary project may actually be triggered by the action. For example, in some jurisdictions, and depending on the construction activity, grading permits may be required for installation of certain management practices (e.g., detention basins). However, in many jurisdictions, the act of constructing a management practice may not rise to the level of activity subject to a grading permit. Further, the implementation of management practices at the farm level, which would be encouraged in area-wide waste discharge requirements (WDRs), is not subject to a discretionary approval by the Central Valley Water Board. Thus, there is no universal trigger for additional CEQA review. At most, such review may be necessary if the construction activity constitutes a discretionary project under the local jurisdiction's authority. To avoid confusion, we suggest that this mitigation measure be revised to clarify that additional CEQA review is only necessary if a discretionary project for approval has been triggered by the construction activity.

Next, we are concerned that the mitigation measure for wetland loss is too broad and fails to recognize that implementation of management practices is most likely to occur on irrigated agricultural land currently in production. The Central Valley Water Board does not have the authority to order the delineation of affected wetland areas identified as converted

croplands because such agricultural areas do not fall within the jurisdiction of the Corps. The Clean Water Act (CWA) and the authority of the Corps to perform operations under the CWA apply only to "waters of the United States." The regulatory definition of waters of the United States specifically states that, "Waters of the United States do not include prior converted cropland . . . ." (33 C.F.R. § 328.3(a)(8).) Furthermore, guidance issued by the U.S. EPA in 2008 clarifying CWA jurisdiction following the Supreme Court case of *Rapanos v. United States* (2006) 547 U.S. 715, made no mention of and had no effect on this exemption for ongoing agricultural operations. As such, cropland continues to be exempt from the Corps' CWA jurisdiction. If it is not within the authority of the Corps to conduct a delineation because the area to be examined is not a water of the United States as defined by federal law or -regulation, then it follows that it is not within the authority of the Central Valley Water Board to order individual agricultural operations to undertake such an action as a mitigation measure.

II. Draft Staff Report

A. Application of State's Anti-Degradation Policy

The Draft Staff Report incorrectly characterizes application of the state's anti-degradation policy. Specifically, the Draft Staff Report implies that application of the anti-degradation policy is triggered merely because the LTILRP will authorize agricultural discharges to surface and groundwaters to continue. (See Draft Staff Report at p. 63 ["From a programmatic standpoint, irrigated land waste discharges have the potential to cause degradation of surface and groundwater, and the requirements of the anti-degradation policies must be followed."].) However, this characterization and application of the anti-degradation policy to the proposed LTILRP is inappropriate. As indicated in State Water Resources Control Board (State Water Board) orders and guidance documents, the anti-degradation policy is triggered when the Central Valley Water Board is taking an action that may cause degradation to high quality waters. It is not applicable if the Central Valley Water Board's action will not cause degradation.

For example, State Water Board Order No. WQ 86-17 clearly states, "[b]efore approving any *reduction* in water quality, or any activity that would result in *reduction* in water quality, the Regional Board must first determine that the change in water quality would not be in violation of State Board Resolution No. 68-16 or the federal antidegradation policy." (*In the Matter of the Petition of Rimmon C. Fay* (Nov. 20, 1986) Order No. WQ 86-17 at p. 17, emphasis added.) More recently, the State Water Board opined that, "[t]he federal antidegradation policy and State Water Board Resolution 68-16 *apply to reductions in water quality*." (*In the Matter of Petitions for Reconsideration of Water Quality Certification for the Re-operation of Pyramid Dam for the California Aqueduct Hydroelectric Project Federal Energy Regulatory Commission Project No. 2426* (Aug. 4, 2009) Order WQ 2009-0007 (*Pyramid Dam*) at p. 12, emphasis added.) By its own admissions in the Draft PEIR, the Central Valley Water Board anticipates that implementation of any of the alternatives

analyzed, except for perhaps Alternative 1 as it applies to groundwater, will *improve* water quality. Thus, because adoption of the LTILRP will not result in a reduction in water quality, the federal and state anti-degradation policies are not applicable.

Furthermore, even though application of the anti-degradation policies may be triggered for changes that have already occurred, such an application only occurs when the changes have not already been reviewed for consistency with those policies. (See *Pyramid Dam* at p. 12.) That is not the case here. The Draft Staff Report incorrectly states that "unpermitted degradation has occurred since 1968." (Draft Staff Report at p. 61.) In fact, irrigated agricultural has been subject to Central Valley Water Board regulation since adoption of the original waivers in 1982 when the Central Valley Water Board adopted Resolution No. 82-036. To adopt waivers pursuant to Water Code section 13269, the Central Valley Water Board was required to find that the waivers were consistent with any applicable regional water quality control plan (i.e., Basin Plan). The water quality control plans for the Central Valley region (for both the Tulare Lake Basin and the Sacramento and San Joaquin River Basins) have included and contained State Water Board Resolution No. 68-16 since the plans were adopted in 1975. Thus, to adopt the waivers, the Central Valley Water Board needed to find that adoption of the waivers was consistent with Resolution No. 68-16. In other words, discharges from irrigated agriculture were found to be consistent with Resolution No. 68-16 in 1982, and therefore only a Central Valley Water Board action that would degrade water quality is subject to the state and federal anti-degradation policies. As already indicated, the proposed action would not degrade water quality but would improve water quality.

Even if implementation of the LTILRP does trigger application of anti-degradation policies, staff's recommendation that all operations subject to the program be subject to the best practicable treatment or control (BPTC) standard is entirely inappropriate. The BPTC standard only applies where there is potential degradation of high quality waters of the state. As articulated by the State Water Board, "[i]n order to determine whether the allowance of limited degradation is consistent with [the 68-16] provisions, we must *first* see if existing water quality is better than water quality established in policies." (*In the Matter of the Petitions of the County of Santa Clara, Santa Clara Water District, City of San Jose, Citizens for a Better Environment and Silicon Valley Toxics Coalition To Review Issuance of Waste Discharge Requirements of Hazardous Materials Cleanup to International Business Machines Corporation (May 5, 1986)* WQ Order No. 1986-8, at p. 29, emphasis added.) This is a fact specific determination that the Central Valley Water Board must make, and cannot be broadly applied to all waters governed by the LTILRP in the absence of any inquiry into whether the affected water is considered high quality.

In spite of this threshold requirement, the Draft Staff Report concludes that because of the large number of water bodies within the scope of the LTILRP, "determination of a baseline water quality is a near impossible task." (Draft Staff Report at p. 60.) Based on the "complexity" of determining the quality of waters covered by the program and the

"significant variation in conditions over the broad areas covered by the program," staff's solution is to forego an individual assessment and simply apply BPTC to all irrigated lands. Essentially, the "long-term ILRP *assumes* that at least *some* of the waters into which agricultural discharges will occur are high quality waters" (*id.* at p. 63) and therefore BPTC should apply to all discharges. This assumption is contrary to the plain language and intent of the anti-degradation policy and the BPTC requirement.

Staff's own conclusions do not indicate that all or even most of the waters affected by the program are high quality waters that would be subject to the BPTC standard. By its own admission in the Draft PEIR, the Central Valley Water Board acknowledges that, ". . . *many* water bodies in the Central Valley Region are already impaired for various constituents associated with irrigated agricultural activities . . ." and that under the LTILRP ". . . multiple water bodies are affected by various discharges, *some* of which may be high quality waters and some of which may by contrast have constituents at levels that already exceed water quality objectives." (Draft Staff Report at pp. 61, 63, emphasis added.) The potential complexity of a more individualized assessment does not abrogate the Central Valley Water Board's responsibility for making determinations as to the status of a water body as high quality or not. Applying a blanket rule for all waters covered by the program, simply because it would be too time consuming or difficult to make individualized determinations to ascertain which waters would fall under the BPTC standard, is entirely inappropriate.

B. Coordination of Groundwater Programs (pp. 79-80)

In its discussion with respect to other regulatory programs, the Draft Staff Report indicates that staff intends to coordinate its efforts with the Department of Pesticide Regulation's (DPR) groundwater protection program. First, this essential coordination effort is buried in a Draft Staff Report's general description of other regulatory programs. To the extent that the Central Valley Water Board intends to truly coordinate with DPR, the coordination element should be clearly identified as part of the RPA. That currently is not the case.

Second, the Central Valley Water Board's proposed method for coordination is not appropriate. The Draft Staff Report proposes that where there is a reported detection of pesticides in groundwater, the LTILRP (i.e., the Central Valley Water Board) would immediately review data and inform growers of the need to implement management practices. We disagree with the implication that any "reported detection of pesticides in groundwater" calls for immediate notification and action by growers. Instead, the LTILRP should evaluate if the reported level of the pesticide in question exceeds applicable groundwater quality objectives, and if future uses of the pesticide will potentially cause the level of pesticide to exceed applicable objectives. Once it has been determined that growers are discharging pesticides to groundwater cause the groundwater to exceed applicable water quality objectives, then it is appropriate to determine if new or additional management practices are necessary.

