Comment Letter 1

California Rice

February 18 2014

Ms. Margaret Wong
California Water Quality Control Board
Central Valley Region
11020 Sun Center Drive, Suite #200
Rancho Cordova, California 95670

SUBJECT: Tentative Waste Discharge Requirements General Order for Sacramento Valley Rice Grower

Dear Ms. Wong:

The California Rice Commission (CRC) appreciates the opportunity to comment on the Tentative Waste Discharge Requirements General Order for Sacramento Valley Rice Growers (Tentative WDR), and its associated attachments. We also appreciate the significant time and effort that you and your staff have spent with the CRC in developing the terms of the Tentative WDR and its attachments, in particular Attachment A (Tentative Information Sheet) and Attachment B Tentative Monitoring and Reporting Program (Tentative MRP). Overall, the CRC finds the Tentative WDR, Tentative Information Sheet and Tentative MRP to be a reasonable approach for protecting surface water and groundwater from discharges of waste associated with the production of rice in the Sacramento Valley.

Our comments provided here address a few remaining issues that we believe need to be resolved to ensure reasonable and consistent compliance with the orders by the CRC and its members. Our comments also respond to and address comments from the City of Sacramento's Department of Utilities, submitted to you on September 13, 2013, and in response to the administrative draft version of the waste discharge requirements. As you know, the CRC and representatives from the City of Sacramento (City) have met on several occasions in an attempt to resolve the concerns expressed by the City. These meetings have allowed us to resolve some of those concerns. The CRC provides responses to the City's comments here to ensure that the administrative record contains accurate information with respect to issues raised by the City in their letter dated September 13, 2013. In general, CRC does not have significant concerns with the tentative documents. However, there are several recent revisions upon which the CRC

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finds it necessary to comment.[1] Our comments on the relevant documents are provided below.

I. CRC Comments on Tentative WDR

- **Provision IV.B.16** has been revised to remove the ability of the CRC to provide growers with an approved summary of the Order's requirements, to be maintained at the Grower's primary place of business. Further, the requirement has been expanded to also require Growers to maintain relevant excerpts of the Order as provided by the Executive Officer and requires that such excerpts be available at all times to operations personnel.

  With respect to removal of an approved summary, the CRC has conveyed previously to Regional Board staff that a well-written summary would provide more benefit to a Grower rather than the Order as adopted by the Regional Board. Orders are written in a certain way that accomplishes the Regional Board's needs, however, as written they provide little clear direction to a Grower that is implementing the mandated provisions. Thus, a well-written summary (that is approved by the Regional Board staff) would be much more useful than requiring that the Order itself be maintained at the Grower's primary place of business.

  1-1

  With regard to maintenance of relevant excerpts, the CRC does not believe that it is feasible and practical for Growers to maintain such excerpts so that they are available at all times. Such a requirement does not account for the fact that often operations personnel are on tractors or harvesters in the field, and not at the primary place of business. Considering that most personnel work directly in the field, it is not practical that certain excerpts be available to them at all times. It is appropriate for Growers to make them reasonably available (e.g., at the shop or office), but not feasible for such excerpts to be maintained on a tractor, harvester, or other farm equipment.

  Accordingly, CRC requests that the most recent revisions to the Tentative WDR be rejected and that the original language from the administrative draft version of the WDR be adopted.

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- **Provision IV.C.3** has been revised to require that the CRC must provide confirmation to the "board of each notification." As drafted, this suggests that

[1] CRC's comments are provided on the Underline/Strikeout Version of the tentative documents as posted on the Regional Board's website on January 17, 2014. Thus, the page numbers and references provided are to the underline version of the document and may not coincide with other posted versions.

the CRC would need to provide the Regional Board notification of each individual Grower within a watershed or sub-watershed area. The CRC does not believe that it is the Regional Board's intent to require such notification, but that the CRC needs to let the Regional Board know when the notification required by this provision has been completed. Accordingly, we recommend that the sentence be revised as follows: "The California Rice Commission must inform the Regional Board when it has provided notification as required by this paragraph."

1-3
- **Provision IV.C.7** has been revised to delete the CRC's ability to prepare a summary of the Order for its Growers and have the summary approved by the Executive Officer of the Regional Board. Similar to our comments above for Provision IV.B.16, the removal of this option is troubling in that it was designed to provide Growers with a useful summary of the Order and its relevant requirements versus having Growers discern what is being required by the Order as adopted by the Regional Board. Again, we recommend that the proposed changes be rejected and that the original language be restored.

II. CRC Comments on Tentative Information Sheet

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- **Page 23, Footnote 38** - The CRC does not support inclusion of footnote 38 as written. Rather, CRC recommends that the footnote be revised as follows: "Pesticides to be monitored includes the parent compound and any environmentally stable degradates of the registered active ingredient. The evaluation factor applies to the parent compound and degradates, which constitutes the total registered pesticide. Potential pesticides to evaluate will be identified through the rice specific process."

1-5
- **Page 31, Section C** - The final GAR was submitted on or about August 2013. The exact date is not relevant. Thus, we recommend that the sentence in question be revised as follows: "A final GAR was submitted ~~2~~ in August 2013 based on staff comments and is available to the public as part of this Order."

1-7
- **Page 41, Section E** - The newly inserted language references the USGS shallow rice wells as identified in Section D.3 as those that will be monitored by the CRC. To ensure that the Tentative Information Sheet properly references which USGS shallow rice wells will be monitored, we recommend that the reference in the Information Sheet be to the wells as identified in Table 5 of the Tentative MRP. Reference to the MRP is more accurate than the general discussion of USGS shallow rice wells contained in the Tentative

Information Sheet. Accordingly, the relevant sentence in the Tentative Information Sheet should be revised as follows: "The USGS shallow rice wells identified in Table 5 of Attachment B to Order R5-2014-XXXX ~~Section D.3 above~~ shall be monitored annually, with all wells monitored the first year, then half of the wells monitored in the second year and the remaining wells the next."

- **Page 42, Section F** - Minor editorial corrections are needed to the following sentences:

  - "Executive Officer approval indicates that concurrence with the GQMP
    is consistent with the waste discharge requirements and ~~that~~ that the
    proper implementation of the identified practices (or equivalently
    effective practices) should result in addressing the water quality
    1-6 problem that triggered the preparation of the GQMP."
  - "The main elements of GQMPs are to . . . , C) considering elements A and B, develop a strategy and milestones to implement practices to ensure discharge from rice fields ~~discharges~~ are meeting Groundwater Limitation III.B.1, ..."

- **Page 48, Section XV** - The Tentative Information Sheet states that the
  Regional Board must establish limitations using one of three specified
  sources. The language included here is not applicable to discharges from rice
  fields, and is not applicable for establishing receiving water limitations. The
  language referenced in the Tentative Information sheet comes directly from
  section 122.44(d)(1)(vi) of the Code of Federal Regulations, Title 40. This
  section of the Code of Federal Regulations specifically applies to the
  establishment of water quality based effluent limitations in federal National
  1-8 Pollutant Discharge Elimination System (NPDES) permits. The Clean Water
  Act (CWA) exempts discharges from irrigated agriculture from the mandates
  of section 402 of the Act that require NPDES permits. (See 33 U.S.C. §1342(l).)
  Accordingly, such federal regulatory provisions relevant only to NPDES
  permits do not apply here and references to such provisions need to be
  deleted from the Tentative Information Sheet.

- **Page 67, section (c)** - The proposed new language includes reference to
  "irrigated lands" as a potential source of concern. Since this Order is specific
  1-9 to discharges from rice growing operations, the reference to irrigated lands
  needs to be narrowed to reference "rice fields" rather than "irrigated lands."

III. CRC Comments on Tentative MRP

1-4 • **Page 4, Footnote 6** - See comment above regarding page 23 and footnote 38.

1-10 • **Page 11, Section A** - The final Groundwater Assessment Report (GAR) was submitted to the Regional Board in August of 2013 - not May of 2013. Thus, the reference to 31 May 2013 needs to be revised.

1-11 • **Pages 4-7, Section V, Annual Monitoring Report** - The Tentative Order for the non-rice acreage in the Sacramento Valley Watershed includes a report component (#18) that requires an evaluation of monitoring data to determine if there are any trends in degradation that may threaten beneficial uses. To the extent that the proposed AMR components in the CRC's Tentative MRP do not include such an analysis, the CRC believes that such an analysis would be appropriate no more frequently than once every three years. Considering the significant amount of data that the CRC has collected over the last twenty years, combined with many special studies and the consistent nature of rice farming, it is not necessary to conduct such a trend analysis on an annual basis.

1-12 • **Page 7, Section A** - As proposed, the rice pesticide evaluation language is confusing in that it combines mandatory terms such as "shall" with reference to consideration of factors that are examples of what should be considered. To avoid confusion, the CRC recommends that the sentence be revised as follows: "The evaluation ~~shall~~ should consider various factors, such as: . . . ."

1-13 • **Page 9, Section VII** - For the sake of clarity, we recommend that a footnote be added after the following sentence: "Table 7 of this MRP lists Basin Plan numeric water quality objectives and NTR/CTR criteria for constituents of concern that may be discharged by Growers." The footnote should state, "The Basin Plan includes additional numeric water quality objectives that may also be applicable to the receiving waters."
1-14 Further, the reference to "degradates" should be removed.

IV. CRC Responses to City's September 13, 2013 Comments

In general, the City of Sacramento expresses concerns with pollutants that may be discharged from rice growing operations in the Sacramento Valley, and that might impact source water supplies used by the City of Sacramento. Due to this concern, the City advocates for additional monitoring. While the CRC understands and appreciates their concerns, the CRC believes that the proactive approach taken by the CRC and its growers over the last several decades to implement both the Rice Pesticide Program and the waiver from waste discharge requirements is protective of water quality and shows that discharges from rice growing operations do not discharge constituents of concern at levels that would impact the City's source waters. For example, as explained in the Tentative Information Sheet, the CRC submitted a comprehensive Surface Water Assessment Report (SAR) in May of 2012 that summarized and assessed all readily available water quality information associated with rice growing operations. (Tentative Information Sheet, p. 18.) This assessment provided the basis for the monitoring and reporting program contained in the Tentative MRP. Considering the level of analyses conducted in the SAR and the long history of monitoring data, it is unnecessary for the Tentative WDR and associated documents to be revised to increase the level of monitoring. Our specific responses to their comments are provided here:

A. Adaptive Management

The City commented that "it is important to include adaptability during its 5 year cycles" because of the long-term nature of the Tentative WDRs. The CRC agrees in general that the irrigated lands program needs to be adaptive, and we believe that the Tentative WDR and Tentative MRP provide for such necessary adaptability. First, the Regional Board maintains discretion and authority to review the terms of the Tentative WDR and its attachments at any time. In fact, the California Water Code requires the Regional Board to periodically review WDRs once they are adopted. (See Wat. Code, § 13263; see also Tentative WDR, p. 24 ["The Central Valley Water Board will review this Order periodically and will revise the Order when necessary."].)

Moreover, the Tentative WDR requires the CRC to submit an annual monitoring report (AMR) to the Regional Board by December 31 of each year, and such reports will be made available for public inspection. (Tentative WDR p. 28.) The AMR must include specific information as is detailed in the Tentative MRP. Based on its review of this information, the Tentative WDR provides the Executive Officer with discretion to require additional technical reports to determine the effects of rice operations or implemented management practices on surface water or groundwater. (Tentative WDR, p. 30.) The MRP may also be revised by the Executive Officer as necessary. (Tentative MRP, p. 1.) Considering the reporting requirements, ongoing review of implementation of the program, the public availability of all reports submitted to the Regional Board, and Executive Officer discretion to revise the MRP as necessary, the CRC believes that the irrigated lands program is adaptable and that no further revisions are necessary to address this comment.

B. Antidegradation

The City's comments suggest that the surface water monitoring program contained in the administrative draft version of the monitoring and reporting program (which is almost identical to the version contained in the Tentative MRP) is not sufficient to ensure compliance with the state's antidegradation policy (otherwise known as Resolution No. 68-16, *Policy for Maintaining High Quality Waters*). The CRC disagrees with the City's comments.

First, the City specifically comments, "the program must be structured such that a trend of degradation alone provides the basis for initiating a response." (City's Comments, p. 3.) In fact, the Tentative WDR does include triggers for responses based on trends in degradation. For example, a surface water quality management plan shall be developed if "the Executive Officer determines that rice lands may be causing or contributing to a trend of degradation of surface water that may threaten applicable Basin Plan beneficial uses." (Tentative WDR, p. 29.)

Second, the City appears to suggest that the surface water monitoring program may not be sufficiently robust "in terms of locations, constituents, and frequencies, . . . to detect degradation trends, ..." (City's Comments, p. 3.) The CRC disagrees with this statement and does believe that the monitoring program in the Tentative MRP is sufficiently robust for all of those purposes. As a preliminary matter, the CRC has been monitoring surface water for a number of different parameters for over 30-years. This monitoring started prior to the irrigated lands program and provides significant information with respect to how rice acreage in the Sacramento Valley may, or may not, impact surface water quality. With respect to the Tentative MRP's proposed monitoring program, it includes appropriate monitoring locations that provide representative data for various rice production areas in the Sacramento Valley, and includes three types of monitoring to be conducted on a five-year rotation cycle. (Tentative MRP, pp. 2-6.) The list of constituents and schedule are also appropriate to determine if there is a trend in degradation caused by rice production. Specifically, both the list of parameters to be monitored and the schedule for monitoring are based on and are directly related to rice production activities. For example, pesticides selected for monitoring need to be monitored during the months of peak application and/or when release occurs. (Tentative MRP, p. 6.)

Rice farming in the Sacramento Valley has been stable and static for over 30 years because there is no significant variance in the acreage as well as the cultivation practices from year to year. Accordingly, the historical data combined with new data clearly provides sufficient information to determine trends of degradation that could be associated with rice production.

Next, the City also questions the findings in the Tentative WDR with respect to maximum benefit to the people of the state. The City's concerns appear to be based on a belief that the degradation allowed by the Tentative WDR could potentially exceed drinking water standards and impose additional costs on the City for treatment of its drinking water. Such a belief is misplaced because the Tentative WDR requires that discharges from rice acreage in the Sacramento Valley not exceed applicable water quality standards, which includes drinking water standards. (Tentative WDR, p. 18.) To the extent that discharges may exceed such standards, the CRC and its members are required to develop and implement surface water quality management plans. Under such plans, compliance with standards must be achieved as soon as practical but not to exceed up to ten years. Further, considering the importance of the rice industry to California, and the world, the Tentative WDR properly includes findings that it is in the maximum benefit to the people of the state to allow some degradation. Because degradation cannot exceed water quality standards, it is highly unlikely and speculative to believe that discharges from the rice industry would potentially trigger the need for new treatment for the City. Accordingly, the findings in the Tentative WDR are appropriate, and supported by substantial evidence.