On another note, we encourage the Central Valley Water Board to coordinate its efforts with existing groundwater programs and not just DPR's. The Central Valley Water Board should expand on partnership opportunities that rely upon the appropriate local entities and state agencies involved in groundwater monitoring and protection (Department of Water Resources, Department of Public Health, etc.) to compile, analyze, and utilize existing groundwater data and protection programs, and identify gaps, prior to proceeding with the adoption, regulation, and enforcement upon potential dischargers of groundwater monitoring programs within the LTILRP. The appropriate local entities will vary throughout the Central Valley and may include agricultural coalitions, local public agencies, and integrated regional water management planning agencies. By coordinating efforts, the Central Valley Water Board can avoid duplicating and conflicting with other local and state programs that are already being implemented by others.

C. Consistency With Non-Point Source Policy (pp. 107-114)

The Draft Staff Report identifies five key elements from the State's Non-Point Source Policy to determine if the five alternatives are consistent with the five key elements. With respect to Key Element 4, we disagree with the Central Valley Water Board's assessment that Alternative 2 is only partially consistent. Key Element 4 states that, "[a]n NPS control implementation program shall include sufficient feedback mechanisms so that the RWQCB, dischargers, and the public can determine whether the program is achieving its stated purpose(s), or whether additional or different MPs [management practices] or other actions are required." Alternative 2 does provide and include sufficient feedback mechanisms. As indicated, Alternative 2 includes monitoring provisions for both groundwater and surface water monitoring, as well as tracking of management practices. (Draft PEIR at pp. 3-12 - 3-13.) The monitoring provisions for Alternative 2 clearly provide for a sufficient feedback mechanism.

D. Economic Impacts and Draft Technical Memorandum Concerning the Economic Analysis of the LTILRP

After examining the full economic analysis of the LTILRP, we are concerned that it fails to address a number of the costs, which will be incurred as a result of implementation of the RPA, or any of the alternatives. The economic analysis is woefully inadequate in that it clearly does not evaluate the potentially substantial costs which may be associated with practices compelled or prohibited by the various alternatives, including but not limited to nutrient management, irrigation practices, and the installation and operation of monitoring wells. The costs of these actions could be in the hundreds of millions of dollars, yet they are not substantially addressed by the economic analysis. Furthermore, the economic analysis contains several generalities and understated assumptions that prevent the reader from attaining a genuine picture of the actual costs and economic impacts of the various alternatives. For example, there is an assumption that growers will simply "find less expensive ways to modify their production practices" and therefore the analysis assumes

economic impacts would be somewhat reduced. (Draft Economic Analysis at pp. 1-3.) The economic analysis also fails to estimate the admittedly understated economic impacts as a result of forward-linked effects, and contains an erroneous estimate of the number of enrolled growers. These generalizations and faulty assumptions severely reduce our confidence in the overall reliability of the economic analysis.

In addition, we are very concerned with the Draft Staff Report's failure to analyze the economic impact of staff's RPA. The Porter-Cologne Water Quality Control Act (Porter-Cologne) requires that both costs and economic impacts be considered when developing a new regulatory program for agriculture. (See Wat. Code, § 13141.) The Draft Staff Report acknowledges this requirement, and the Draft PEIR does make an attempt to analyze the economic impact and cost of the LTILRP. Unfortunately, it does so in the context of the individual alternatives, none of which represent the actual staff proposed alternative that has been recommended for implementation.

Just as the cumulative impacts of the preferred alternative are not analyzed in staff's RPA, the economic impacts of the RPA are not analyzed either. As noted earlier in our comments, because the RPA is actually a conglomeration of other project alternatives, the Draft PEIR does not truly analyze the proposed project. In the same vein, without analyzing the RPA, it is impossible for the Draft Staff Report to analyze the true economic impact of that project. The Draft Staff Report does attempt to assemble relevant pieces from Alternatives 2 and 4 to produce an estimated economic impact and cost. However, there is no indication that the independent economic analysis on which those estimates are based is supported by using pieces of other alternatives. Assumptions contained in the actual independent economic analysis may not remain true if variant pieces of each alternative are selectively taken out and subsequently reassembled, as is the case in the RPA. Taking isolated figures from an economic analysis that was designed to summarize the ramifications of different alternatives in their entirety may not accurately reflect the true economic impacts of the RPA. The Draft PEIR should have contained a full economic impact analysis of the RPA not based exclusively on the estimated costs of pieces assembled from the other alternatives. The Draft PEIR fails to do so, and therefore there is no basis on which to accurately calculate the economic impact or costs of the RPA.

In addition, the failure of the Central Valley Water Board to adequately describe and analyze a no project alternative is simultaneously a failure to represent the economic impacts of that no project alternative. As noted in our earlier concerns, Alternative 1 does not adequately represent the no project scenario because continuation of the existing waiver program would additionally be a project subject to CEQA. The economic impact analysis notes that "full implementation of Alternative 1 is considered the continuation of the existing program" yet this does not take into account the fact that the current waiver program would expire absent Central Valley Water Board action. Consequently there is no consideration of the economic impact of the true no project alternative, the analysis of which would provide a more adequate baseline for comparison purposes.

Aside from the more general deficiencies in the economic impact analysis contained in the Draft Staff Report, there are specific economic impacts that did not receive a thorough analysis. Specifically, the recommended shift to pressurized systems would require significant infrastructure changes for irrigation districts, including the construction of new pipelines and modification or construction of flow regulating structures and turnouts. This would require significant capital investment from growers and irrigation districts, and increased costs to the irrigation districts could ultimately be passed on to growers in the form of increased water rates. In addition, the Draft PEIR places the burden on growers and third party groups to prove that best management practices for groundwater quality protection and cleanup are effective through monitoring and assessment without taking into account the impact and cost of such efforts. Without taking these costs into account, the Draft Staff Report fails to analyze the actual costs and economic impact of the proposed project as it is required to do. Finally, the staff alternative indicates that the Tier 2 groundwater monitoring would have to both establish a baseline and trend and identify management practices. (Draft Staff Report at p. 158.) However, the potentially significant costs of undertaking this activity are also not contained in the economic analysis.

III. Recommended Program Alternative

A. Adoption of Individual WDRs Will Require Compliance With CEQA

The adoption of the eight to twelve WDRs discussed in the staff's recommended program alternative is a "project," as defined in CEQA. (Pub. Resources Code, § 21065.) CEQA and its requirements apply to discretionary projects proposed by public agencies. (*Id.*, § 21080(a).) The Central Valley Water Board's approval of WDRs is a discretionary decision, and therefore it is subject to CEQA. Thus, when the Central Valley Water Board goes to adopt the eight to twelve individual WDRs, it will be required again to consider the environmental impacts associated with adoption of the individual WDRs. To the extent the Central Valley Water Board intends to rely on the Draft PEIR for its determination of environmental impacts, the Draft PEIR provides insufficient analysis and is only applicable on a limited basis.

B. Timeframe for Implementation is Aggressive

We are concerned that the timeframe for implementation outlined in the RPA is far too aggressive and operations subject to the LTILRP may be unable to meet the recommended deadlines. (RPA at p. 144.) First, the expansion from regulation of surface water only to surface and groundwater will be a struggle for each coalition to achieve, and it will certainly take more than three months for coalitions and growers to analyze whether compliance is feasible. Furthermore, the Draft Implementation Timeframe allots a mere 30 months before new participants are enrolled in the program. Thirty months is an extremely optimistic estimate for the coalitions and the Central Valley Water Board to be able to convince growers who have never been part of the waiver that they need to enroll in the program, if they are in fact subject to its requirements. Finally, an anticipated full implementation deadline of three

years is simply too aggressive. (See section G.2.b below [three years is needed to allow for the development of groundwater quality management plans].) Since fall of 2008, the Stakeholder Advisory Workgroup has been meeting and providing feedback on issues pertaining to the development of a LTILRP. Even now, the EIR process is ongoing and a full hearing before the Central Valley Water Board on the LTILRP is tentatively scheduled for the summer of 2011. It is worrisome that a program requiring three years of stakeholder input, comments, and review is recommended for full implementation in such a short timeframe. Furthermore, the existing conditional waivers have been the controlling standard for such an extended period, a full transition to a new program in just three years may prove to be unworkable. It is overly aggressive to expect that the coalitions and the Central Valley Water Board can fully implement a new long-term program that includes groundwater in a three year time period.

C. Adoption of Conditional Prohibition of Discharge Inappropriate

As we have indicated throughout this process, we are concerned with the Central Valley Water Board's intent to adopt a conditional prohibition into both Basin Plans (i.e., Sacramento and San Joaquin Rivers, and Tulare Lake). According to Central Valley Water Board staff, the intent is to provide the Central Valley Water Board with more direct enforcement authority over individuals that are not participating in the LTILRP. While the agricultural organizations are supportive of Central Valley Water Board efforts to utilize its enforcement authority appropriately to ensure equal and fair application of the LTILRP over all persons subject to its requirements, we are concerned with the use of a Basin Plan prohibition in this manner. The prohibition provisions in Porter-Cologne were included to authorize regional water quality control board's to determine that the discharge of certain types of waste or certain areas should be prohibited to protect water quality. (See Wat. Code, § 13243.) It was not included to circumvent notification requirements for bringing enforcement actions against non-compliant individuals. Furthermore, all persons should be afforded appropriate due process rights, including notification regarding non-compliance before being subject to administrative civil penalties. Also, adequate enforcement tools appear to be in place without invoking prohibitions of discharge. Lastly, we observe that (1) a stated objective of the LTILRP is to avoid economic impact on agricultural operations, and that (2) a prohibition of discharge would severely impair the ability of most farms to function. This unnecessary provision therefore is out of keeping with the objectives of the LTILRP, as stated in this same document. As such, we continue to be opposed to this provision.

D. Presumption That All Irrigated Agriculture Creates a Discharge of Waste Is Inappropriate

The Draft Staff Report inappropriately presumes that all irrigated agriculture creates a discharge of waste. The Draft Staff Report states that, "[b]ecause all irrigated agricultural operations could affect groundwater quality, they have been considered in the scope of the long-term ILRP." (Draft Staff Report at p. 143.) The Draft Staff Report makes this

presumption in spite of the fact that staff acknowledges there is only a possibility that individual irrigated lands actually create a discharge of waste. (See Draft Staff Report at p. 143 ["Operations associated with irrigated agriculture . . . *may* leach waste into groundwater, *potentially* causing degradation, or causing or contributing to exceedances of water quality objectives." (Emphasis added.)].) While the Central Valley Water Board may have the authority to regulate irrigated agriculture that creates a discharge of waste under the LTILRP, the Central Valley Water Board does not have unfettered regulatory authority to regulate agricultural practices that do not create such a discharge. One fundamental limitation on the Central Valley Water Board's authority to regulate irrigation practices is that the activity must result in a "discharge of waste" that impacts water quality. Simply because it would be "difficult to determine" whether individual irrigated lands are creating a discharge of waste does not eliminate the Central Valley Water Board's statutory obligation to only regulate activities that actually create a discharge of waste. While a blanket determination that all irrigated agriculture creates a discharge of waste may be convenient for regulatory authority purposes, it is an inaccurate presumption with no evidentiary support. Presuming all irrigated agriculture creates a discharge of waste simply because some irrigated agriculture may potentially or could possibly affect water quality is entirely inappropriate and does not fall within the Central Valley Water Board's authority to regulate only those irrigation practices that result in a "discharge of waste."

In addition, this improper presumption is coupled with an improper shift in the burden to the landowner or operator to disprove that presumption. Water Code section 13267 authorizes the Central Valley Water Board to require reports from those who discharge waste, but requires that the Central Valley Water Board "provide the person with a written explanation with regard to the need for the reports" and "identify the evidence that supports requiring that person to provide the reports." In contrast, the Draft Staff Report makes a broad assumption that all irrigated agriculture creates a discharge of waste, subjecting operations to various reporting requirements without providing a written explanation or supporting evidence, even while acknowledging that some of those operations do not create a discharge of waste.

Thus, the Draft Staff Report needs to be revised to remove the presumption that agricultural irrigation constitutes a discharge of waste to groundwater.

E. Third-Party Organizations Not Appropriate Entities to Identify Potential Impacts to Sensitive Areas

We are concerned that the Draft Staff Report places an impractical burden of identifying potential impacts to sensitive resources on third party organizations. The Draft Staff Report states, "Where an irrigated agricultural operation/third-party group determines that a proposed management practice/monitoring well may impact a sensitive resource, the ILRP will require . . . ." the individual or third party to mitigate the effects or come up with an alternative course of action. (Draft Staff Report at p. 172.) With this language, the RPA

implies that the third-party organizations will be reviewing and approving all management practices, and their environmental settings for every covered coalition member. Such a requirement and expectation of the third-party groups is unrealistic and therefore the language should be modified.

F. Determination of Impact to Sensitive Resources is Cost Prohibitive

The RPA includes a number of regulatory requirements for individual agricultural operations. One of the requirements would require individual agricultural operations to determine if a proposed management practice will impact a sensitive resource. This requirement is directly linked to the mitigation measures described in the Draft PEIR and discussed previously. As indicated above, the mitigation measures, which would require agricultural operations to hire consultants to conduct wetlands and habitat delineations, are costly and impractical. As a result, the mitigation measures are infeasible and not appropriate for application to agriculture. Further, ongoing agricultural operations on already converted cropland are exempt from Corps requirements and, therefore, requiring such delineations are outside the Central Valley Water Board's authority. While we support and encourage avoidance of sensitive resources, we cannot support the extreme costs that would be placed on individual growers for delineating sensitive resources, except as already required by other environmental statutes and regulations.

G. As Described, No Areas Would be Eligible to be Classified as Tier 1

As a preliminary matter, we encourage the Central Valley Water Board to revise the Tier 1 and Tier 2 classifications to clearly indicate that the designation of water bodies between Tier 1 and Tier 2 must be limited based on the use of scientific, quality-controlled data. Further, the designations between Tier 1 and Tier 2 should be clearly defined within the RPA. We recommend that the primary designation for Tier 2 surface water should be management plan triggers, excluding natural and non-agricultural sources of dissolved oxygen (DO), pH, and pathogens. Tier 2 groundwater designations should be initially limited to DPR groundwater management zones and areas where nitrates or other constituents are known to affect drinking water quality. All other waters should remain in Tier 1 until quality data indicates otherwise.

1. Tier 1

According to the RPA, a major factor in determining if an area is classified as Tier 1 (i.e., low priority) or Tier 2 (high priority) depends on if irrigated agricultural operations are identified as causing or contributing to a water quality problem to surface and/or groundwater. Based on this priority factor, it appears that the Central Valley Water Board would need to assess all individual agricultural operations in an area to determine if each individual operation is eligible to be classified as Tier 1. Such an approach is infeasible, which will mean that all areas will be classified as Tier 2.

Further, in determining what is classified as Tier 1 or Tier 2, the RPA provides no specificity with respect to situations where most water quality standards are met, except for one or two. For example, in some areas, water quality standards are met for almost all parameters except for pH, dissolved oxygen, and/or bacteria. When dealing with these types of constituents of concern, it is very difficult to ascertain the actual cause of exceedances, and even more difficult to show that the exceedances are caused by irrigated agricultural operations. In many cases, exceedances for these constituents of concern are caused by natural and other non-agricultural sources. However, based on the language in the RPA, it is possible that areas with no other water quality exceedances will be classified as Tier 2 areas and therefore be subject to more stringent reporting and monitoring requirements as compared to those in Tier 1. To avoid such consequences, we encourage that the RPA be amended to recognize that exceedances of these types of constituents will not trigger significant monitoring and regulatory compliance burdens as is required in Tier 2.

2. Tier 2 (i.e., high priority areas)

a. Surface Water

The RPA would require the development of a surface water quality management plan[2] (SQMP) for any parameter that exceeds water quality objectives two or more times in a three-year period. The exceedance trigger for the development of SQMPs, as expressed here, is not an appropriate trigger for many parameters. This requirement fails to take into account the purpose of the water quality objective at issue and the beneficial use for which it is designed to protect. More specifically, the two or more exceedances in three years is a standard derived from U.S. EPA's *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Uses* (1985 Guidelines). Thus, at most, this standard should be applied where there are two or more exceedances of water quality objectives designed to protect aquatic life beneficial uses. It is inappropriate to use this standard to trigger implementation of SQMPs where there are exceedances of water quality objectives designed to protect non-aquatic life beneficial uses. For example, many water quality objectives are for the protection of human health over a long-term period of exposure. Thus, two exceedances in three years do not necessarily mean that the beneficial use in question is being impaired. Another example is salts. Salt objectives are usually set to protect agricultural beneficial uses. Crop impacts from salt are based on salt build-up over time—not acute impacts. Thus, the requirement for a SQMP based on just two exceedances is unreasonable. This arbitrary requirement results in the unnecessary expenditure of time and resources on constituents that are not of concern considering the purpose of the objective. (RPA at p. 153.)