At the end of its antidegradation comments, the City also states that Resolution No. 68-16 requires "intergovernmental coordination" with affected local, state, and Federal agencies. (City's comments, p. 5.) The City refers to this being in State Water Resources Control Board (State Board) guidance. However, the City does not indicate what guidance document mentions such intergovernmental coordination. More importantly, guidance is just that - guidance. While it can be instructive to regional boards in general, it is not a properly adopted regulation. The controlling policy here is Resolution No. 68-16 as adopted by the State Board. The policy contains no mention of "inter-governmental coordination." Accordingly, such coordination is not required or mandated by the policy. Regardless, the Tentative WDR and Tentative MRP include numerous opportunities for all interested stakeholders to review reports and documents prepared by the CRC, including a rice specific process for determining what are the appropriate pesticides for monitoring under this program. Considering the many provisions contained in the Tentative WDR and MRP for stakeholder input, it is not necessary for the orders to be further revised in the manner as suggested by the City.

For this, and other reasons clearly articulated in Tentative Information Sheet, the Regional Board has made the appropriate findings necessary to allow degradation to high quality waters.

C. Opportunity for Participation/Interested Party/Availability of Electronic Information

As indicated immediately above, the Tentative WDR and Tentative MRP include significant opportunities for stakeholder review and input on the many reports and documents being required by these collective orders. Regional Board staff has clearly indicated to the CRC that their review process of documents will be a transparent process, and that all reports submitted by the CRC to the Regional Board's Executive Officer will be posted electronically on the Regional Board's website. Related to that, the Regional Board has recently revamped its website to make it easier for stakeholders to locate information relevant to this program. Considering the provisions currently proposed in the Tentative WDR and Tentative MRP, combined with the improved website, it is unnecessary for the Regional Board to further revise the orders in response to these comments.

D. Monitoring Program

Pesticides - The City makes reference to a number of issues associated with pesticides to support its argument for a sufficiently robust monitoring program for pesticides. In response, it is important to first note that the monitoring program contained in the Tentative MRP is sufficiently robust with respect to rice pesticides. It includes, among other things, a requirement for a rice pesticide evaluation that considers a number of different factors for determining what rice pesticides should be monitored. The rice pesticide evaluation is not limited to just those pesticides that may impact aquatic life, but also considers potential impacts to human health through drinking water. From this evaluation, the CRC will be required to monitor selected pesticides at all identified monitoring locations when such locations are scheduled for monitoring. (See Tentative MRP, pp. 4-5.) Further, samples must be taken at times that coincide with peak application and months following peak application. (Tentative MRP, p. 6.) Thus, the rice pesticides selected for monitoring and the frequency for when monitoring will occur is sufficient. Further, it is important to note that this monitoring is in addition to monitoring that occurs for the Rice Pesticides Program, which specifically addresses thiobencarb.

Further, the City references the ongoing nature of development of drinking water standards as a reason for ongoing evaluation of rice pesticides. The CRC agrees that a rice pesticide evaluation is appropriate, and as indicated immediately above, such a process is included in the AMR. Also, it is important to understand that the regulation of pesticides themselves is an ongoing process by the United States Environmental Protection Agency's (U.S. EPA) Office of Pesticide Programs. Once a pesticide is registered, it is continually subject to review by U.S. EPA and registrants are required to constantly provide new and updated scientific data. To better explain the U.S. EPA's process and the continuous nature of the agency's review, a Technical Memorandum prepared by Exponent is attached. (Attachment A.) Exponent is a well-known, and reputable scientific consulting firm that has years of experience with the U.S. EPA pesticide registration and registration review (formerly known as reregistration) processes. In addition, please see the technical summary memorandum prepared by Dr. Vincent J. Piccirillo, VJP Consulting, Inc., on the propanil degradate known as 3,4-DCA. (Attachment B.)

Total Organic Carbon - The City also mentions that total organic carbon is a constituent of concern for them because it is a surrogate measure of disinfection by-products precursor material in water. To this end, the City has requested on several occasions that the Tentative MRP be revised to include winter release monitoring for total organic carbon. The CRC does not believe that such monitoring is necessary for several reasons. As is further explained in the Technical Memorandum prepared by Dr. John Dickey (Attachment C.), which was provided to the City on January 31, 2014, the organic load from rice discharges and irrigated agriculture that would reach the City of Sacramento is small (i.e., between 3 to 4 percent of organic carbon at the intake). This load was determined by modeling during the development of the Regional Board's Drinking Water Policy, a process in which the City participated. Further, studies conducted by researchers from the University of California, Davis evaluated organic carbon loads that would occur at the edge of the field after winter release of flooded rice fields. (Attachment D.) Although the study did find that there was an increase in organic loading from rice field outflows during the winter season, the loads were temporal in nature and dissipated quickly in the watershed, as evidenced by the previously cited watershed modeling results. Since winter season loads are temporal in nature, and since modeling to develop the Drinking Water Policy shows that organic loads from rice and irrigated agriculture are small at the City's intake, the CRC does not believe that winter season monitoring of organic carbon is necessary.

E. Management Plan Requirements

Erosion and Sediment Control - The City indicated that they believed erosion and sediment control measures should be included in the CRC Tentative Order. As explained in a Technical Memorandum prepared by Dr. John Dickey, which was provided to the City on January 31, 2014, such measures are not necessary in rice fields. (Attachment E.) As explained by Dr. Dickey in his memorandum, due to their flat topography, rice fields act as a sediment trap and are not net sediment sources like some other types of fields. Dr. Dickey's findings are supported by several multi-year studies that show why rice fields are not a source of sediment in Sacramento Valley waterways. Due to the significance of this information, and the practical realities associated with management of rice fields, sediment and erosion control measures are not necessary.

F. Thiobencarb Memorandum

The City includes significant information with respect to thiobencarb in its comments on the Administrative Draft Order. Because thiobencarb is subject to Regional Board regulation through the highly successful Rice Pesticides Program (see finding 52 of Tentative Order), it is not necessary to respond to the City's comments with respect to thiobencarb. Issues of concern with respect to thiobencarb are addressed in that program. To the extent that the City is making reference to thiobencarb as an example of pesticides that can impact the municipal drinking water use, such general discussion is addressed by the CRC above.

Thank you for you consideration of our comments. Please contact me at (916) 387-2264 if you have any questions.

Sincerely,

Tim Johnson
President & CEO

cc: Ms. Pamela Creedon, Executive Officer, California Water Quality Control Board Central Valley Region
Mr. Joe Karkoski, Chief, Irrigated Lands Regulatory Program

Attachment A

Tentative WDR General Order for

Sacramento Valley Rice Growers

February 18, 2014

Exponent Summary on the Regulation of Pesticide

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REGULATION OF PESTICIDES

INTRODUCTION

The US Environmental Protection Agency (EPA or the Agency) regulates pesticides under The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Federal Food, Drug, and Cosmetic Act (FFDCA), and the Agency's regulations (Code of Federal Regulations, 40 CFR 150-189). Extensive amounts of scientific data and information are used by EPA in deciding whether to register or continue the registration of each pesticide product. Each pesticide is subject to ongoing scientific and regulatory scrutiny. EPA and the states conduct vigorous compliance, enforcement, and training programs to ensure that pesticides are used properly and safely. Each pesticide must be labeled with appropriate use directions and precautionary information and is subject to additional requirements such as buffer zones and other use restrictions to ensure that the pesticide meets Federal and state safety standards.

PESTICIDE PRODUCTS

FIFRA defines a pesticide as a substance intended to "prevent, destroy, repel or mitigate any pest (FIFRA section 2(u)). Section 2(t) of FIFRA specifies that pests include, among other things, insects, fungi, and weeds. Thus, any product designed and used to mitigate a pest is a pesticide.

Pesticides are used for multiple purposes. They may be used by growers for the production of agricultural products; pest control operators to control insects such as termites in buildings including homes, schools and office buildings; lawn care professionals to maintain healthy turf, shrubs and trees around homes, on golf courses, and in other locations; hospital personal for disinfection purposes; water supply organizations to maintain public health standards for water supplies; and consumers to control insects, weeds and rodents in the home environment.

Pesticides can be conventional chemical pesticides or naturally occurring biochemical substances. Pesticides also include microbial products that function as pesticides. Finally, pesticides include certain crops that have been genetically modified to produce proteins that are pesticidal in nature.

Pesticides typically consist of active ingredients that function as pesticides, and other ingredients (sometimes referred to as inert ingredients) that are not pesticidal themselves but function to facilitate the activity of the active ingredients. Such ingredients function, for example, as solvents, emulsifiers and dispersing agents.

FEDERAL AND STATE REGULATION OF PESTICIDES

Pesticide products cannot be sold or distributed in the United States unless they are registered by EPA under FIFRA.

A pesticide registration is a license granted by EPA. The Agency issues a registration for a pesticide product only after it has determined that the use of the product will not cause "unreasonable adverse effects on the environment". The term "unreasonable adverse effects on the environment" is a FIFRA term (Section 2(bb)) that includes risks to the environment, animals, plants, and human beings. Unreasonable adverse effects are those effects in which risks exceed benefits, or, in the case of dietary and related risks, risks that exceed a reasonable certainty of no harm standard.

EPA makes a decision whether or not to register a pesticide after the Agency has assessed the potential risks that may result from the use of the pesticide. Agency risk assessments are based on the results of studies submitted by the applicant for registration (registrant), and information from other sources such as university researchers and the published literature.

When EPA registers a pesticide, it approves a particular product composition and specific label language including use directions and safety information. The Agency also approves one or more uses for the pesticide product. The registrant must request approval of registration amendments to add uses, modify application techniques, change the composition of the product, or otherwise change the product or its labeling.

If the use of a pesticide may result in residues of the pesticide on food, EPA makes a decision whether or not to register the product for use on a particular crop (e.g., corn), and must also determine what level of the pesticide on food is acceptable. The Agency makes that residue level determination, and then sets a tolerance under the FFDCA, which specifies the maximum amount of the pesticide that is permitted on the food. If pesticide levels exceed a tolerance level, the food in question is in violation of the FFDCA.

In addition to requirements for EPA registration, a pesticide must also be registered by the individual states. States may choose to register or not to register the pesticide based on their own assessments. In addition, although states may not mandate different label language than that approved by EPA, states may impose additional use restrictions and requirements by regulation. If a state decides not to register a pesticide, that product cannot be sold or distributed in that state. The California Department of Pesticide Regulation (CDPR) is the agency that regulates the use of pesticides in California. Among the state pesticide regulatory agencies, CDPR has the reputation of being quite competent technically and strong in its regulatory positions.

EPA and the states coordinate compliance, enforcement and training efforts to ensure that registered pesticides are used properly.

EPA REGISTRATION REVIEW

Once EPA grants a registration for a pesticide product, that pesticide is subject to continuing Agency review. New information or study data that raise concerns may be received from the registrant, state regulators, other regulatory agencies, universities and other sources. If any of this information leads the Agency to conclude that action is needed, EPA can take mandatory action or work with a registrant to make voluntary changes to a registration.

In addition, EPA conducts a formal periodic re-review process called registration review (formerly known as reregistration). As science evolves and new registration data requirements are put in place by EPA, the scientific database supporting a pesticide registered in previous years becomes out-of-date and must be upgraded. The Agency requires a registrant to conduct new studies that meet current data requirements. If a registrant chooses not to conduct the required studies, EPA will suspend or cancel the registration for that product.

During the registration review process, EPA reviews the data and information it currently has in its possession. The Agency discusses possible risk concerns and steps that may be needed to address those concerns. EPA then issues a data call-in requiring each registrant of a particular product to conduct new studies to meet registration requirements. Once those studies have been submitted, the Agency conducts revised risk assessments, and determines whether or not to continue a product's registration and whether registration modifications are needed to address risk concerns.

The EPA registration review or reregistration program has been ongoing since the 1970's. Important agricultural pesticides have been subject to multiple registration review cycles. For example, the Agency issued a Registration Standard (reregistration document) for propanil in 1987. Subsequently, EPA issued data call-ins for additional data for this pesticide in 1989, 1994, and 1995. EPA published a Reregistration Eligibility Decision Document (RED) for propanil in 2003, and the Agency amended that RED in 2006. Finally, propanil is scheduled for another registration review in 2015.

Because of the registration review (reregistration) program, EPA is constantly upgrading its database and knowledge concerning pesticide products. Pesticides cannot remain on the market and in use unless pesticide companies provide all of the data required by EPA, and unless the Agency determines that the registrations can continue and that the pesticides continue to meet the statutory safety standard.

In the case of propanil, EPA used studies that had been required earlier to reach a reregistration decision in 2003 and 2006. As a result of this intensive reregistration review, EPA determined that dietary exposure from rice and drinking water for both propanil and its 3,4-DCA degradate were acceptable. The Agency did require that certain mitigation measures be put in place to address ecological and worker exposures. For example, EPA required water holding (discharge) intervals for rice because the Agency determined that this requirement would address concerns about endangered and non-endangered aquatic species.

SPECIAL REVIEW, CANCELLATION AND SUSPENSION

If, at any time after registration, EPA determines that a pesticide no longer meets the standard for registration (as a result of a registration review or based on other new information), the Agency may require that the registration be modified or cancelled. For example EPA may require that that application rates or methods be changed or the Agency may require that additional personal protective equipment be used by workers. Additionally, EPA may require that particular uses be dropped from the label or may require additional precautionary use information.

If EPA determines, based on new information, that a newly identified risk needs to be addressed, the Agency may initiate a special review process. The special review procedure begins with the Agency announcing its concerns and the basis for those concerns. After comments are received, EPA proposes steps needed to eliminate the risk concerns (e.g., cancel the product, cancel certain uses, require changes in use directions or safety information). Comments are again received, and EPA then issues a final decision.

EPA may choose not to conduct a special review procedure and proceed directly to a cancellation process under Section 6 of FIFRA. This procedure includes the right for an administrative hearing if non-EPA parties believe the cancellation action is not appropriate. During the conduct of a cancellation hearing, a registrant can continue to sell the product subject to the Agency's proposed cancellation action.