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[2] The SQMP would need to be developed for the watershed represented by the monitoring site.

Further, the RPA states that under the SQMP, irrigated agricultural operations are required to implement management practices to achieve BPTC. This requirement is inconsistent with the state's anti-degradation policy. As stated previously, Resolution No. 68-16 applies only to high quality waters (i.e., those achieving water quality objectives). BPTC, which is part of Resolution No. 68-16, applies only when there is a discharge to a high quality water. By virtue of the fact that a SQMP is required, the Central Valley Water Board has already determined that the water body is not a high quality water for the parameter in question, and therefore BPTC is not required.

b. Groundwater

In general, we are concerned with the requirement for third-party groups to develop and submit groundwater quality management plans (GQMPs) within 18 months of adoption of the individual area/coalition WDR. Considering the need to collect and analyze available information to identify constituents of concern and areas of concern, 18 months is not a sufficient timeframe to collect and evaluate the available information. Instead, we recommend that the RPA allow three years for the development of GQMPs in order to allow for the development of local programs to address prioritized groundwater quality problems. Further, and as discussed previously, the RPA must allow for the use of existing groundwater data to prioritize necessary and appropriate actions for addressing groundwater quality problems at the local level. Without these foundational steps, the requirements within the LTILRP may be duplicative and conflict with other local and state programs managing groundwater.

More importantly, we are concerned that the Central Valley Water Board's assessment and definition of groundwater is the first encountered groundwater. Although not specifically discussed in the Draft PEIR or the RPA, most beneficial uses of groundwater do not actually occur in the first encountered groundwater. For example, municipal supply wells must be at least 50 feet below surface, and not 10 feet. (Calif. Department of Water Resources, Calif. Well Standards, Bulletin 74-90 (June 1991).) However, tiers will be assigned based on the quality of water in the first encountered zone. The Draft Staff Report thereby makes an improper assumption that measuring discharge from irrigated lands covered by the LTILRP at the shallow first encountered groundwater level will provide an accurate picture of actual impact on the beneficial uses in that area. We do not believe this determination to be appropriate or supportable under Porter-Cologne.

In addition, the proposed measurement of groundwater in the first encountered zone fails to take into account the assimilative capacity of soil in irrigated lands governed by the LTILRP. There is considerable treatment that occurs as water makes its way through the soil profile, and in many areas it can be reasonably expected that there will be significant dilution and attenuation of constituents prior to reaching any groundwater extraction point. Furthermore, because the lands covered by the LTILRP are so varied in soil composition, the assimilative capacities of those lands also vary, and indiscriminately using first encountered

zone measurements may produce inconsistent and inaccurate results. The Draft Staff Report fails to consider this possibility. Because there is a significant possibility that a dilution of constituents will occur before discharge reaches the level at which it is put to beneficial use, and a substantial likelihood that groundwater data collected at the first encountered zone will bear little relationship to the actual impact on beneficial uses in that area, determining compliance with water quality objectives in the first encountered zone is inappropriate. The Draft Staff Report's failure to consider the potential variances in assimilative capacity of irrigated agricultural lands, the blanket use of a first encountered zone measurement to determine groundwater quality, and the Report's failure to include the possibility of measuring at mixing zones is inappropriate and potentially unsupportable under Porter-Cologne. (Wat. Code, § 13000 ["The Legislature further finds and declares that activities and factors which may affect the quality of waters of the state shall be regulated to attain the highest water quality which is reasonable . . . ."].)

c. Periodic Review of Approved SQMPs/GQMPs

The RPA would require review of SQMPs at least every two years and GQMPs every five years. Review of the SQMPs/GQMPs would include third-party groups as well as other interested parties. In general, we do not oppose periodic review of SQMPs/GQMPs with Central Valley Water Board staff. However, we believe it is unnecessary for this review process to include "other interested parties." (Draft Staff Report at p. 154.) The Central Valley Water Board represents the public interest and therefore it is unnecessary for other stakeholders to participate in reviews at this level. Further, such a requirement is unprecedented and has no legal basis. SQMPs/GQMPs are designed to identify management practices that would be appropriate and applicable for the constituent of concern and the watershed in question. Thus, Central Valley Water Board review on the sufficiency of SQMPs/GQMPs is appropriate. While the SQMPs/GQMPs are public documents once submitted to the Central Valley Water Board, they are not the type of documents that require Central Valley Water Board approval and therefore they are not subject to formal public review and comment.

Although not specified in the RPA, we anticipate the development of SQMPs/GQMPs would be required pursuant to the Central Valley Water Board's authority under Water Code section 13267. Section 13267 allows the Central Valley Water Board to require the submittal of technical and monitoring reports as long as the burden of preparing the report bears a reasonable relationship to the need for the report and the benefits to be obtained. Nothing in section 13267 requires that such reports be subject to public review or comment, or be open for discussion with other interested parties.

In all of the Central Valley Water Board's other programs, individual dischargers are not required to have management plans reviewed periodically by other interested parties. Typically, when dischargers are required to submit special studies or management plans, the plan is submitted to the Central Valley Water Board staff for review and comment, revised

based on Central Valley Water Board staff comments, and then implemented. At most, the municipal stormwater program requires that stormwater management plans be subject to public review, comment, and adoption by the Central Valley Water Board. However, this requirement for municipal stormwater management plans stems from federal NPDES permit requirements and is not applicable here. (See *Environmental Defense Center v. EPA* (9th Cir. 2003) 344 F.3d 832, 856.)

Further, by allowing other interested parties to evaluate the sufficiency of SQMPs/ GQMPs, the process may be stalled with protracted negotiations between all of the parties to determine what is sufficient. If other interested parties have concerns with the sufficiency of SQMPs/GQMPs, they may express their concerns to the Central Valley Water Board at any time without being a required entity in the periodic review process.

d. Individual Farm Water Quality Management Plans (FWQMPs)

The RPA proposes to require individual FWQMPs if objectives are not met, improvements do not occur within the approved time schedule for implementation, ***or*** where irrigated agricultural operations are not implementing requirements in SQMPs/GQMPs. In other words, FWQMPs could be required for any and/or all agricultural operations in high-priority areas. By stating that such plans could be required in any of these situations, the RPA provides no time for SQMPs/GQMPs to be developed and implemented. Further, it undermines the compliance schedule provisions in the RPA because it allows for the Central Valley Water Board to require FWQMPs even if the compliance period for the constituent of concern has not yet expired.

e. SQMP/GQMP Requirements (Appendix D)

We are also concerned with some of the language and recommendations contained in Appendix D for the ILRP Surface and Groundwater Quality Management Plan Requirements. With respect to Key Element 3, as we have stated previously, BPTC applies only to high quality waters. (See Resolution No. 68-16.) However, the SQMP/GQMP requirements would have coalitions ensure that all growers are implementing practices that achieve BPTC. If a SQMP is required, by definition, the water body is not high quality and BPTC is not triggered.

Similar to our earlier comments that the Draft Staff Report makes an improper presumption that all irrigated agriculture creates a discharge of waste, Key Elements 4-9 of the proposed requirements fail to account for the possibility that irrigated agriculture may not be the predominant source of the identified exceedances. As a general qualification, the requirements should state that *only* if irrigated agriculture is identified as the predominant source of the pollutant discharge should the Surface and Groundwater Quality Management Plan be required to (4) identify practices to address the constituents of concern, (5) evaluate the effectiveness of management practices, (6) describe the grower outreach strategies,

(7) track management practice implementation, (8) prepare a monitoring plan to track water quality, and (9) describe a schedule and milestones for the action taken. There is a real possibility that inputs from other point and non-point sources are contributing to the exceedances identified at monitoring sites, and identification of irrigated agriculture as the predominant source of the exceedances should be a prerequisite to taking the steps identified above.

In addition, Key Element 5 notes that acceptable approaches to the evaluation of management practice effectiveness include field studies at representative sites. (Draft Staff Report at p. D-1.) We are concerned that this language could be interpreted to mean that only field studies are acceptable, or that field studies represent the preferred approach by the Central Valley Water Board. To the extent that this section is susceptible to such an interpretation, we oppose the inclusion of that language in the Draft Staff Report. We are also concerned that Key Element 8 of the proposed GWQMP requirements could have serious cost implications. Specifically, a requirement that the GWQMP include ". . . other sites or a different depth to groundwater (e.g., monitor first encountered groundwater versus supply wells) or frequency of sample collection . . ." could result in significant expense. Finally, we are concerned that there is no requirement or limiting language that states schedules and milestones described in Key Element 9 of the GWQMP must be reasonable. Management practices may be difficult to adopt and in some cases are highly dependant on funding. As such, schedules and milestones created as a result of this proposed element must be reasonable, and the language of Appendix D should be changed to reflect this reasonableness requirement.

f. FWQMP Requirements (Appendix D)

As a preliminary matter, we must express concern with the standard established for approval of the FWQMP. Appendix D states, "At a minimum, plans would describe those practices needed or currently in use to achieve ground and surface water quality protection." The language "to achieve water quality protection" implies that FWQMPs need to include practices that guarantee compliance with water quality objectives. As indicated previously, we do not believe this to be the appropriate standard. Instead, the goal and purpose of FWQMPs should be to control discharges of pollutants to the maximum extent practicable. This is consistent with requirements and standards imposed on municipal stormwater discharges.

The FWQMP would require information regarding irrigation methods, acreages, and crop types. While such requirements appear to be reasonable, they fail to take into consideration the dynamic nature of farming. At best, growers can provide general information with respect to acreages farmed and the types of crops generally grown each year; however, it is not possible to account for all potential cropping patterns the grower may utilize over the next five years in an FWQMP. Further, it would not be practical or feasible to require growers to submit new FWQMPs or amendments to FWQMPs whenever farming

operations change. Likewise, it would be unreasonable and out of keeping with LTILRP goals to constrain farmers in their ability to respond to changing market conditions by altering, for example, crop choices in response to commodity price outlook.

To account for the variability and uncertainty associated with farming operations, we recommend that Appendix D be revised to require submittal of typical crop information for that agricultural operation. For example, where Appendix D would require "description of operations including, number of irrigated acres, crop types, and chemical/fertilizer application rates and practices," we recommend instead that it require similar information as follows: description of typical farming operations for the farming entity, including an estimate of irrigated acres, typical crop types, typical crop rotations, and identification of typical chemicals and/or fertilizers used for the crops identified.

If FWQMPs are required, growers should only be required to identify potential conduits of which they have knowledge or are aware. Further, as currently proposed, the requirement is extremely broad. It suggests, for example, that growers can implement actions that will prevent any contamination from entering groundwater. While we agree that management practices should be implemented to control the discharge of pollutants to the maximum extent practicable, growers cannot provide absolute certainty that the implementation of certain practices will ensure that all potential conduits do not carry contamination to groundwater. Thus, the requirement in Appendix D should be revised to state as follows: (6) identification of any potential conduits to groundwater aquifers on the property known (e.g., active, inactive, or abandoned wells; dry wells; recharge basins; or ponds) and steps taken, or to be taken, to ensure all identified potential conduits do not carry contamination to the maximum extent practicable.

Other concerns with respect to Appendix D are as follows:

- Appendix D would require the FWQMP to include maps showing the location of irrigated production areas, discharge points, and named water bodies. Similar to comments expressed previously on the informational requirements, growers can provide maps that depict typical operations. However, it is not possible to provide maps that are not subject to change due to normal operational considerations. Also, growers can identify known discharge locations, if any exist, but may not be able to depict all potential locations due to the diffuse nature of non-point source pollution. Like the informational requirements for crop types, this provision should be revised to only require maps that depict typical farming operations at the time the FWQMP is developed and submitted to the Central Valley Water Board.

- Appendix D would also require FWQMPs to include, "information on water quality management practices used to achieve general ranch/farm management objectives and reduce or eliminate discharge of waste to ground and surface waters." To better clarify the use of management practices, we recommend that the sentence be revised as follows: "applicable information on water quality

management practices used to help control the discharge of pollutants to the maximum extent practicable, achieve general ranch/farm management objectives, and reduce or eliminate discharge of waste to ground and surface waters."

- As proposed, FWQMPs would also be required to include, "measures instituted to comply with California Code of Regulations, Title 3, Section 6609 requirements for wellhead protection (from pesticide contamination) along with methods for wellhead protection from fertilizer use[]." The wellhead protection requirements from pesticide contamination are adopted, authorized, and administered by DPR. The Central Valley Water Board has no authority to determine if growers are complying with these requirements. As such, it is inappropriate for the Central Valley Water Board to require this information as part of the FWQMP. With respect to wellhead protection from fertilizer use, there currently exists no regulatory program that requires measures for such activities. Further, it would appear that such practices and/or measures would be general farm management practices to control the discharge of pollutants to the maximum extent practicable. Thus, there is no need for the FWQMP to include specific requirements for wellhead protection.

- Finally, buried in Appendix D is the following statement: "In addition to the minimum elements described above, the Executive Officer may require ground or surface water quality monitoring to evaluate the effectiveness of the practices implemented by the grower." We find it highly inappropriate to bury this important element in the appendix. By placing the information here, the Draft PEIR fails to account for and analyze potential environmental and economic impacts associated with such monitoring requirements. As a result, the economics impact assessment greatly underestimates the RPA and its potential impact to agriculture.

H. Monitoring Provisions

It is difficult to assess the monitoring provisions in the RPA because it defers establishment of monitoring requirements until such time that individual waivers or WDRs are developed. By not providing specificity with respect to monitoring requirements, the Draft PEIR is unable to adequately assess environmental and economic impacts that may be associated with such monitoring requirements. Specifically, the monitoring provisions in the RPA state that areas with insufficient information would be required to complete "assessment monitoring or studies within 5 years of long-term program adoption." However, based on such a statement, it is impossible to ascertain the extent of monitoring that may be required—especially with respect to groundwater monitoring.

In general, we are concerned with the groundwater monitoring requirements that appear to occur at the out-set of the program. As specified in Alternative 2, it is more appropriate to first rely on information from other programs and data that already exist (e.g., GAMA, DPR, CV-Salts, Department of Public Health, Department of Toxic Substances Control) to identify and prioritize the groundwater areas of concern prior to requiring expensive and unnecessary additional groundwater monitoring. Thus, it is unnecessary for agricultural coalitions and entities to conduct groundwater monitoring to identify areas of concern. Although the RPA provides for "regional groundwater monitoring," even on a regional basis, groundwater monitoring is expensive and all efforts should be made to avoid duplicative groundwater monitoring requirements.

I. Proposed Time Schedules for Compliance are Unreasonable

The RPA proposes time schedules for compliance with water quality objectives that are unreasonable. In general, the RPA states that time schedules should be set for a period of five to ten years but cannot exceed ten years. There is nothing in any statute or regulation that requires time schedules for non-point sources of pollution to be set at no more than ten years. In fact, for several of the parameters, it may be decades before compliance with water quality objectives can be achieved. Thus, it is unrealistic for the RPA to set an arbitrary time limit of ten years for compliance with water quality objectives.

More importantly, we believe it impractical to include time schedules as part of the LTILRP. While we agree that we should be implementing management practices to protect water quality and to work towards meeting water quality standards, it is not possible to ensure compliance with standards in the timeframes provided, if at all. At most, agriculture can implement management practices that are designed to protect and improve water quality. There is no guarantee or certainty that compliance with objectives will be achieved by implementing management practices, particularly as it relates to groundwater. As we indicated in our previous communications, it is essential for agriculture that a presumption of compliance be part of any LTILRP. In other words, where an operator is implementing management practices, there must be a presumption of compliance with water quality standards in general, and water quality objectives specifically.

Additionally, the time schedule language currently proposed conflicts internally. For example, in one paragraph it states that the Executive Officer or the Central Valley Water Board may modify the time schedules, while in another it states that all objectives must be achieved as soon as technically and economically possible but no later than the timeframes identified. However, as we indicated above, we do not support the inclusion of time schedules for meeting water quality standards as part of the LTILRP at this time. Thus, instead of clarifying the language, it should be deleted altogether.

J. RPA Continues to Ignore Issues Regarding Point of Compliance and Interpretation of Narrative Water Quality Objectives

At the beginning of the stakeholder process for the LTILRP, the agricultural representatives on the stakeholder committee expressed concerns with respect to the Central Valley Water Board's continued refusal to address issues regarding points of compliance in both surface and groundwater, the application of beneficial use designations through the tributary rule and the Sources of Drinking Water Policy, as well as issues surrounding the interpretation of narrative water quality objectives. The RPA continues to ignore these fundamental issues, which must be addressed. Our ability to comply with the terms of any LTILRP is contingent on the Central Valley Water Board reasonably designating beneficial uses and interpreting narrative water quality objectives. Otherwise, we are forced to protect water bodies for uses that do not exist and have no potential for existing, as well as complying with stringent and unreasonable numeric criteria that apply to beneficial uses not present in agricultural drains. Until the Central Valley Water Board is willing to openly discuss the designation of beneficial uses, appropriate points of compliance, and interpretation of narrative water quality objectives, the agricultural industry cannot fairly assess the RPA, or any future proposal for that matter.