If EPA believes that the continued sale and use of a pesticide poses an imminent hazard, the Agency can immediately suspend the sale and use of a pesticide while a hearing is conducted to determine the final decision concerning continued registration.

DATA REQUIRED TO SUPPORT REGISTRATION

EPA specifies what studies are required for registration (40 CFR 158). The studies must be conducted according to guidelines specified by the Agency, and the studies must be conducted according to Good Laboratory Practice standards specified by EPA regulations (40 CFR 160). In addition, the Agency specifies how study results are to be submitted to EPA. Finally, studies conducted to support registration are subject to inspection and audit by EPA personnel.

Studies required to support a registration include product chemistry, residue chemistry, toxicology, ecotoxicology, environmental fate, exposure studies, and, for public health pesticides, efficacy data. Product chemistry studies characterize physical and chemical properties of a pesticide. Residue chemistry studies characterize and quantify pesticide residue levels on food to be consumed by humans and animals. Toxicology studies identify potential acute and chronic hazards (e.g., possible cancer risk or reproductive concerns). Ecotoxicology studies are conducted to identify possible hazards to plants and animals. Environmental fate studies are designed to determine where a pesticide goes in the environment after it is applied, how long it persists, and what does it break down to in the environment. Finally, exposure studies (and modeling information) provide exposure data that are used in conjunction with toxicity data to characterize possible risks.

The studies conducted to support the registration of an active ingredient and products containing that active ingredient take years to conduct, may require several years of EPA review, and cost millions of dollars. EPA scientists review each study, which may be accepted, rejected or considered supplemental. If a study is rejected, it must be repeated by the pesticide registrant. If a study is considered supplemental, additional information must be provided to upgrade the study. The data submitted by a registrant are used by EPA scientists to conduct risk assessments that address possible risk to workers, bystanders, consumers, plants, animals and the environment. Those risk assessments are used to determine whether or not a pesticide meets the standard for registration.

RISK ASSESSMENT PROCESS

Human Health Risk Assessments

Data from toxicology and ecotoxicology studies provide information concerning toxicity or hazard. Toxicology study results do not, by themselves, say anything about risk. Toxicity information must be combined with exposure estimates to develop a sense about potential risk. In other words, risk is a combination of toxicity and exposure. For example, if there is no exposure to a highly toxic material, there is no risk. On the other hand, if there is substantial exposure to a moderately toxic substance, there may be significant risk.

EPA scientists typically review all of the available toxicity studies and develop opinions concerning toxic effects at various dose levels and by various routes of exposure. Based on all of the available toxicity information, the scientists then determine which study results (endpoints) to use for risk assessment purposes; again, considering different routes of exposure, and different lengths of exposure. Agency scientists develop a hazard assessment report to document the results of their review of the toxicology database for a pesticide.

Exposure information from individual studies, multiple study databases, models, and various exposure assumptions describe how much exposure may occur when a product is used in particular ways. Again, Agency scientists document the results of their exposure assessment work.

Upon completion of a hazard assessment and an exposure assessment, EPA scientists then conduct risk assessments which involve combining toxicity and exposure data to provide an assessment of potential risk to different target populations (e.g., workers, bystanders, consumers, plants, animals). Risks are typically considered for acute (short-term) and chronic (long-term) exposure scenarios.

It is important to understand that EPA risk assessments for pesticide products are supported by a robust set of toxicology and exposure data and information. In addition, risk assessments are designed to be very protective in nature.

Toxicology studies are typically conducted at three dose levels. Some study animals are not exposed; they are the control animals. Other animals are exposed to low, mid and high dose levels. A well designed and conducted study shows toxicity at least at one dose level, and no toxicity at a lower dose level. That is, in a well-designed study, dose levels are set at high enough levels to produce some toxic effect. In a particular study, the lowest dose level where an adverse effect is observed is the Lowest Observed Adverse Effect Level or LOAEL. The dose where no adverse effect is observed is the No Observed Adverse Effect Level or NOAEL.

When determining appropriate toxicity endpoints for risk assessment purposes, EPA scientists determine which toxicology studies are appropriate for each exposure scenario (route and duration of exposure). For each exposure scenario, the scientists identify the lowest NOAEL from the appropriate group of studies. In other words, among several studies there may be NOAELs that are at different dose levels. The Agency scientists select the lowest NOAEL available for risk assessment purposes so that the risk assessment is protective in nature. In summary, the endpoints selected for risk assessment purposes are dose levels where no adverse or toxic effect occurs, and are the lowest NOAELs available for risk assessment purposes.

The next step for the EPA scientists is to determine the appropriate uncertainty or safety factors to apply to the risk assessments. While various terms are used, this paper uses the terms safety factors and margins of safety (MOS). Safety factors are generally of three types.

Using the results of animal studies to estimate risk to humans is characterized by a certain level of uncertainty. Animals and humans are different species and may react differently to a chemical. In addition, humans may have varying levels of sensitivity to a particular chemical. EPA scientists usually apply a factor of 10X to account for possible differences between animals and humans, and a second 10X for possible differences between people. Multiplying 10 times 10 gives an MOS of 100 that is used to evaluate risk to people.

Agency scientists now sometimes require an additional 10X safety factor to provide an additional level of protection to children and women of childbearing age (refer to FQPA section below). Multiplying the MOS of 100 by the additional 10X gives an MOS of 1000 for use in characterizing possible risk to children and women of childbearing age.

After determining the appropriate MOS value for a particular risk assessment, EPA scientists also calculate a reference dose or RfD for use in evaluating risk. An RfD is determined by taking the NOAEL dose level selected for risk assessment purposes, and dividing that dose level by the MOS of 100 or 1000. For example, if the NOAEL is 1 mg/kg (milligram of pesticide per kilogram of body weight of the test animal), the RfD with an MOS of 100 is 0.01 mg/kg, and the RfD with an MOS of 1000 is 0.001 mg/kg.

Once the desired MOS and RfD values are determined, EPA scientists compare the estimated exposure determined for a particular use scenario (e.g., a consumer applying a pesticide) to the NOAEL selected or to the RfD calculated for risk assessment purposes. To illustrate, if the desired MOS is 100 and the exposure estimate is 100 times (or more) less than the risk assessment NOAEL, then the exposure and possible risk is acceptable. For example, if the estimated exposure is 0.01 mg/kg, and the NOAEL selected for risk assessment is 1 mg/kg, and the required MOS for the exposed individual is 100, then the exposure is acceptable.

Alternatively, the estimated exposure can be compared to the RfD. If the estimated exposure to the consumer applying the pesticide is less than the RfD (which incorporates the desired safety factors, the exposure is again acceptable. In my example, the RfD is 0.01 mg/kg (NOAEL of 1 mg/kg divided by the MOS of 100). Again, if the estimated exposure is less than the RfD, then the exposure is acceptable.

To get a good sense of the protective nature of an EPA risk assessment, one must understand that an acceptable exposure must be at least 100 times or 1000 times less than the lowest NOAEL dose level in a suite of toxicology studies. That is, the exposure must be 100 or 1000 times less than a dose level at which NO TOXIC EFFECT occurred. Only, then is the exposure and risk acceptable.

In summary, EPA's risk assessment procedures and standards for registration require substantial margins of safety (MOS values) for exposures to be acceptable. Agency standards are thus quite protective in nature.

Environmental and Ecological Risk Assessments

While the above discussion focuses on potential exposure and risk to humans, comparable risk assessment practices are used by EPA scientists when evaluating possible risks to plants and animals. In considering environmental risk (e.g., pesticides in surface water or ground water), EPA focuses on possible risk from these exposures to humans, plants and animals.

Aquatic life benchmark values are based on toxicity studies reviewed by the EPA, and used in the Agency's risk assessments developed as part of the decision-making process for pesticide registration and registration review. The EPA Office of Pesticide Programs (OPP) relies on studies required under FIFRA (also see 40 CFR 158), as well as laboratory and field studies available in the public scientific literature to assess environmental risk. Each aquatic life benchmark is based on the most sensitive toxicity endpoint available to EPA for a given taxon (for example, freshwater fish).

FOOD QUALITY PROTECTION ACT (FQPA)

Congress passed the FQPA in 1996. The Act amended both FIFRA and the FFDCA. The FQPA revised and strengthened the risk assessment processes used to evaluate pesticide chemicals. Specifically, the FQPA mandated an additional 10X safety factor (see earlier discussion) to protect children who might be more sensitive to a pesticide than adults. In addition, the FQPA required EPA to aggregate all exposures for a particular pesticide when evaluating risk. For example, a consumer may be exposed to a pesticide residue on food, a certain level of the pesticide may be in drinking water, and the consumer may use and be exposed to the same pesticide. All possible exposures must be added together and provide an adequate margin of safety for the pesticide to be registered. In addition, the FQPA required that all exposures to all pesticides with the same mechanism of toxicity must be added together (cumulative exposure), and that total exposure must meet safety standards for the pesticides to be acceptable.

INTERNAL AND EXTERNAL REVIEW OF EPA SCIENCE

EPA's OPP is responsible for the regulation of pesticides. OPP scientists review and evaluate studies, conduct exposure and risk assessments, and develop policies and guidance needed to standardize how studies are planned, conducted, submitted, and reviewed. Within EPA's OPP science divisions, there are several levels of review of the work done by staff scientists. In addition, committees of senior scientists review data and make decisions concerning endpoint selection for risk assessments, and select appropriate safety factors needed to properly characterize risk information.

OPP scientists may also reach out to the scientific staff in other EPA program offices for advice and counsel on certain scientific issues. In addition, OPP scientists consult with scientists in EPA's Office of Research and Development concerning risk assessment questions.

Finally, Section 25(d) of FIFRA requires that EPA establish a Scientific Advisory Panel (SAP), which consists of outside experts from academia and other organizations. EPA utilizes the SAP to seek comments and recommendations concerning science policies and procedures, and to obtain advice concerning risk issues related to particular pesticides or classes of pesticides.

The end result is that the work performed by EPA scientists concerning pesticide products is carefully reviewed and evaluated, and is conducted with an extensive network of peer review and oversight. This oversight combined with the extensive amounts of data that must be submitted to support pesticide registrations provides a rigorous technical environment that supports the strong pesticide regulatory programs administered by EPA.

RESTRICTED USE PESTICIDES

As discussed earlier, when EPA registers a pesticide product, the Agency has to make a determination that the use of that pesticide will not cause unreasonable adverse effects on the environment (FIFRA Section 3(c)(5)). Section 3(d)(1)(C) of FIFRA and regulations found at 40 CFR 152.160 provide that EPA can require additional regulatory restrictions to ensure that the use of a pesticide will not cause unreasonable adverse effects on the environment. This later section of FIFRA deals with "restricted use" pesticides.

EPA will not register a pesticide unconditionally unless the Agency is convinced that the pesticide can be used without causing unreasonable adverse effects. As discussed, when the Agency registers a pesticide it specifies the exact formula for that pesticide and the precise label language that must be used. The label language describes how a product must be used and what precautionary measures must be followed to use the product safely.

In addition to these general requirements, EPA may determine that only specially trained and certified applicators or individuals operating under their supervision should apply a particular pesticide to ensure that the pesticide can be used without causing unreasonable adverse effects. While such a pesticide may potentially have more toxicity than another pesticide, EPA controls the potential risk and ensures safe use by controlling exposure through the use of specially trained applicators. That is, in such a case, the Agency classifies that pesticide as a "restricted use" pesticide. As a restricted use pesticide, the product can only be applied by or under the supervision of a trained, certified applicator.

When the Agency classifies a pesticide as a restricted use pesticide, that action triggers additional regulatory safety requirements to ensure undue risk will not be caused by the use of the pesticide. A restricted use pesticide must be clearly labeled as such, and must specify the reason EPA decided to classify the product for restricted use. For example, the Agency may want to put additional protections in place to protect workers or ground water, and restricts a pesticide for one of those reasons. That reason must be listed on the product label. In addition, the restricted use classification triggers EPA mandated, state operated certification and training requirements for individuals applying or supervising the application of the pesticide.

Section 23 of FIFRA allows EPA to enter into cooperative agreements with states whereby the states are delegated the authority and are granted funds to cooperate in the enforcement of FIFRA. While, EPA has its own compliance and enforcement personnel across the US, the states are really the enforcement eyes and ears of a comprehensive program designed to ensure that distributors and users of pesticides follow the law and protect man and the environment.

As part of this Agency-state partnership, EPA sets standards for certification and training programs which are conducted by the states (40 CFR 171). The Agency-mandated national standards ensure consistency in training from state to state. The hands-on, in the field experience of state regulators ensure that certified applicators are trained in a comprehensive manner. This system provides the safety needed for the use of restricted use pesticides.

States train and certify applicators to allow them to use particular categories of restricted use pesticides. For example, one applicator may be certified to apply restricted use pesticides used in agriculture, another may be certified to use restricted use pesticides to ensure a safe drinking water supply, and another may be certified to apply restricted use pesticides for termite control in buildings. Requiring certification on a category-by-category basis ensures that precautionary measures needed to ensure safe use of pesticides for different purposes are well understood by the specially trained applicators.

Regardless of whether a pesticide is a restricted use pesticide or not, in registering either pesticide, EPA makes a determination that the pesticide meets the safety standard for registration, and can be used without causing unreasonable adverse effects.

BUFFER ZONES HOLDING INTERVALS, AND OTHER MITIGATION MEASURES

As discussed, when EPA registers a pesticide the Agency determines what use directions and precautionary restrictions are necessary to ensure that the product can be used safely. In some cases, EPA may decide that “buffer zones” are needed to protect workers, bystanders, plants, animals, and water. Buffer zones are specified areas around a pesticide application site in which the pesticide in question cannot be used. In other cases, such as propanil use on rice, EPA requires that water be held for a period of time after propanil has been applied to ensure that the propanil use will not present any undue risk to aquatic species. The evaluation of possible water holding requirements is standard in the registration and registration review process for rice pesticides. Water holding requirements range from zero to 30-days. Holding times allow the pesticide to degrade to an acceptable level before release from a field.

Whether a buffer zone, holding interval, or any other risk mitigation measure is mandated to protect either human beings or the environment, EPA goes through a careful evaluation of toxicity, exposure and risk data and information to determine the appropriate mitigation requirements. In other words, the Agency does not use a one-size, fits-all approach. Rather EPA determines the appropriate mitigation measure for particular pesticides and pesticide use sites.