IV. Conclusion

The agricultural coalitions, commodity groups, organizations, and water districts identified below appreciate the opportunity to comment on the Draft PEIR, RPA, and associated documents. As indicated above, we have significant concerns with the Draft PEIR and the RPA. However, we continue to believe that Alternative 2 provides the necessary protection for water quality, while allowing the various agricultural entities the ability to assist growers and the Central Valley Water Board in developing reasonable programs for the protection of surface and ground water in the Central Valley. Further, unlike the RPA, Alternative 2 has been analyzed in the Draft PEIR and therefore is less vulnerable to CEQA challenges than the RPA. Thus, we encourage the Central Valley Water Board to consider the comments provided above, and recommend Alternative 2 as the preferred alternative for Central Valley Water Board consideration.

If you have any specific questions with respect to these comments, please contact Theresa "Tess" A. Dunham at (916) 446-7979. Thank you.

Sincerely,

California Farm Bureau Federation
California Rice Commission
East San Joaquin Water Quality Coalition
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Modesto Irrigation District
Oakdale Irrigation District
Sacramento Valley Water Quality Coalition
San Joaquin County Resource Conservation District / Delta Water Quality Coalition
South San Joaquin Irrigation District
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Western Plant Health Association
Westside San Joaquin Water Quality Coalition

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Irrigation cooling effect: Regional climate forcing by land-use change

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Received 6 November 2006; accepted 29 December 2006; published 7 February 2007.

[1] Regional detection of a greenhouse warming signal relies on extensive, long-term measurements of temperature. The potentially confounding impact of land-cover and land-use change on trends in temperature records has mostly focused on the influence of urban heat islands. Here we use a regional climate model to show that a regional irrigation cooling effect (ICE) exists, opposite in sign to urban heat island effects. The magnitude of the ICE has strong seasonal variability, causing large dry-season decreases in monthly mean and maximum temperatures, but little change in rainy-season temperatures. Our model produced a negligible effect on monthly minimum temperature. In California, the modeled regional ICE is of similar magnitude, but opposite sign, to predictions for future regional warming from greenhouse gases. Given our results for California and the global importance of irrigated agriculture, past expansion of irrigated land has likely affected observations of surface temperature, potentially masking the full warming signal caused by greenhouse gas increases. **Citation:** Kueppers, L. M., M. A. Snyder, and L. C. Sloan (2007), Irrigation cooling effect: Regional climate forcing by land-use change, *Geophys. Res. Lett.*, *34*, L03703, doi:10.1029/2006GL028679.

1. Introduction

[2] Biogeophysical changes associated with land-cover and land-use change are known to alter local, regional and global climate. For example, conversion of natural vegetation to croplands can increase or decrease temperature depending on whether conversion occurs in tropical or temperate areas, and can increase or decrease humidity depending on the type of natural vegetation replaced, and the type of crops established [*Bounoua et al.*, 2002]. Discussion of the impact of land-cover and land-use change on trends in observational climate records has mostly focused on the influence of urban heat islands [*Kalnay and Cai*, 2003; *Parker*, 2004; *Trenberth*, 2004]. However, irrigated agricultural land is more widespread than urban land, and has significant potential for altering climate. Irrigated land is particularly extensive in semi-arid regions, where lack of reliable rainfall has resulted in diversion of water to supplement soil moisture. Irrigation can alter climate by reducing soil albedo, increasing transpiration and evaporation, and enabling higher leaf areas than would otherwise be possible. Short-term model sensitivity tests [*Adegoke et al.*, 2003; *Segal et al.*, 1998; L. M. Kueppers et al., Seasonal temperature responses to land-use change in the western United States, submitted to *Global and Planetary Change*, 2007, hereinafter referred to as Kueppers et al., submitted manuscript, 2007] and observational analyses [*Barnston and Schickedanz*, 1984] suggest potentially significant impacts of irrigation on local clouds, precipitation and temperature. Few studies have focused on persistent multi-year climate effects of irrigated agriculture [*Boucher et al.*, 2004; *Lobell et al.*, 2006a, 2006b], and to date these have been global in scale.

[3] Irrigated land area has expanded rapidly over the last 200 years. In 1800, irrigation occupied ~8 million hectares globally, increasing to 40 million hectares in 1900, to 100 million hectares by 1950 [*Postel*, 1999], and to more than 270 million hectares in 2000 [*Siebert et al.*, 2005]. In the United States (U.S.), irrigation began with the settling of the western states. By 1900, irrigated area occupied 3.2 million hectares of the western U.S. [*Postel*, 1999], expanding to 14.8 million hectares by 1974 [*Frederick and Hanson*, 1982]. A large fraction of the West's irrigated land lies in California, where 81,000 hectares in 1878 expanded to more than 1.8 million hectares in 1928 [*Pisani*, 1984]. Irrigated area in California continued to grow through the mid-20th century, with an increase of 650,000 hectares between 1945 and 1974 [*Frederick and Hanson*, 1982], but has recently stabilized at ~3.3 million hectares (1974–1997 mean, $n = 7$ census estimates) [*National Agricultural Statistics Service*, 2004].

2. Experimental Design and Model Description

[4] We conducted a regional climate model (RCM) sensitivity experiment to quantify the climate effect of irrigated agriculture in California, reporting here the difference between two 20-year model runs differing only in the characteristics of the land surface. We took an RCM approach because local to regional climate impacts of land-use change are often pronounced, while globally averaged changes and remote climate effects due to atmospheric teleconnections are relatively small [*Bounoua et al.*, 2002; *Chase et al.*, 2000]. An RCM approach also allows land surface (including land use) heterogeneity to be better represented.

[5] The first run (MOD) used a modern vegetation distribution (circa 1990) that included both irrigated and non-irrigated agriculture, as well as urban land. Because irrigated area did not change systematically during the time period of our study, we held irrigated area constant in the MOD case. The second run (NAT) used potential natural vegetation, and did not include any agricultural or urban land cover types. To characterize modern land cover we used the Global Land Cover Characteristics database, version 2.0, which determines land use and land cover categories for each 1-km pixel based on 1992–1993 AVHRR data [*Loveland et al.*, 2000]. To characterize

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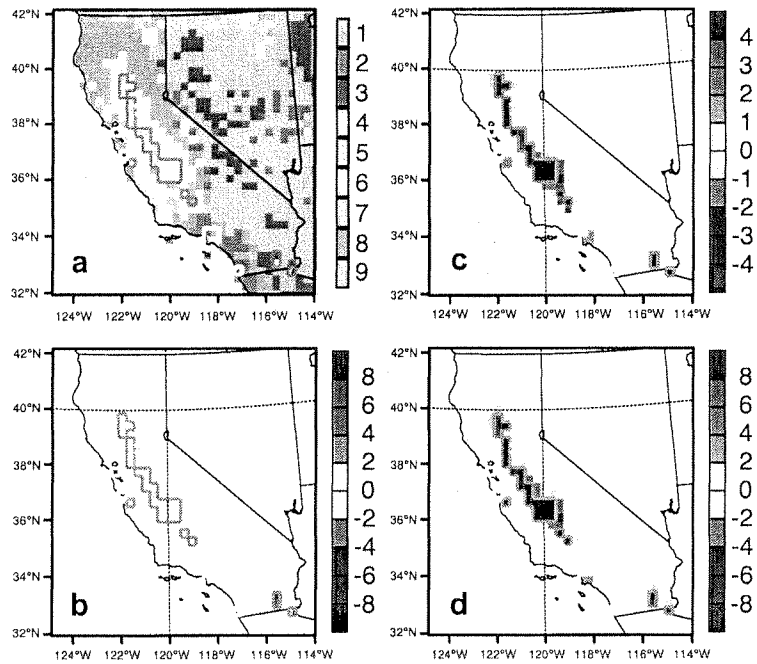

Figure 1. (a) Potential natural vegetation used in the NAT case, with grid cells replaced by irrigated agriculture in MOD outlined in gray, and grid cells replaced by urban areas in MOD outlined in white. Vegetation types are 1) semi-desert, 2) evergreen shrub, 3) desert, 4) short grass, 5) tall grass, 6) mixed woodland, 7) deciduous broadleaf trees, 8) evergreen needleleaf trees, and 9) tundra. Difference (MOD-NAT) in August (b) Tmin, (c) Tmean, and (d) Tmax (°C), with outlines as in Figure 1a and with only statistically significant ($p < 0.05$, $n = 20$ years) differences shown.

potential natural vegetation we used the natural land cover described by Kueppers et al. (submitted manuscript, 2007), which assigned modern agricultural and urban pixels to natural types based on a nearest-natural-neighbor approach. We compared the result to the potential natural vegetation map by *Ramankutty and Foley* [1999], to ensure consistency.

[6] We used the International Center for Theoretical Physics (ICTP) Regional Climate Model, RegCM3 [*Pal et al.*, 2007]. RegCM3 is a third-generation regional-scale climate model derived from the National Center for Atmospheric Research-Pennsylvania State (NCAR-PSU) MM5 mesoscale model. RegCM3 has the same dynamical core as MM5, the CCM3 radiative transfer package, and the Biosphere-Atmosphere Transfer Scheme (BATS) land surface model. Improvements to RegCM3 over previous versions include a new large-scale cloud and precipitation scheme, SUBEX, a new ocean flux parameterization, and the availability of a new cumulus convection scheme. RegCM has been validated against observations of modern-day climate in the domain studied here, and does a good job of simulating spatial and temporal climate features [*Bell et al.*, 2004; *Snyder et al.*, 2002].

[7] RegCM3 represents vegetation as a single layer canopy with irrigated crops having fairly low roughness length, low stomatal resistance, leaf area similar to grassland and forest, and albedo similar to deciduous broadleaf trees. To mimic the effects of irrigation, RegCM3 forces root zone (top 1 m for irrigated crops) soil moisture to field capacity at every time step, year round. This assumes that irrigated agricultural land is managed to have high water availability at all times of year, independent of crop cycles. In the absence of spatially and temporally explicit data, we believe this to be a reasonable approximation since much of the study region supports a year round growing season. Where there is no irrigation, the land surface model determines soil moisture as a function of precipitation, evapotranspiration, and soil properties, allowing drainage and runoff.

[8] For both MOD and NAT model runs, we used a domain centered at 37.5°N/121.5°W, spanning 28.5°N to 47.0°N and 110.5°W to 132.0°W with a horizontal resolution of 30 km, used NCEP/DOE Reanalysis II [*Kanamitsu et al.*, 2002] as lateral boundary condition data, and used National Oceanic and Atmospheric Administration Optimally Interpolated Sea Surface Temperatures [*Reynolds et al.*, 2002]. We held atmospheric CO_2 concentrations constant at 355 ppm. We discarded the first two years of the January 1979 – December 2000 model runs as equilibration time, and report results from the final 20 years (January 1981 – December 2000) as differences between the two cases (MOD-NAT).

3. Results

[9] Over the 20-year time period of the RCM sensitivity experiment, August mean and maximum temperatures were, on average, 3.7 ± 0.2 and 7.5 ± 0.3°C lower, respectively, where natural vegetation was converted to irrigated agriculture (Figure 1 and Table 1). August minimum temperatures were 0.9 ± 0.2°C lower, although this effect was less geographically consistent; in most grid cells, minimum

Table 1. Climate Differences Between Model Cases in Irrigated Areas[a]

	Tmean, °C		Tmin, °C		Tmax, °C		SMT, mm		LHFS, W/m^2		SHFS, W/m^2		RH, %	
	Mean	s.e.m.	Mean	s.e.m.	Mean	s.e.m.	Mean	s.e.m.	Mean	s.e.m.	Mean	s.e.m.	Mean	s.e.m.
Jan	0.02	0.07	0.25	0.05	−0.4	0.1	3.8	0.8	5	2	−3	1	0.01	0.01
Feb	−0.07	0.09	0.18	0.06	−0.5	0.2	3.8	0.9	9	4	−6	3	0.02	0.01
Mar	−0.27	0.13	0.10	0.09	−1.0	0.2	**5.8**	0.9	20	6	−15	5	0.04	0.01
Apr	−1.13	0.16	−0.07	0.13	−3.0	0.2	**13.1**	0.6	**63**	7	**−48**	6	**0.11**	0.01
May	−2.07	0.16	−0.40	0.14	**−4.6**	0.2	**17.7**	0.4	**108**	7	**−86**	5	**0.17**	0.01
Jun	**−3.09**	0.17	−0.78	0.16	**−6.1**	0.2	**20.9**	0.3	**147**	6	**−116**	5	**0.22**	0.01
Jul	**−3.78**	0.18	−0.96	0.16	**−7.3**	0.2	**22.5**	0.2	**163**	5	**−127**	4	**0.25**	0.01
Aug	**−3.69**	0.19	−0.86	0.16	**−7.5**	0.3	**22.7**	0.3	**147**	4	**−114**	4	**0.25**	0.01
Sep	**−3.02**	0.15	−0.65	0.13	**−6.7**	0.2	**21.3**	0.2	**108**	4	**−81**	3	**0.23**	0.01
Oct	**−1.85**	0.13	−0.31	0.08	**−4.4**	0.2	**17.7**	0.3	**58**	4	**−42**	3	**0.17**	0.01
Nov	−0.38	0.11	0.10	0.06	−1.3	0.2	8.8	0.8	14	3	−10	2	0.05	0.01
Dec	0.01	0.07	0.27	0.06	−0.5	0.1	5.4	0.8	6	2	−3	1	0.02	0.01

[a]Mean differences between cases (MOD-NAT) and standard error of the mean differences (s.e.m.) were calculated from 20-yr averages in grid cells irrigated in MOD (n = 30 grid cells). Bold values indicate months when all 30 grid cells had statistically significant ($p < 0.05$) changes between cases (n = 20 years for each grid cell). Tmean, mean temperature; Tmin, minimum temperature; Tmax, maximum temperature; SMT, top layer (0–10 cm) soil moisture; LHFS, latent heat flux; SHFS, sensible heat flux; and RH, relative humidity.

temperature did not change significantly (Figure 1 and Table 1). There was a latitudinal trend in the size of the effect; southern irrigated areas generally had larger temperature decreases, relative to northern areas (Figure 1). This trend corresponds with general trends in temperature and precipitation, with southern areas being warmer and drier than northern areas. The modeled decreases in temperature were accompanied by large increases in relative humidity (25 ± 1%, absolute change), as well as a shift away from sensible and toward latent heat fluxes (Table 1).

[10] The irrigation cooling effect (ICE) was not confined to the near-surface atmosphere in irrigated grid cells, but spread to adjacent grid cells and the lower troposphere via advection of the relatively cooler, moister air (note statistically significant differences in unmodified grid cells in Figures 1 and 2). For California as a whole, the model produced a net decrease of 0.38 ± 0.05°C in August mean temperature due to land-use change.

[11] The ICE also led to changes in regional circulation. During the warm summer months in California's Central Valley, daytime heating of the surface typically results in unstable conditions; the rising air draws in cooler air from western coastal areas. The decrease in surface temperatures stabilized the atmosphere, reducing the strength of the westerly land-sea breeze by 25 to 75 cm/s (−20 to −40%) along the western margin of the Central Valley. The presence of irrigation in the Central Valley also generated inland breezes [*Seth and Giorgi*, 1996] due to the contrast between the relatively cool, moist irrigated areas and adjacent warm, dry natural vegetation. Inland airflow of up to 50 cm/s (+10 to +20%) appeared in the southern part of the Central Valley, where the temperature and humidity effects of irrigated agriculture were most pronounced (Figure 2). No significant changes in precipitation or clouds were detected.

[12] While the RCM produced the most widespread climate changes in the month of August, statistically significant changes occurred year round for maximum temperature, relative humidity, and sensible and latent heat flux, primarily in southern California's Imperial Valley. The temporal pattern of the ICE in this Mediterranean-like region is most pronounced in the warm, dry summer months, minimal in the cool, wet winter months, and intermediate, but still significant in many areas, in spring and fall (Table 1). From year to year, variation in large-scale atmospheric flow can influence the magnitude of cooling produced by the model, since the size of the ICE is partially dependent on the difference in soil moisture available for evapotranspiration between the two cases. Summers following relatively wet winters (defined as total Dec–Mar precipitation >1σ above mean 1981–2000 levels) tend to have less pronounced cooling from irrigation than other summers (i.e., the maximum drop in temperature from NAT to MOD model cases is smaller following wetter winters) (Figure 3). Over all years, the maximum cooling is positively related to Dec–Mar precipitation ($r = 0.77$), with drier years having a larger cooling effect. Thus, the ICE is most pronounced

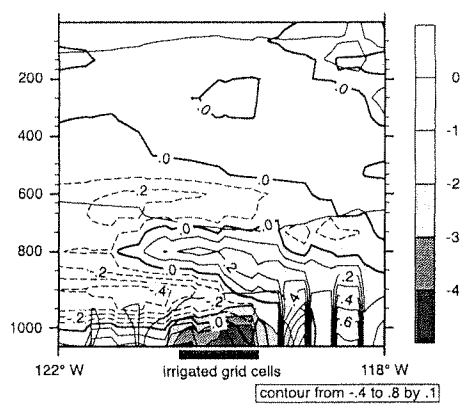

Figure 2. Vertical cross-section of modeled atmospheric temperature difference (color fill; °C), and difference in wind velocity (black contours; m/s) between model cases (MOD-NAT) along a line of constant latitude (36.4 deg N). Decreases in wind velocity are shown with dashed contours, and increases are shown with solid contours. RegCM3 has 18 vertical levels in the atmosphere that were interpolated to pressure levels (mb) for plotting. The longitudinal extent of the irrigated region is shown with the black box below the x-axis.