WORKER PROTECTION STANDARDS AND POSTING

There are specific EPA regulations in place to protect agricultural workers and pesticide handlers (40 CFR 170). These regulations cover employees who mix, load and apply agricultural pesticides, and also workers who perform cultivation and harvesting work. Pesticide applicators are prohibited from applying pesticides in a manner that will expose workers or other persons. In addition, worker personal protective equipment must be provided, and training is required for pesticide handlers and workers. Workers are also not allowed to enter pesticide-treated areas until certain time periods have elapsed, and workers must be notified about treated areas and treated areas must be posted so workers can avoid inadvertent exposures.

CALIFORNIA STATE PESTICIDE REGISTRATION

In California, a pesticide cannot be legally marketed and used unless the EPA has registered it and the product also receives approval through the CDPR registration program. In California, CDPR has both a pesticide registration and an enforcement program, which regulates all pesticides that are used and sold in the state and enforces the use of those chemicals. The state statute provides CDPR the authority to deny the registration of any pesticide that does not meet California standards for safety and protection. The enforcement of pesticides takes place at the local (county) level with oversight and assistance from CDPR and the California Department of Food and Agriculture (CDFA). The CDPR provides information to county inspectors, through the network of County Agricultural Commissioners (CACs). One tool provided to the county inspectors is the Pesticide Use Enforcement Program Standards Compendium.

ROLE OF THE COUNTY AGRICULTURAL COMMISSIONERS

When an enforcement action is necessary, the CAC has the following options: revoking or suspending the right of a pest control company to do business in the county; prohibiting harvest of a crop that contains illegal residues; and issuing civil and criminal penalties. Farmers must obtain site-specific permits from their CAC to buy or use many agricultural chemicals as mandated through the Restricted Materials Permit Program. The CAC must evaluate the proposed use to determine if the pesticide can be used safely, particularly in sensitive areas such as near wetlands, residential neighborhoods, schools, or organic fields. State law requires commissioners to ensure that applicators take precautions to protect people and the environment. The CAC has the right to deny any pesticide permit, or require additional conditions in order to meet local pesticide regulatory standards.

In most counties, the CAC is the first contact on many farm-related issues. In addition to pesticide use regulation, the CACs enforce laws and regulations administered by CDFA, including those related to pest detection, eradication and exclusion, and quality standards for fruits and vegetables. The CACs work with the State Department of Fish and Wildlife to investigate wildlife loss associated with pesticides and to prevent agricultural runoff into wildlife areas.

The mandatory reporting of all agricultural pesticides occurs through the full use reporting program which began in 1990. Farmers include all pesticides on the permit whether restricted or not due to the mandatory full use reporting. All pesticide use reports go through the CAC office and then into the CDPR system. California was the first state to implement a full use-reporting program and publish annual, public reports.

INFORMATION SOURCES

EPA's website (www.epa.gov) provides a wealth of information concerning the Agency's pesticide programs and about individual pesticide products. In addition, there are extensive links to other websites that provide additional information. Through the EPA and other websites, individuals can learn how pesticides are regulated, how potential risks from the use of pesticides are evaluated, how to safely use pesticides, and what data are used to make decisions about individual pesticides. In addition to EPA and other Federal websites, states have websites that provide additional information.

CONCLUSIONS

EPA and CDPR are technically competent agencies that conduct rigorous reviews of scientific data and information to determine whether pesticides should be registered and allowed to be sold and used. Both agencies have strong statutes and regulatory mandates, and cooperate in compliance, enforcement and training programs to ensure that registered pesticides are used properly, and do not present undue risk to man or the environment. In addition to pesticides meeting all EPA data requirements, pesticide registrants provide data specific to California growing conditions and worker exposure. The California laws and regulations provide for enforcement of pesticide use and sales.

ADDITIONAL INFORMATION CONCERNING PESTICIDE LAWS

As discussed earlier, the EPA regulates the use of pesticides under the authority of two federal statutes: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA).

FIFRA provides the basis for regulation, sale, distribution and use of pesticides in the United States. FIFRA authorizes the EPA to review and register pesticides for specified uses. The EPA also has the authority to suspend or cancel the registration of a pesticide if subsequent information shows that continued use would pose unreasonable risks. Key elements of FIFRA include the following:

- Pesticide products must obtain an EPA registration before sale and use
- Registration based on a risk/benefit or reasonable certainty of no harm standard
- Strong authority to require data
- Ability to regulate pesticide use through labeling, packaging, composition, and disposal requirements
- Ability to suspend or cancel a product's registration

The FFDCA authorizes the EPA to set maximum residue levels, or tolerances, for pesticides used in or on foods or animal feed. Pesticide regulatory actions under the FFDCA include the following:

- Mandates strong provisions to protect infants and children
- Provides the authority to set tolerances in foods and feeds (maximum pesticide residue levels)
- Provides authority to exempt a pesticide from the requirement of a tolerance
- Rule-making process required to set tolerances or exemptions
- Establishes requirements for a tolerance or tolerance exemption
- Mandates primarily a health-based standard for setting the tolerance, "reasonable certainty of no harm"

- Pesticide residues in foods are monitored and the tolerances enforced by FDA (fruits and vegetables, seafood) and USDA (meat, milk, poultry, eggs, and aquacultural foods)

The Food Quality Protection Act (FQPA) of 1996, amended FIFRA and FDCA setting tougher safety standards for new and old pesticides, and to make uniform requirements regarding processed and unprocessed foods. Major changes from FQPA include the following:

- Amended both FIFRA and FFDCA, significantly changing how the U.S. EPA regulates pesticides
- Establishes a single safety standard under FFDCA by which tolerances are set tolerances - not a risk/benefit standard (with some exceptions)
- Assessment must include aggregate exposure including all dietary exposures, drinking water, and non-occupational (e.g., residential) exposures
- When assessing a tolerance, the EPA must also consider cumulative effects and common mode of toxicity among related pesticides, the potential for endocrine disruption effects, and appropriate safety factor to incorporate
- Requires a special finding for the protection of infants and children
- Must incorporate a 10-fold safety factor to further protect infants and children unless reliable information in the database indicates that it can be reduced or removed
- Established a tolerance reassessment program and lays out a schedule whereby EPA must reevaluate all tolerances that were in place as of August, 1996 within 10 years
- The EPA must now periodically review every pesticide registration every 15 years

The Endangered Species Act (ESA) of 1973 prohibits any action that can adversely affect an endangered or threatened species or its habitat. In compliance with this law, EPA must ensure that use of the pesticides it registers will not harm these species.

CDPR must comply with the laws listed above, and the California Food and Agricultural Code (FAC). Division 6 of the FAC (specifically Sections 11401 – 12499) pertains to the registration, sale and use of pesticides. The California legislature provides amendments or additions through laws such as the Business and Professions Code, Health and Safety Code, Public Resources Code and the Education Code.

ADDITIONAL INFORMATION CONCERNING PESTICIDE REGULATIONS

The Federal Register provides the full-text of Federal Register documents issued by EPA or other Federal Agencies that concern environmentally related issues

The Code of Federal Regulations (CFR) is a codification of the rules published in the Federal Register by the Executive departments and agencies of the Federal Government. The CFR is divided into multiple titles, which represent broad areas subject to Federal regulation, with environmental regulations contained mainly in Title 40.

California Code of Regulations (CCR) is a series of regulations formally adopted by state agencies. Regulations about pesticides and pest control operations are mainly in Title 3 (Division 6) and Title 16 (Division 19).

ADDITIONAL REFERENCE INFORMATION

All information in this document is available on the U.S. EPA and DPR websites.

1. DPR. A Guide to Pesticide Regulation in California. http://www.cdpr.ca.gov/docs/pressrls/dprguide/dprguide.pdf
2. DPR. Assessing the health risk of pesticides. http://www.cdpr.ca.gov/docs/dept/factshts/artic12.pdf
3. DPR. County plays key role in regulating pesticides. http://www.cdpr.ca.gov/docs/dept/factshts/cac.pdf
4. DPR. How California regulates pesticide use. http://www.cdpr.ca.gov/docs/dept/factshts/main2.pdf
5. DPR. Pesticides and food: how we test for safety. http://www.cdpr.ca.gov/docs/dept/factshts/residu2.pdf
6. DPR. Pesticide Registration – Desk Manual. http://www.cdpr.ca.gov/docs/registration/manual/index.htm
7. U.S. EPA. Laws Affecting EPA's Pesticide Programs. http://www.epa.gov/pesticides/factsheets/legisfac.htm
8. U.S. EPA. Pesticide Registration Program. http://www.epa.gov/pesticides/factsheets/registration.htm
9. U.S. EPA. Protecting the Public from Pesticide Residues in Food. http://www.epa.gov/pesticides/factsheets/registration.htm
10. U.S. EPA. Setting Tolerances for Pesticide Residues in Foods. http://www.epa.gov/pesticides/factsheets/stprf.htm

Attachment B

Tentative WDR General Order for

Sacramento Valley Rice Growers

February 18, 2014

Propanil 3,4-DCA and Drinking Water Risks

Dr. Vincent J. Piccirillo
VJP Consulting, Inc.

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DATE: December 4, 2013

TO: Roberta Firoved, California Rice Commission
Edward Ruckert, MW&E

FROM: Vincent J. Piccirillo, Ph.D., DABT

SUBJECT: Propanil and 3,4-DCA drinking water risk

The two major aspects of any risk assessment are the determination of the appropriate toxicity endpoint for the duration of expected exposure and the amount of exposure. In the Reregistration Eligibility Decision (RED) for Propanil, EPA evaluated chronic (long-term) oral water exposure to propanil. Based on available toxicity studies in animals and appropriate margins of safety, EPA determined the chronic Population Adjusted Doses (cPAD) for all populations of 0.009 mg/kg/day.

Oral exposure has 2 components, dietary and drinking water. To determine the maximum contribution from water allowed in the diet, EPA first looks at how much of the overall allowable risk is contributed by food and then determines a ñdrinking water level of comparisonò (DWLOC). The DWLOC is the acceptable concentration of the pesticide in drinking water that will not lead to undue risks to various subpopulations such as children, women of childbearing age and men. Based on the DWLOC and daily drinking water consumption, EPA calculates estimated environmental concentrations (EECs), i.e., the maximum concentration of propanil/DCA in a daily consumption of drinking water that is acceptable from a risk standpoint.

Propanil is a rice herbicide and a dietary risk assessment using rice field residue and processing data was conducted. The dietary risk assessment determined that dietary exposure was 0.000394 mg/kg/day for children, 0.000134 mg/kg/day for females and 0.000196 mg/kg/day for males. The ñoverall allowable risk doseò contributed by drinking water is determined by subtraction of the allowable risk from food from the cPAD. The overall allowable risk contributions for drinking water are shown in Table 1. As the dietary component is negligible, the overall allowable risk contributed by drinking water is close to the cPAD. Based on the overall allowable risk dose, the calculated chronic DWLOCs for propanil are 86 parts per billion (ppb) for children, 266 ppb for adult females and 308 ppb for adult males for propanil and its principal metabolic degradate, 3,4-DCA, and residues convertible to 3,4-DCA, the residues of concern for the drinking water risk assessment.

EECs may be determined by modeling of use and environmental fate data or from actual monitoring data if available. Estimated environmental concentrations (EECs) that are above the corresponding DWLOC exceed the Agencyôs level of concern. Models have been developed to evaluate the threshold drinking water risks. At the time of the RED, monitoring data for propanil residues in ground and surface water from the USGS was available and provided information on the magnitude and frequency of propanil and 3,4-DCA detections. As shown in Table 1, the monitoring data show the groundwater EEC from rice applications to be 0.4 ppb and the surface water EEC to range from 6 to 72 ppb. These values are clearly below the DWLOCs and demonstrate no risk concern for propanil and DCA from combined dietary and drinking water consumption.

Recently, propanil and 3,4-DCA monitoring results from CDPR for the period 1994-2010 and USGS monitoring results were modeled in RiceWQ, a specific model designed to evaluate rice uses. The CDPR monitoring included propanil analytical results for 2,226 samples with concentrations ranging from no detection to a maximum of 47 ppb. The USGS database for 3,4-DCA included 3,183 samples with a maximum concentration of 0.626 ppb. Based on this modeling (Table 2), propanil concentrations ranged from 3.5 to 7.1 ppb and 3.4-DCA concentrations ranged from 2.9 to 5.3 ppb. These concentrations are well below the DWLOCs (86 to 308 ppb) determined by USEPA in the RED.

The California Rice Commission under the Irrigated Lands Regulatory Program (ILRP) conducted monitoring studies in rice growing regions in California from 2006 to 2011. In general, all of the monitoring results were consistent with the CDPR and USGS data as well as the modeled RiceWQ values. The only exception was a 47 ppb concentration found at Lurline Creek on June 3, 2009. Although this concentration was substantially higher than other monitored values in this study, it should be noted that this single high event is well below the DWLOCs.

In conclusion, this document expands the drinking water risk assessment performed by USEPA by modeling the expansive monitoring results from the CDPR and USGS expansive evaluations of propanil and DCA residues in water from rice growing regions. The EECs determined from this modeling supports the EPA conclusion from the RED that propanil and DCA residues in potential drinking water do not reach levels of concern.

Table 1. Comparison of Calculated Chronic DWLOCs and EECs for Propanil and 3,4DCA.

Population Subgroup	cPAD (mg/kg/day)	Chronic Food Exposure (mg/kg/day)	Maximum Chronic Water Exposure (mg/kg/day)	Groundwater EEC (Rice) (ppb)	Surface Water EECa (Rice) (ppb) Based on Propanil and 3,4-DCA	Chronic DWLOC (ppb)
Children	0.009	0.000394	0.008606	0.4	Range of 6 to 72	86
Females		0.000134	0.008866			266
Males		0.000196	0.008804			308

Table 2. Maximum Theoretical Concentrations of Propanil and 3,4-DCA from RiceWQ

Scenario	No. Applications	Rate (lbs a.i./ac)	Water Depth (inches)	Concentration Propanil (ug/L)	Concentration 3,4-DCA (ug/L)
1-4 leaf	1	4	5	3.5	2.9
2-4 leaf	1	6	5	5.3	4.3
Max seasonal	2	8 (total)	5	7.1	5.8

Attachment C

Tentative WDR General Order for

Sacramento Valley Rice Growers

February 18, 2014

Dissolved Organic Carbon in the Sacramento Valley Watershed

Dr. John Dickey, PlanTierra

MEMO

From: *John Dickey/PlanTierra*

To: *Roberta Firoved*

Date: February 17, 2014

Subject: ***Dissolved Organic Carbon in the Sacramento Valley Watershed***

The purpose of this memo is to briefly summarize dissolved organic carbon (DOC) relationships in the Sacramento Valley Watershed, with particular focus on rice fields as potential sources.