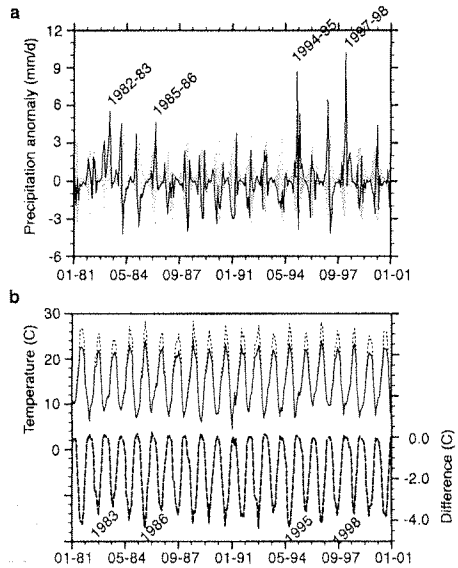

Figure 3. From January 1981 to December 2000, (a) mean monthly precipitation deviations from 1981–2000 monthly means (solid line), with the shaded area representing one standard deviation from the monthly means; and (b) monthly temperature in the MOD case (solid) and NAT case (short-dash), with the difference between cases (MOD-NAT) shown below (heavy long-dash). All monthly values are spatial averages over grid cells that are irrigated in the MOD case (n = 30). Individual years with relatively high December–March precipitation and small maximum temperature differences are noted (see text).

during warm, dry times of the year, and during relatively warm, dry years, and vice versa.

4. Discussion and Conclusions

[13] The actual magnitude of the ICE for this region or the many other agricultural regions around the world is not known. This study used a single RCM to estimate the climate effects of irrigated agriculture. Like all climate models, RCMs have differing sensitivity to climate forcings. In a 1-year RCM intercomparison study, using the same land surface cases as in the current study, we found that RegCM3 had relatively high sensitivity to irrigation, and underestimated temperatures in irrigated regions compared to a global gridded observational dataset (Kueppers et al., submitted manuscript, 2007). The experiment reported here used an idealized representation of irrigation, forcing soil moisture to field capacity at all times. Finally, we focused our study on a single region – California – where mechanized irrigation has resulted in a large area that is intensely irrigated. Irrigation in other regions is likely a mix of mechanized sprinklers, flooded fields, ditch irrigation, and drip irrigation. The amount of water added to the soil, and period of elevated soil moisture, varies considerably around the world. In spite of these caveats, we believe that the ICE portrayed here is qualitatively correct.

[14] As with the urban heat island effect, understanding the spatial and temporal "fingerprint" of the ICE may be critical for detecting greenhouse gas-driven climate change. In California, 626 (76%) of the National Oceanic and Atmospheric Administration Cooperate Observer Program climate stations (73% of total stations) are located in areas with some irrigated agriculture [*Siebert et al.*, 2005]

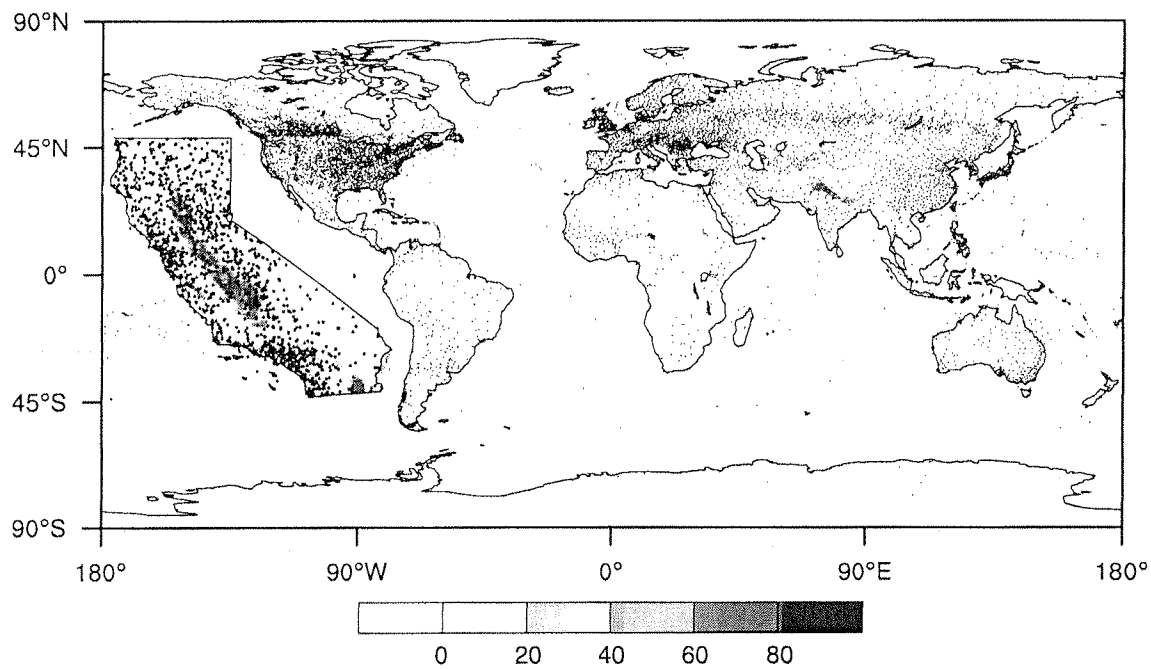

Figure 4. Global irrigation intensity [*Siebert et al.*, 2005] represented by the percent of irrigated area in each grid cell, plotted together with the locations of climate stations used by a global observational dataset [*Willmott and Matsuura*, 2001]. California climate stations active between 1995 and 2000 are shown in the inset.

(Figure 4, inset). A recent analysis across multiple observational datasets detected consistent positive trends (1950–2000) in winter through summer minimum temperatures, and in winter mean and maximum temperatures in California (C. Bonfils et al., Identification of external influences on temperatures in California, submitted to *Climatic Change*, 2007). Consistent trends in mean and maximum temperature were absent spring through autumn. We found mean and maximum temperatures between the months of May and October to be most influenced by the ICE in irrigated areas, and found few significant changes in minimum temperatures at any time of year. Based on our findings, one interpretation of Bonfils et al. is that over the 50 year period of their study, and where irrigation extent was increasing concurrently with greenhouse gas concentrations, land-use change provided a seasonally variable regional climate forcing opposite to greenhouse forcing.

[15] Greenhouse gas increases coincided with the expansion of irrigation in California from the late 19th century to the late 20th century, a longer period than the 50 years of the Bonfils et al. study. While increasing greenhouse gas concentrations may have increased temperatures over the last 150 years [*Intergovernmental Panel on Climate Change*, 2001], expanding irrigation may have introduced a countervailing temperature effect over at least part of the same time period, limiting detection of a global (greenhouse) warming signal in observations of temperature. Finally, in California, the modeled regional ICE is of similar magnitude, but opposite sign, to predictions for future regional warming from greenhouse gases [*Snyder et al.*, 2002; *Snyder and Sloan*, 2005]. Irrigated area has currently stabilized, but if it declines due to lack of sufficient water supply or conversion of irrigated agriculture to urban land, greenhouse gas-driven warming may be reinforced by regional land-use change.

[16] In addition to California, India, China, the Black Sea region, and the Great Plains of the United States have large areas under irrigation, with 53% of stations in one global observational dataset occurring in irrigated areas [*Siebert et al.*, 2005; *Willmott and Matsuura*, 2001] (Figure 4). Our results suggest that the climatic effects of irrigation can be relatively large on a regional scale. We hypothesize that past expansion of irrigation may have masked regional increases in temperature due to greenhouse gas increases. As a result, the true impact of greenhouse gas increases may have been underrepresented by temperature observations. Without accurate time-series data on the historic extent and amount of irrigation, it is impossible to estimate how the ICE may have changed over longer time periods, and in other regions. Development of such datasets is critical for quantifying the global influence of irrigation on trends in climate.

[17] **Acknowledgments.** We thank M. Tyree for helping generate the potential natural vegetation dataset, L. Edwards, C. Willmott and K. Matsuura for providing climate station locations, and C. Bonfils, W.J. Riley and H. Kanamaru for helpful conversations. This study was supported by grants (to L.C.S.) from the California Energy Commission, the National Science Foundation, and the D. and L. Packard Foundation.

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Sincerely,

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