DOC has been studied substantially in studies performed by the California Rice Commission's various scientific partners. Despite the importance of this pollutant in the watershed, based on these results, DOC was not found to be high a high regulatory priority for CRC.

A Sacramento Valley scale watershed model was developed in the WARMF framework (Herr, 2013) for the Drinking Water Policy Technical Working Group, a stakeholder process in which agriculture and drinking water purveyors (including the California Rice Commission and City of Sacramento) were participants. The model characterized production and transport of constituents in and through the Sacramento Valley to the San Francisco Bay Delta. As part of this modeling effort, relative contributions of various sources to DOC loads in the Sacramento River, and to resulting concentrations at the I Street Bridge (roughly the location of the City of Sacramento's drinking water intake) were assessed. Findings of this study relative to this parameter, at this location, were as follows:

- Rice fields and irrigation systems occupy about 570,000 acres in the watershed. Most of this area is upstream of the I St. Bridge reach of the Sacramento River. This type of land surface was found to contribute about 3 to 4% DOC observed in this reach.
- Urban land surfaces occupy about 407,000 acres in the watershed. Much of this area is not tributary to the I St. Bridge reach. Nevertheless, urban land surfaces contribute 1 to 2% observed DOC at this location.
- Municipal and industrial point sources contribute 6 to 8% of DOC observed in the I St. Bridge reach.

Other collaborative studies (Krupa et al, 2011; Ruark et al., 2010) took a detailed look at DOC dynamics in rice fields and in rice dominated portions of the watershed. These studies evaluated TOC/DOC of outflows from rice fields cultivated under differing straw decomposition and winter flood practices, as well as TOC/DOC in peripheral drain sites. Findings of these studies included the following:

- Observed rice fields were generally net importers (sinks) of DOC during the growing season, and net exporters of DOC during the wintertime.
- Peak DOC was observed with the onsets of winter discharge; however, these peaks were followed by a sharp temporal decrease for each winter flooded rice field. This indicates that peak concentrations are ephemeral and should not be the basis of steady state loading calculations.
- Rice fields may not be the cause of peak DOC concentrations typically observed later in the winter season.
- Outflow and internal drain water reuse rates strongly affect DOC transformations and transport in rice-dominated sub-watersheds.
- DOC production in rice fields is influenced by straw management and rates of water flow. However, these aspects of the cropping system are involved in many other agronomic and environmental relationships of rice fields, so that straw and water management regimes are highly constrained.

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Krupa, Monika, Robert G. M. Spencer, Kenneth W. Tate, Johan Six, Chris van Kessel, and Bruce A. Linquist. Controls on dissolved organic carbon composition and export from riced dominated systems. Biogeochemistry, 0DOI 10.1007/s10533-011-9610-2.

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Attachment D

Tentative WDR General Order for

Sacramento Valley Rice Growers

February 18, 2014

Seasonal Losses of Dissolved Organic Carbon and Total Dissolved Solids from Rice Production Systems in Northern California

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Comment Letter 1

Seasonal Losses of Dissolved Organic Carbon and Total Dissolved Solids from Rice Production Systems in Northern California

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Water quality concerns have arisen related to rice (*Oryza sativa* L.) field drain water, which has the potential to contribute large amounts of dissolved organic carbon (DOC) and total dissolved solids (TDS) to the Sacramento River. Field-scale losses of DOC or TDS have yet to be quantified. The objectives of this study were to evaluate the seasonal concentrations of DOC and TDS in rice field drain water and irrigation canals, quantify seasonal fluxes and flow-weighted (FW) concentrations of DOC and TDS, and determine the main drivers of DOC and TDS fluxes. Two rice fields with different straw management practices (incorporation vs. burning) were monitored at each of four locations in the Sacramento Valley. Fluxes of DOC ranged from 3.7 to 34.6 kg ha^{-1} during the growing season (GS) and from 0 to 202 kg ha^{-1} during the winter season (WS). Straw management had a significant interaction effect with season, as the greatest DOC concentrations were observed during winter flooding of straw incorporated fields. Fluxes and concentrations of TDS were not significantly affected by either straw management or season. Total seasonal water flux accounted for 90 and 88% of the variability in DOC flux during the GS and WS, respectively. Peak DOC concentrations occurred at the onset of drainflow; therefore, changes in irrigation management may reduce peak DOC concentrations and thereby DOC losses. However, the timing of peak DOC concentrations from rice fields suggest that rice field drainage water is not the cause of peak DOC concentrations in the Sacramento River.

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Rice fields dominate the landscape of California's Sacramento Valley, with approximately 200,000 ha of land under production (California Department of Food and Agriculture, 2009). Historically, rice straw was burned after harvest to inexpensively remove straw biomass for ease of tillage and to mitigate pest and disease problems. The burning of rice straw emits smoke and other airborne pollutants which affect overall air quality and has been linked to asthma hospitalizations (Jacobs et al., 1997). State regulations have commanded a drawdown in the burning of rice straw (California Rice Straw Burning Reduction Act AB1378, 1991), and currently, the burning of rice straw is only permitted under specific conditions. In 2002, <7% of the rice acreage was burned and <13% was burned in 2003 (Hill et al., 2006). The most popular method of straw disposal includes incorporating straw into the soil after harvest followed by flooding during winter months to enhance decomposition. This change in straw management has lead to the creation of habitat for migratory water fowl (Brouder and Hill, 1995) which leads to further straw decomposition (Bird et al., 2000). Straw incorporation and winter flooding have also been shown to have the agronomic benefit of requiring less fertilizer nitrogen to achieve optimum yields (Linquist et al., 2006). In addition, incorporation of straw has lead to an increase in carbon (C) sequestration rates in California's rice fields (Kroodsma and Field, 2006). However, these benefits come at an economic cost through increased water use, additional tillage practices, and pesticide applications.

Water quality concerns have arisen in relation to the potential increase in DOC concentration and export caused by combination of straw incorporation and winter flooding. The DOC can react with chlorine during drinking water disinfection and lead to the formation of harmful byproducts, such as trihalomethanes (Xie, 2004). The maximum contaminant level for trihalomethane is 80 μg L^{-1} (USEPA, 2009) and efforts are currently underway to assess and define safe levels of DOC for drinking water intakes. The large

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Abbreviations: B, burned; C, carbon; DOC, dissolved organic carbon; FW, flow-weighted; GS, growing season; I, incorporated; MF, maintenance flow; TDS, total dissolved solids; WS, winter season.

input of organic C (as straw biomass) to rice fields after harvest can impact the terrestrial C cycle by increasing soil water DOC concentrations (Katoh et al., 2005), and by increasing the export of DOC to surface waters. The surface hydrology of the Sacramento Valley is dominated by engineered waterways, including peripheral drainage canals that transport used irrigation water from agricultural fields to large flowing surface waterways, which eventually flow into the Sacramento River. The Sacramento River is the major drinking water source for the Sacramento metropolitan area and contributes 84% of the freshwater supply to the Sacramento-San Joaquin Delta, which itself is a drinking water source for an additional 22 million California residents. Specific organic compounds, such as pesticides used in rice production, have been detected in the Sacramento River (Finlayson et al., 1993; Crepeau and Kuivila, 2000; Orlando and Kuivila, 2004) indicating that rice production can affect the downstream water quality. Therefore, DOC exported from rice fields may represent a large allochthonous input into Sacramento Valley surface waters, and perhaps the Delta as well. Median concentrations of DOC in the Sacramento River (measured between 1980 and 2000) have been shown to be <2 mg L^{-1} (Saleh et al., 2003). Chow et al. (2007) reported average DOC concentrations in the lower Sacramento River between 1.48 and 1.92 mg L^{-1}. Surface waterways within the Sacramento Valley that receive rice field drainage water, such as the Colusa Basin Drain, have higher average DOC concentrations compared to the Sacramento River and are often the highest in the Sacramento Valley (Chow et al., 2007; Saleh et al., 2003).

Dissolved organic C has environmental and ecological implications beyond trihalomethane formation, such as facilitated transport of metals and organic pollutants (Chiou et al., 1986; Römkens and Dolfing, 1998; Tetzlaff et al., 2007; Schuster et al., 2008) and as an energy source for aquatic microorganisms (Amon and Benner, 1996). Winter flooding of rice fields has likely caused changes to the aquatic C cycle in the Sacramento Valley, as organic forms of C are transferred from the rice cultivated landscape. Other drinking water characteristics such as color, taste, and odor can be affected by DOC, and also can be affected by the concentration of total dissolved solids (TDS) (Bruvold, 1970). The secondary drinking water standard for TDS, which are comprised of dissolved salts, carbonates, metals, and organics, is set at 500 mg L^{-1} (AWWA Staff, 2003; USEPA, 2009).

Field-scale quantification of DOC and TDS fluxes from rice production systems have not been measured and the effect of straw management practices on DOC and TDS concentrations and fluxes have not been evaluated. In addition, seasonal dynamics of DOC and TDS concentrations from rice field outlets remain largely unknown. The objectives of this study were to: (i) evaluate seasonal concentrations of DOC and TDS in rice field drain water, supply canals, and drainage canals in the Sacramento Valley; (ii) quantify seasonal fluxes and flow-weighted (FW) concentrations of DOC and TDS from burned and straw-incorporated rice fields, and (iii) determine the main drivers of DOC and TDS flux and concentration in rice field drainage water.

Materials and Methods

This study was conducted on rice grower fields in California's Sacramento Valley between 1 Apr. 2006 and 30 Mar. 2008 (Fig. 1). The cooperating grower sites were located near Marysville, Biggs, Arbuckle, and Willows. Each site was located in a different rice growing area of the valley and represents a range of soil types and characteristics (Table 1). At each site, two fields of varying straw management were identified for this study: straw incorporation (I) or burning (B). Each individual field varied with respect to overall water management during the growing season (GS, 1 April–30 September) and the winter season (WS, 1 October–30 March). During the growing season, all rice fields were flooded at the time of planting. Aerial seeding occurred 3 to 5 d after the onset of flooding. Early in the growing season when pesticides were applied, some fields were completely drained and others remained flooded but did not have outflow. After pesticide application, the drained fields were immediately reflooded. Once the hold time for each pesticide expired, most fields were managed with maintenance flow (MF), where a continuous outflow of water was maintained to establish a consistent depth of water in the field. Some growers did not have any water leaving their fields and instead managed flood water depth through regulation of input water. Fields were completely drained at least 3 wk before harvest. In the winter season, straw incorporated fields were flooded during the time period of late October to late February to aid in rice straw decomposition. All straw incorporated fields were winter flooded with the exception of Arbuckle-I in 2006. During winter flooding on straw incorporated fields, water was managed with MF or through regulation of input water (Table 2). The owner of Marysville-B decided to flood the field during the WS of 2006 to create a habitat for waterfowl and was managed with MF. Water management on all other burned fields included either flooding with rainwater (outlet blockage) or allowing rainwater to immediately run off of the fields (no outlet blockage). After the growing season in 2006, two fields were taken out of rice production (Marysville-B and Arbuckle-I). A new straw-incorporated field site was identified at Arbuckle (Table 2). At the Marysville site, the Marysville-I for the GS of 2006 was burned (becoming Marysville-B) and a new straw incorporated site was identified (Table 2). Before the WS of 2007, Marysville-B and Willows-B were unable to be burned because of unfavorable weather conditions. No new burned fields were able to be identified at Marysville and Willows for the 2007 winter season. The field which was Marysville-B for the 2007 growing season was identified as the straw-incorporated field for the 2007 winter season (Table 2).

Each field had one or two water inlets that allowed irrigation from supply canals and one water outlet that drained water into peripheral drainage canals. Outflow was measured by installing a rectangular weir fitted with a Global-Water pressure sensor/data logger (Gold River, CA) in the main outlet of each field. The pressure sensor recorded the water height over the weir every 15 min. A ruler was placed on each weir to calibrate the pressure sensors and to estimate flow rates when pressure sensors were unable to be installed or malfunctioned. For the 2006 growing season, outflow was measured entirely

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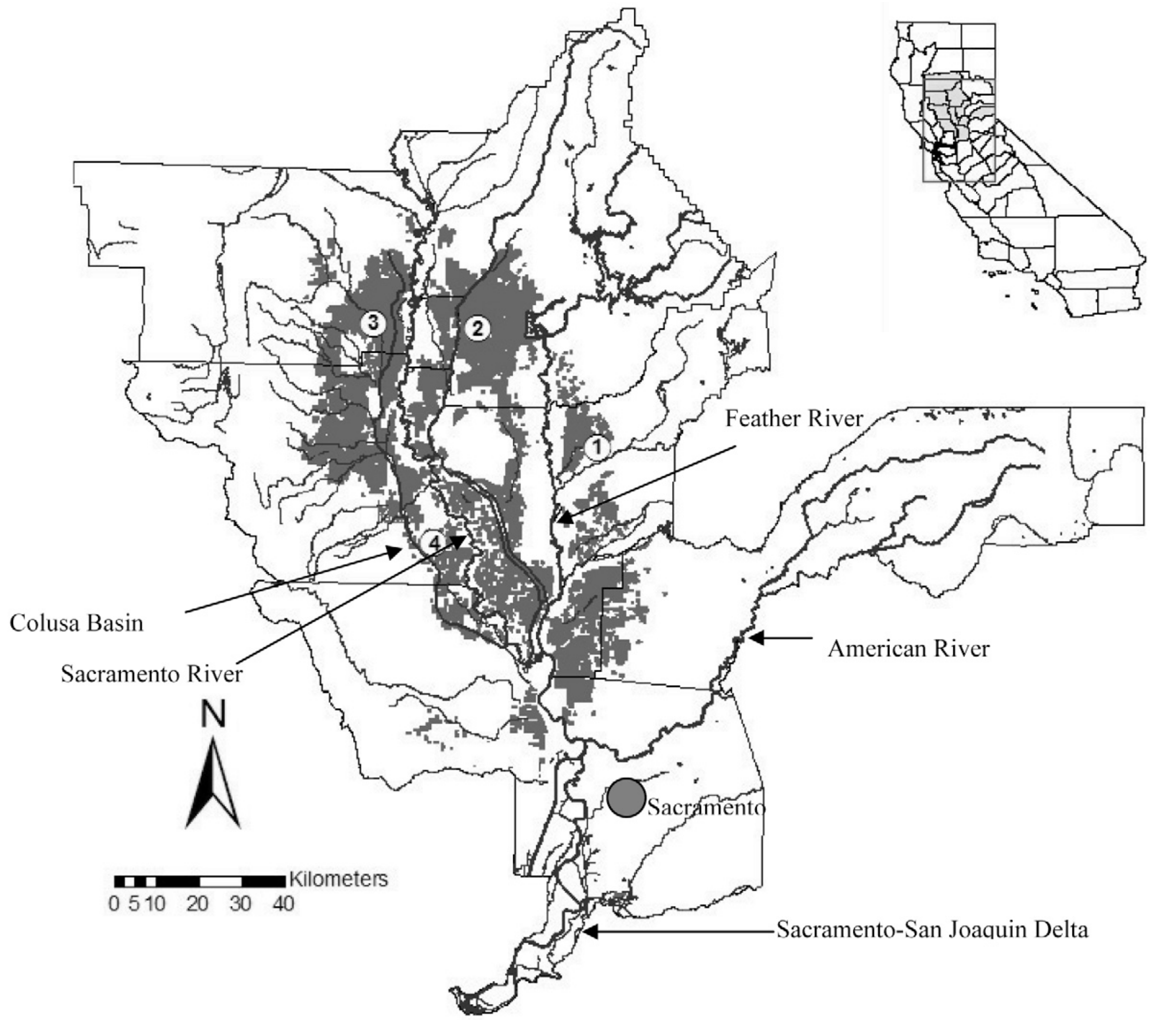

Fig. 1. Locations of experimental sites (1 = Marysville, 2 = Biggs, 3 = Willows, 4 = Arbuckle) and major surface water bodies in Sacramento Valley, CA. Gray areas represent the rice growing acreage of the Sacramento Valley.

Table 1. Field sizes, soil classification, and soil characteristics, including pH, cation exchange capacity (CEC), total carbon (TC), soil organic carbon (SOC), and texture of 10 rice fields in the Sacramento Valley.

Field	Location	Size	Soil classification†	pH	CEC	TC	SOC	Sand	Silt	Clay
		ha			meq 100 kg^{-1}	—g kg^{-1}—		—%—		
1	Marysville	25.9	Fine, mixed, active, thermic Abruptic Durixealfs	4.8	14.2	10.4	9.3	37.5	35.0	27.5
2	Marysville	24.3	Fine, mixed, active, thermic Abruptic Durixealfs	4.8	16.5	11.1	9.3	35.5	29.3	35.3
3	Marysville	9.3	Fine-loamy, mixed, active, thermic Aquic Haploxerepts Fine, mixed, active, thermic Abruptic Durixeralfs	4.8	14.1	17.6	11.2	41.0	39.0	20.0
4	Biggs	42.1	Very-fine, smectitic, thermic Xeric Epiaquerts Very-fine, smectitic, thermic Xeric Duraquerts	5.0	52.7	17.1	11.1	12.0	24.8	63.3
5	Biggs	57.9	Very-fine, smectitic, thermic Xeric Epiaquerts Very-fine, smectitic, thermic Xeric Duraquerts	5.2	52.0	19.1	12.1	15.8	24.0	60.3
6	Arbuckle	52.2	Fine, smectitic, thermic Xeric Endoaquerts	6.0	53.0	20.9	15.4	8.4	35.4	56.3
7	Arbuckle	58.7	Fine, smectitic, thermic Xeric Endoaquerts	6.2	49.5	19.2	13.1	7.0	39.0	54.0
8	Arbuckle	68.0	Fine, smectitic, thermic Xeric Endoaquerts	6.0	52.6	19.7	13.9	8.8	37.8	53.5
9	Willows	45.3	Fine, smectitic, thermic Sodic Endoaquerts	5.8	38.1	21.1	17.0	16.8	42.3	41.0
10	Willows	32.4	Fine, smectitic, thermic Sodic Endoaquerts Fine, smectitic, thermic Typic Haploxererts	5.8	32.3	20.3	18.1	22.4	40.5	37.1

† Representing >75% of the soil area.

from observed weir heights. Weirs were used to measure water flow during periods of maintenance flow, but were removed from field outlets to allow the field to be drained early in the growing season and at the end of each flooding season. To estimate water loss during the drain periods, four to eight rulers were placed in each field (one ruler per 2 to 11 ha) and depth of water was recorded before, during, and after the drain. Early growing season and end of winter season drain volumes were

Table 2. Agronomic and water management practices of 10 rice fields in the Sacramento Valley. Early water management practices during the growing season include: no early flooding (N), flooding with water held (H), or flooding followed by a complete field drain (D). Mid-growing season water management practices include: no water drained (N), maintenance flow (MF), or accidental water loss as leakage (Leak). Winter water management practices include: flooding with water held (H), flooding with maintenance flow (MF), flooding with rainfall (RF), or no flooding (NF). For the NF management, outflow occurred as surface runoff.

Field	Site	Trt†	Planting date	Variety	Flooding date	Water management Early	Water management Mid	Drain date	Yield	Trt†	Burn date	Incorp date	Flood date	Water management	Drain date‡
									Mg ha^{-1}						
				2006 Growing Season								2006 Winter Season			
1	Marysville	I	26 May	Koshihikari	22 May	N	MF	6 Sept.	6.5	B	19 Nov.		14 Nov.	MF	14 Feb.
2	Marysville	B	11 May	Koshihikari	7 May	N	MF	31 Aug.	7.6				–	–	–
3	Marysville									I		16 Nov.	11 Nov.	MF	14 Feb.
4	Biggs	I	15 May	M202	12 May	H	MF	3 Sept.	13.3	I		17 Oct.	21 Oct.	MF	29 Jan.
5	Biggs	B	8 May	M206	8 May	H	MF	21 Aug.	11.0	B	16 Oct.			NF	none
6	Arbuckle	I	12 May	M206	12 May	D	MF	22 Aug.	11.6						
7	Arbuckle									I		none	none	RF	none
8	Arbuckle	B	11 May	M206	11 May	D	MF	22 Aug.	12.9	B	21 Oct.			RF	none
9	Willows	I	14 May	M204	14 May	N	Leak	7 Sept.	na	I		1 Nov.	8 Nov.	H	1 Feb.
10	Willows	B	25 May	M205	25 May	N	Leak	14 Sept.	11.0	B	28 Oct.			RF	none
				2007 Growing Season								2007 Winter Season			
1	Marysville	B	22 May	Koshikihari	17 May	N	MF	12 Sept.	5.8	I		19 Oct.	20 Oct.	MF	20 Feb.
2	Marysville														
3	Marysville	I	26 May	Koshikihari	21 May	N	MF	12 Sept.	7.2						
4	Biggs	I	24 Apr.	M206	20 Apr.	H	MF	10 Aug.	12.4	I		28 Sept.	8 Oct.	MF	28 Jan.
5	Biggs	B	16 Apr.	M205	13 Apr.	D	MF	13 Aug.	13.5	B	1 Oct.			NF	
6	Arbuckle														
7	Arbuckle	I	27 Apr.	M202	27 Apr.	D	MF	21 Aug.	11.9	I		20 Oct.	26 Nov.	MF	5 Feb.
8	Arbuckle	B	28 Apr.	M206	27 Apr.	D	N	21 Aug.	12.6	B	8 Oct.			RF	8 Feb.
9	Willows	I	30 Apr.	M205	24 Apr.	N	N	27 Aug.	11.7	I		1 Oct.	12 Oct.	H	15 Feb.
10	Willows	B	30 Apr.	M205	24 Apr.	N	N	27 Aug.	11.2						

† Trt, straw management treatment; I, incorporated; B, burned.

‡ The drain date was the date when the outlets were unblocked, allowing field to be completely drained; none indicates that fields did not have standing water at release date.

calculated as the product of the water depth before and after drainage and the rice field area. The end of growing season final drain volumes were calculated in the same manner, correcting for volume displacement of rice plants. Rainfall data was collected by the University of California Integrated Pest Management Program (2009) and the official rainfall monitoring stations were within 15 km of each corresponding field site.

Samples were collected from supply canals across from the field inlets, from rice field outlets as water flowed over the weir, and from peripheral drains 10 to 30 m downstream of the field outlet. Samples were collected on a weekly or biweekly basis, with more intensive sampling conducted following the onset of MF, during the final drain, or after rainfall events. Water samples were stored on ice and filtered with a 1.5 μm glass fiber filter within 24 h of sample collection. Samples were frozen until subsequent analyses could be performed. Although DOC is often operationally defined as organic C passing through a 0.45 μm filter, data reported by Chow et al. (2005) indicate little difference in DOC concentrations between 0.45 and 1.25 μm pore sizes. Our selection of a slightly larger pore size reflects our desire to account for as much of the nonsediment bound organic C as possible. Filtered samples were analyzed for DOC using a Shimadzu TOC-V CSN Analyzer (Kyoto, Japan). Total dissolved solids were determined using an Oakton CON11 handheld conductivity/TDS meter (Vernon Hills, IL), which was calibrated at 25°C. During the growing season, three subseasons were identified: (1) early season, (2) mid-season, and (3) the final drain. Early-GS drainage occurred as drainflow before pesticide application, field draining for pesticide application, or the first 30 d of drainflow. Mid-GS drainage included the remaining drainflow up to the final drain. Three subseasons were also identified within the winter season: (1) early winter season, (2) mid-winter season, and (3) the final drain. The early-WS included the first 30 d of MF and the mid-WS included the remaining period of MF. Flooding season and subseason fluxes (kg ha^{-1}) of DOC and TDS were calculated as the sum of the products of each sample concentration (mg L^{-1}) and the flow-proportional volume associated with that sample. The flow-proportional volume was calculated as the total outflow occurring between days that are midway between each sampling date. Flow-weighted DOC and TDS concentrations were calculated for each season and subseason by dividing the total solute flux by the total water flux of each period.

Yield and biomass measurements were collected before harvest by collecting aboveground plant samples from an area of 0.59 m^2 at four locations within each field. Plant samples were oven-dried at 60°C, rice grain was separated from the plant, and both rice grain and straw biomass were weighed. Rice yields were reported on a 14% moisture basis and straw biomass was reported on a dry weight basis. To estimate the amount of residue that remained after burning, remaining plant biomass was collected from an area of 0.59 m^2 at four locations within the field. Soil samples (0–15 cm depth, 6 cm in diameter) were collected from each harvested area in 2006, except for field sites added after the 2006 growing season (i.e., Marysville-I and Arbuckle-I) where soil samples were collected in 2007. Soil samples were air dried, ground, and analyzed for pH (saturated paste method; U.S. Salinity Laboratory Staff, 1954), CEC (barium acetate saturation and calcium replacement method; Rible and Quick, 1960), total carbon (combustion gas analyzer method, AOAC, 1997), soil organic C (modified Walkley–Black method; Nelson and Sommers, 1996), and texture (hydrometer method; Sheldrick and Wang, 1993) by the University of California Agriculture and Natural Resources Laboratory.

Statistics were performed using SAS (SAS Institute, Inc., 1999). Analysis of variance (Proc. GLM) was conducted on the randomized complete block, blocked split plot design, with site as the block effect, straw management as the whole plot treatment, year as the split plot block effect, and flooding season as the split plot treatment. When the year effect was not significant in the model, this effect was removed and the model was run as a randomized complete block, split plot design. To evaluate the effect of subseason, ANOVA was conducted in the same manner, with subseason, instead of season, as the split plot treatment. Regression analysis was preformed on log-transformed variables between water flux and DOC and TDS flux (Proc. REG). The resulting linear model was transformed to the equation:

$$L = a\, Q^b$$

where L is the solute flux and Q is the water flux (nonlog transformed variables). Slope values (b) < 1 indicate that larger outflows are associated with lower seasonal FW-concentrations and values > 1 indicate larger outflows are associated with greater seasonal FW-concentrations compared to low outflows.

Results

Total water outflow across all fields ranged from 300 to 4720 m^3 ha^{-1} during the growing season (Table 3). Total water outflow across all incorporated fields that were flooded during the winter season ranged from 680 to 8360 m^3 ha^{-1} (Table 3). Only one burned field was flooded; in the WS of 2006 Marysville-B was flooded and the total water outflow was 13,060 m^3 ha^{-1} (Table 3). In burned, unflooded fields, rainfall caused between 0 and 1100 m^3 ha^{-1} of outflow (Table 3). Across all field sites, winter rainfall ranged from 166 to 249 mm in 2006 and 375 to 496 mm in 2007. The outflow from Biggs-B represented 2.6 and 6.4% of the winter rainfall in 2006 and 2007, respectively. In 2007, Arbuckle-B used rainfall to flood the field, and the outflow represented 22.2% of the seasonal rainfall. Rice yields ranged between 5.8 and 7.6 Mg ha^{-1} for the Koshihikari varieties, and 11.0 and 13.5 Mg ha^{-1} for all medium grain varieties (Table 2). Based on straw biomass collected at harvest, incorporation of straw added between 3.7 to 5.3 Mg ha^{-1} of organic C to the soil in 2006 and between 2.7 and 4.4 Mg ha^{-1} of organic C to the soil in 2007. The burning of straw varied from site to site. Burning removed between 80 and 90% of the straw biomass across all sites and years. Overall, burning of these sites removed similar amounts of biomass as was reported by Linquist et al. (2006) (73–80%).

Dissolved Organic Carbon and Total Dissolved Solids Concentrations

Among all collected water samples, DOC concentrations ranged between 0.6 and 77.7 mg L^{-1} for rice field outlets, 0.5 and 79.9 mg L^{-1} in peripheral drainage canals, and below detection limit (< 0.05 mg L^{-1}) and 13.6 mg L^{-1} in supply canals (Fig. 2). Median DOC concentrations in outlets, drainage canals, and supply canals were 9.5, 8.0, and 1.7 mg L^{-1}, respectively. Although the DOC concentrations from outlets exhibited large variability in each month, clear trends in monthly concentrations were detected (Fig. 2). The largest DOC concentrations were observed in October and November, the first 2 mo of the winter flooding season. The monthly patterns of DOC concentrations were similar between rice field outlets and peripheral drain canals. In supply canals, the DOC concentrations were generally lower than in the outlets and drain canals. Furthermore, the variation in DOC concentration in the supply canals was typically low, with the greatest variation occurring in the summer months.

Among all collected water samples, TDS concentrations ranged between 6.8 to 794 mg L^{-1} in rice field outlets, with a median concentration of 138 mg L^{-1}. The TDS concentrations ranged from 37 to 900 mg L^{-1} and 24.1 to 637 mg L^{-1} in peripheral drain canals and supply canals, with median concentrations of 89.2 and 51.8 mg L^{-1}, respectively. Among all collected samples, only 1.3% of all outlet samples exceeded the EPA drinking water standards (500 mg L^{-1}), while 7.1% of peripheral drain samples exceeded these standards. No trend was detected for TDS concentrations in rice field outlets, peripheral drains, or supply canals (Fig. 2). However, monthly patterns of TDS concentrations were noticeably dissimilar to monthly DOC concentrations. Based on median DOC and TDS concentrations, DOC typically represents only 7% of the TDS.

Seasonal Fluxes and Flow-Weighed Concentrations

Seasonal DOC fluxes ranged from 3.7 to 34.6 kg ha^{-1} during the growing season and from 0 to 202 kg ha^{-1} during the winter season. Although the winter season had over twice the average DOC flux compared to the spring season (35.4 vs. 14.2 kg ha^{-1}, respectively), the DOC fluxes were not significantly different between these flooding periods (P = 0.14). Seasonal fluxes of TDS were also not significantly different between the growing and winter season (293 and 232 kg ha^{-1}, respectively; P = 0.38). Across all flooding seasons, no differences in DOC or TDS flux between burned and straw-incorporated fields were determined. Furthermore, no interaction effect between straw management and season on DOC or TDS flux was observed.

Table 3. Seasonal water, dissolved organic carbon (DOC), and total dissolved solid (TDS) fluxes of 10 rice fields in the Sacramento Valley (na = data not available).

		Growing season 2006			Winter season 2006				Growing season 2007			Winter season 2007			
Field	Location	Water flux	DOC flux	TDS flux	Water flux	Rainfall	DOC flux	TDS flux	Water flux	DOC flux	TDS flux	Water flux	Rainfall	DOC flux	TDS flux
		m^3 ha^{-1}	—kg ha^{-1}—		m^3 ha^{-1}	mm	—kg ha^{-1}—		m^3 ha^{-1}	—kg ha^{-1}—		m^3 ha^{-1}	mm	—kg ha^{-1}—	
1	Marysville	2020	9.1	114	13,060	245	94.5	949	430	3.7	31	2270	430	31.3	166
2	Marysville	4640	22.1	258											
3	Marysville				900	245	19.7	88	800	6.8	59				
4	Biggs	4720	18.6	258	6160	249	202	645	3350	21.7	341	8360	375	82.8	567
5	Biggs	3140	18.7	193	60	249	0.5	5.2	4540	34.6	320	240	375	1.7	26
6	Arbuckle	2290	12.7	110											
7	Arbuckle				0	166	0	0	2550	24.2	641	1570	496	16.9	268
8	Arbuckle	3270	20.8	408	0	166	0	0	750	6.3	158	1100	496	11.3	159
9	Willows	1290	13.7	282	680	174	22.0	139	1240	8.0	319	1300	393	12.8	237
10	Willows	300	2.0	59	0	174	0	0	640	3.6	141				

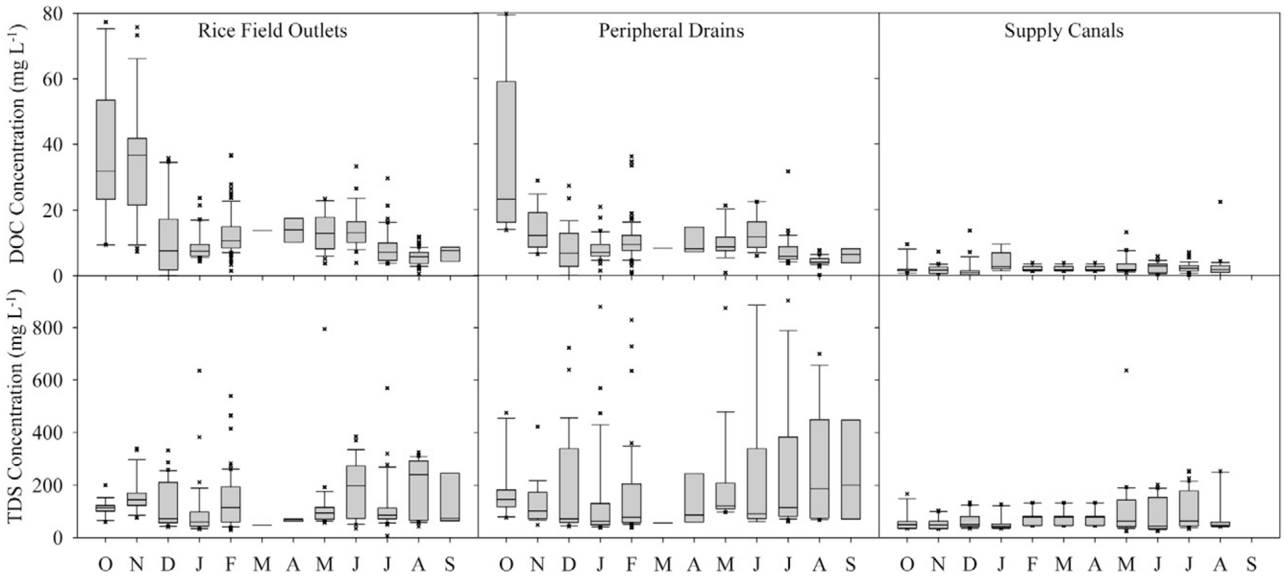

Fig. 2. Box-plot of monthly dissolved organic carbon (DOC) and total dissolved solid (TDS) concentrations from samples collected from rice field outlets, peripheral drainage canals, and irrigation supply canals of 10 different rice fields in the Sacramento Valley.

Straw management had a significant effect on seasonal FW-DOC concentration (P = 0.03), as straw incorporated fields had a higher average seasonal FW-concentration (12.5 mg L^{-1}) compared to burned fields (7.2 mg L^{-1}). The average FW-DOC concentration for the winter season (14.9 mg L^{-1}) was double of that for the growing season (6.8 mg L^{-1}) but this difference was not statistically significant (P = 0.5). There was a significant interaction effect between season and straw management (P = 0.01), which was evident during the WS, as straw-incorporated fields had a greater average FW-DOC concentration compared to burned fields (18.8 vs. 8.1 mg L^{-1}). However, the two winter seasons had different FW-DOC concentrations as incorporated fields in the WS of 2006 had nearly a three times greater average FW-DOC concentration than incorporated fields in the WS of 2007 (29.0 vs. 11.1 mg L^{-1}).

Straw management had a significant effect on sub-season FW-DOC concentrations (P = 0.02), while the effect of sub-season was not significant (P = 0.13). There was a significant interaction effect (P = 0.03) between straw management and subseason suggesting that while incorporated fields had greater FW-DOC concentrations than burned fields, the patterns of FW-DOC concentrations were also different. This was evidenced by the large FW-DOC concentration in early WS for the incorporated fields (Fig. 3). Within the winter season, the average FW-DOC concentration for the first month of outflow in incorporated fields was 35.8 mg L^{-1}, while the remaining period of outflow was 16.0 mg L^{-1} and the final drain was 15.5 mg L^{-1} (Fig. 3). These concentrations were two to four times higher than sub-seasonal FW-DOC concentrations from burned fields. The FW-DOC concentration from Marysville-B in early-WS of 2006 (the lone burned field with early-WS outflow) was 7.7 mg L^{-1}; across all burned fields with outflow, the average FW-DOC concentrations for the mid-WS and final drain of the WS were 7.0 and 9.5 mg L^{-1}, respectively. Each straw incorporated field that had MF exhibited the same trend of decreasing DOC concentrations over the WS [Biggs-I in 2006, Marysville-I in 2007, and Biggs-I in 2007 (Fig. 4); Marysville-I in 2006 and Arbuckle-I in 2007 (data not shown)]. Only a slight decreasing trend was observed

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for Marysville-B in 2006 (Fig. 4). Similar decreasing patterns in DOC concentration were also observed during the growing season (data not shown). At Willows, the in-field DOC concentrations appeared to decrease over time without any DOC being exported from the field with drain water (Fig. 5).

In contrast to DOC, seasonal FW-TDS concentrations were not significantly different between straw management treatments. Additionally, FW-TDS concentrations were not significantly different among seasons and no interaction effect between straw management and season was observed. Average seasonal FW-TDS concentrations were 120 mg L^{-1} for winter and 130 mg L^{-1} for the growing season. In addition, FW-TDS concentrations were not significantly different across subseasons and there was not a significant interaction effect between straw management and subseason (Fig. 6).

The relationship between log-transformed values of water flux and DOC flux was significant, with seasonal outflow accounting for 90 and 88% of the variability in DOC flux during the GS and WS, respectively. Across all fields, the slope for the GS outflow-DOC flux relationship was 0.87. The 90% confidence limit for this slope was between 0.74 and 1.00, indicating that based on a slightly larger confidence limit, this slope would be significantly <1, providing evidence that an increase in outflow through greater water usage dilutes the seasonal FW-DOC concentration. The slope of the outflow-DOC flux relationship during the WS was not significantly different than 1, indicating that greater total outflow, originating from flooding and rainfall, did not dilute the FW-DOC concentration. Water flux accounted for 49 and 90% of the TDS flux during the GS and WS, respectively. Neither seasonal slope of the outflow-TDS flux relationship was significantly different than 1.

Discussion

Dissolved Organic Carbon in the Sacramento Valley

The highest DOC concentrations in rice field outflow occurred at the onset of winter flooding of straw incorporated fields (Fig. 2) in October and November. The pattern of high DOC concentrations at the onset of drainflow, followed by a sharp decrease over time (Fig. 2 and 3), was observed in each winter flooded rice field where maintenance flow occurred. Stepanauskas et al. (2005) reported that in 2000 and 2001 peak DOC concentrations in the Sacramento River occurred between January and March. Since seasonal patterns of DOC concentrations differ between rice fields and the mouth of the Sacramento River (Fig. 2 vs. Stepanauskas et al., 2005), rice field DOC was not likely the main contributor to the Sacramento River during these peak periods. Consequently, this would indicate that the contribution of DOC from rice production systems in the Sacramento Valley toward the Delta would be minimal. However, it is probable that rice production systems are a main source of DOC for upstream locations in the Sacramento River during the growing season because little rainfall occurs. In addition, surface water bodies that receive rice field drainage waters, such as the Colusa Basin Drain, have the highest DOC concentrations of the Sacramento Valley watershed (Saleh et al., 2003; Chow et al., 2007) and flow directly into the Sacramento River. Other

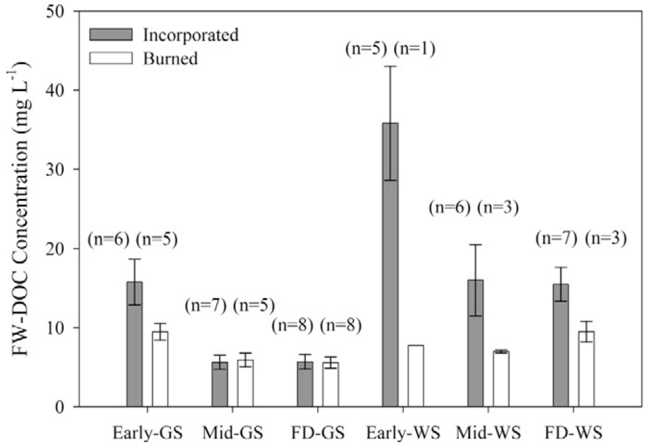

Fig. 3. Average subseason flow-weighted (FW) dissolved organic carbon (DOC) concentrations for incorporated and burned fields. Subseasons include: early growing season (Early-GS), mid-growing season maintenance flow (Mid-GS), final drain of growing season (FD-GS), early winter season (Early-WS), mid-winter season maintenance flow (Mid-WS), and final drain of winter season (FD-WS). Early-GS includes drainflow before pesticide application, draining of the field, or the first 30 d of drainflow. Mid-GS includes all remaining drainflow up to the final drain. Early-WS includes the first 30 d of maintenance flow and Mid-WS includes all remaining drainflow up to the final drain. Sample populations (*n*) are provided and error bars represent standard error.

organic compounds, such as pesticides used in rice production, have the ability to be transported across the same distance (Orlando and Kuivila, 2004, Finlayson et al., 1993). However, it should be noted that rice fields are not the sole potential source of DOC in the Sacramento Valley, as there are many wetlands in the region, which are known to increase DOC concentration in surface waters (Díaz et al., 2008). Wetlands have been shown to have a large impact on watershed level DOC flux, as positive linear relationships between wetland area and DOC flux have been determined (e.g., Laudon et al., 2004). In addition, urban areas can impact DOC in streamwater; Sickman et al. (2007) determined that urban runoff accounted for 17% of the DOC flux in the Sacramento River.

Dissolved Organic Carbon and the Terrestrial Carbon Budget

The seasonal fluxes of DOC with drainage water represented only a small portion of the terrestrial C pool in rice systems. Average annual DOC losses per site represented 0.22% of the soil organic carbon in the upper 15 cm (assuming a bulk density of 1.2 g cm^{-3}). Among straw incorporated fields, DOC losses via drainflow represented between 0 and 3.8% of the rice straw C in WS-2006 and between 0.3 and 1.9% in the WS of 2007. As a C export pathway, drainage waters were small in comparison to C loss via grain removal (2.4 to 5.5 Mg ha^{-1}, based on yields in Table 2 and a C concentration of 41%) and annual heterotrophic carbon dioxide (CO_2)-C fluxes (2.4 Mg ha^{-1}; McMillan et al., 2007), but were similar to methane (CH_4)-C fluxes in nonflooded burned fields (13–50 kg ha^{-1}) and in flooded, straw-incorporated fields (98–205 kg ha^{-1}; Fitzgerald et al., 2000). It

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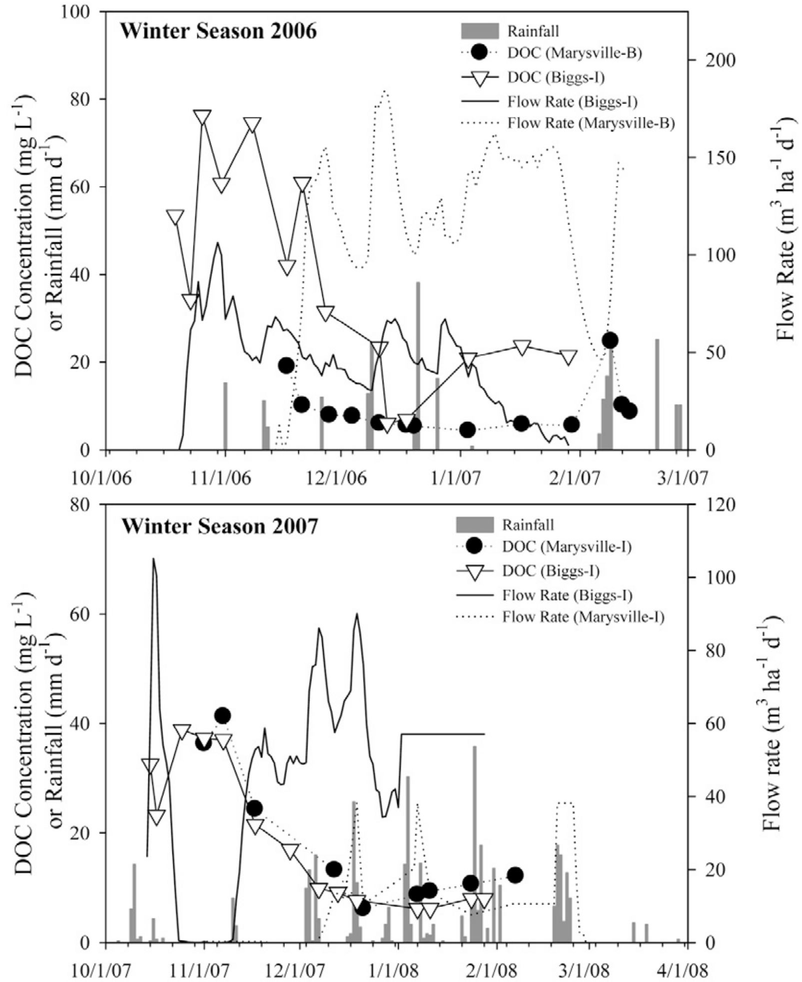

Fig. 4. Dissolved organic carbon (DOC) concentrations in outflow from two representative fields during maintenance flow in winter season 2006 and winter season 2007. I = incorporated; B = burned.

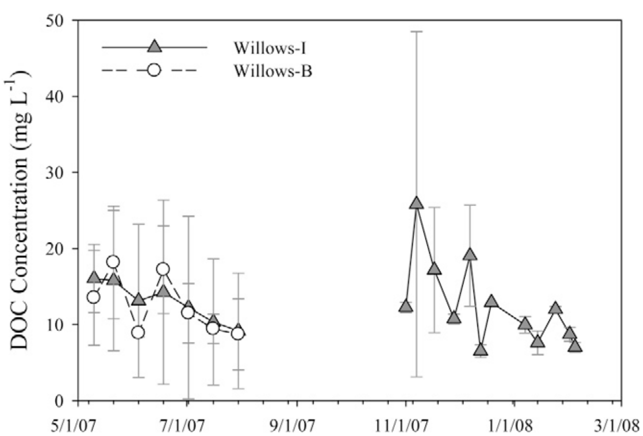

Fig. 5. Dissolved organic carbon (DOC) concentrations from samples collected in-field at Willows during the growing season and winter season of 2007. Error bars represent standard deviation. I = straw incorporation, B = burning.

appears that in incorporated fields with high rates of maintenance flow (e.g. Biggs-I) winter losses of C as DOC could even exceed CH_4–C losses (Table 3).

Water management affected whether rice productions systems were net importers or exporters of DOC during the growing season. After estimating seasonal water inflows as the sum of outflow and evapotranspiration (9200 m^3 ha^{-1}; Lourence and Pruitt, 1971) and estimating growing season influx using average seasonal DOC concentrations in supply canals, rice fields received more DOC than they exported during the growing season. Based on this simple calculation of inflow, which does not account for percolation losses, the average growing season net import of DOC was 13 kg ha^{-1}. Other surface irrigation systems in California have also been shown to result in a similar net import of DOC to the system (21.4 kg ha^{-1}; Poch et al., 2006). Without reliable estimates for evaporation during winter flooding, a winter season dissolved C budget is difficult to discern. Using the evapotranspiration that Lourence and Pruitt (1971) measured in September (1460 m^3 ha^{-1}), and assuming a 4-mo flooding period, provides a total winter season evaporation estimate of 5840 m^3 ha^{-1}. Based on this estimation and averaged across all fields, winter flooding resulted in a net export of DOC (42 kg ha^{-1}), although at two fields, net imports were estimated. McMillan et al. (2007) measured an annual net C influx to rice systems of 670 kg ha^{-1} and Kroodsma and Field (2006) determined that California rice fields sequester 550 kg ha^{-1} yr^{-1}, but dissolved C fluxes were not considered

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in either calculation. Winter flooding on straw-incorporated fields, when managed with MF can result in a net export of 180 kg ha^{-1} of DOC (Biggs-I in 2006). Our results suggest that future research on California's agricultural systems should consider the dissolved C components when assessing whether production systems are a net source or sink of C.

Dissolved Organic Carbon and Water Management

Subseasonal dynamics of DOC concentrations in rice field outflows were affected by straw management and the timing of water operations. During the winter season, straw-incorporation increased DOC losses over burning, but outflow accounted for 88% of the variability in DOC loss among all fields. Winter outflow was also a strong predictor of TDS flux. Water flux has also been shown to be the driving factor of DOC loss from other agricultural systems (Ruark et al., 2009; Brye et al., 2001) as well as agriculturally dominated watersheds (Dalzell et al., 2007). Dalzell et al. (2007) also suggest that a strong relationship between water flux and DOC flux is a common trait of managed landscapes. During the growing season, a significant dilution effect was determined; greater amounts of outflow diluted seasonal FW-DOC concentrations. During the winter season, a dilution effect was not determined; greater amounts of outflow did not dilute seasonal FW-DOC concentrations. However, during the winter season, DOC concentrations clearly decrease over time (Fig. 4), suggesting that DOC is immediately available for loss after straw incorporation and that large amounts of DOC can get flushed out of the system at the onset of outflow. Also, DOC concentrations appear to be affected by changes in daily flow rate or occurrence of rainfall (Fig. 3), although more intensive sampling is required to better understand these relationships.

The DOC concentrations decreased in flooded fields when no outflow occurred (Fig. 5). Delaying the onset of outflow may provide a large benefit in reducing DOC concentrations in outflow. Holding water during October and November would reduce the DOC concentrations in outflow, but other tradeoffs such as straw decomposition rates and greenhouse gas fluxes, would need to be assessed. In addition, the mechanism for the decrease in DOC concentration is unknown. Several processes can cause the removal of DOC in these systems including microbial utilization, photochemical oxidation, and flocculation and settling of particles. Further research is required to assess if the reduction in DOC concentration in low-flow irrigation management conserves the organic C in the terrestrial system or increases C losses through other pathways.

Conclusions

Straw incorporation and winter flooding of rice fields have added a new flux of DOC and TDS into Sacramento Valley surface waterways over the past 15 yr. Based on our data, it is evident that the export of DOC from these fields can contribute to increased DOC concentrations in the Sacramento River, but rice fields may not be the cause of peak DOC concentrations typically observed later in the winter season. Further investigation into quality components of DOC is required to fully address this issue. Rice field outlet water rarely exceeded drinking water standards for TDS and therefore would not be considered a source for this potential contaminant. Reduction in DOC concentrations from rice outlets may be achieved through changes in water management, but environmental and agronomic trade-offs need to be fully explored. Such changes in water management may need to be considered in parts of the world where rice production is extensive and surface waters are used as the main drinking water source.

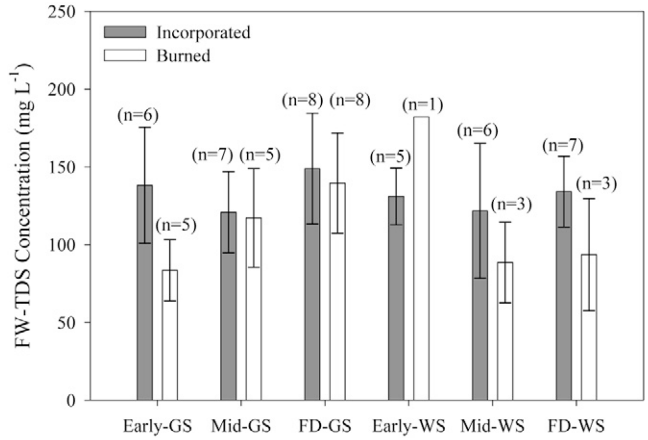

Fig. 6. Average subseason flow-weighted (FW) dissolved organic carbon (TDS) concentrations for incorporated and burned fields. Subseasons include: early growing season (Early-GS), mid-growing season maintenance flow (Mid-GS), final drain of growing season (FD-GS), early winter season (Early-WS), mid-winter season maintenance flow (Mid-WS), and final drain of winter season (FD-WS). Early-GS includes either discrete drainflow events in April through June or the first 30 d of drainflow. Mid-GS includes all remaining drainflow up to the final drain. Early-WS includes the first 30 d of maintenance flow. Sample populations (*n*) are provided and error bars represent standard error.

Acknowledgments

The authors would like to thank Robert Rousseau, Ligia Bacchereti Azevedo, and Luis Felipe Tiene da Silva for help with laboratory analysis and Jennifer Krenz-Ruark for contributions to the manuscript. The authors would also like to acknowledge Steve Bickley, Karen McCalister, and Christopher Preciado for help with sample collection and field maintenance. Funding for this project was provided by the California State Water Resources Control Board's Nonpoint Source Pollution Control Grant Program.

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Attachment E

Tentative WDR General Order for

Sacramento Valley Rice Growers

February 18, 2014

Sediment Production and Transport in and around Sacramento Valley Rice Fields

Dr. John Dickey, PlanTierra

MEMO

From:	*John Dickey/PlanTierra*
To:	*Roberta Firoved*
Date:	February 17, 2014
Subject:	***Sediment Production and Transport in and around Sacramento Valley Rice Fields***

The process of sediment removal from the land in flowing water is called "water erosion". Depending on its fate in the watershed, eroded sediment may or may not become a pollutant of concern. Nevertheless, lands where the rate of water erosion is low are generally less likely to be sources of pollution by sediment, and thus generally not a cause for concern when attempting to control sediment pollution in watersheds.

The Revised Universal Soil Loss Equation (RUSLE [USDA, 2013]) quantitatively relates a series of determining factors to rates of soil erosion. These are listed here, along with a discussion of each as it relates to rice farming areas in the Sacramento Valley:

- Climate (e.g., rainfall erosivity). This factor is in some ways similar among rice fields and the surrounding landscape areas. However, one expression of climate is the potential to grow plant cover. The realization of this potential is captured in another factor, land use.
- Soil (erodibility). Rice lands often have heavy-textured (i.e., rich in clay) soils, that cohere, and that may thus resist erosive forces better than, for example, sandy soils.
- Topography (Slope length, steepness, and shape). Rice is grown on very flat land surfaces, where 1) suitable soils are most frequently found, and 2) it is more practical to grow a flooded crop. Rice fields are further leveled by farmers to provide a uniform depth of flooding and water management. This uniformity benefits the crop by improving weed control and preventing transformation and volatilization of applied nitrogen. The slope length is shortened by installation of border levees (or "checks") to impound water. The combined effect of these flat surfaces and shortened slope lengths is an extremely low potential for water erosion. In fact, sediment laden water that flows onto rice fields (for example, during flooding events) tends to deposit suspended sediment as it spreads out and slows down. This sediment capture is effectively a negative rate of erosion that helps to diminish the water quality impacts of erosion from uplands, providing a net benefit to water quality.
- Land use (cover-management [cultural] practices [including crops that are grown, yield level, and management of crop residue] and support practices [including small impoundments, such as impoundment terraces]). Among other things, this factor captures the protection of soil surfaces from water erosion by standing or residual plant material. Rice stands are grown densely to maximize rice yield, and are extremely protective. During the growing season, roots anchor soil, and standing plants slow the rate of irrigation water flow through the field, so that outflow is often not turbid. Crop residues (stems and leaves) are usually left on the land surface, or punched partially into the soil. This mode of cover management tends to further reduce the rate of erosion by rainfall and flowing water.

Thus, experience and theory indicate that, for very obvious reasons, rice cultivation is a mode of land management that tends to trap, rather than to produce sediment in the Sacramento Valley watershed.

This characterization is generally supported by a thorough, 4-year study (October 1977 to March 1982) of sediment production and transport in the 1-million-acre Colusa Basin, a major rice growing region in the Sacramento Valley (Mirbagheri and Tanji, 1981; Tanji et al., 1978; Tanji et al., 1980a; Tanji et al., 1980b; Tanji et al., 1981; Tanji et al., 1982). The project's objectives were to: (1) assess the area's soil erosion and sediment production, (2) conduct field investigations on suspended matter production and transport, (3) evaluate and determine factors contributing to erosion and sediment production, as well as the transport, deposition, and re-suspension of sediments, (4) develop a sediment transport model, (5) create recommendations for best management practices to minimize sediment production in the Colusa Basin Drain (CBD) area, and (6) consult with interested parties about research plans and results, and get input on feasibility and implementation of proposed management practices. Some of the findings of this study include the following:

- The main source of sediment in the watershed is sheet and rill erosion from irrigated and dry farmed uplands (lands lying above floodplains), with an average of 0.28 t/a-y in sediment produced.
- Sheet and rill erosion and sediment production from irrigated agriculture was specifically studied through tomato, corn, and rice fields, and sediment loads produced from each crop were measured. The sediment loads produced by the tomato and corn fields were comparable as both types were furrow irrigated fields. These types of crop fields added sediment load to the supply water's load. The rice fields, in contrast, acted as settling basins for suspended sediment, due to their frequent state of continuous flood.
- Erosion of stream banks and overflow areas is locally accelerated, specifically in those channels with unprotected channel banks or in channel overflow areas during high rainfall events.
- On the average, sediment produced is comprised of 60% mineral, 30% organic, and 10% algal fractions.
- Production, transport, and deposition are modulated by:
  - Hydraulic characteristics of land surfaces and channels
  - Electrochemical (electrical conductivity [salinity] and sodium adsorption ratio [cation balance]) of sediments, which together affects the balance between flocculation and dispersion, and thus between settling and suspension.
  - Biological (carp and crayfish) activity in channels, which tends to re-suspend sediment after it has settled. It was found that 20% of total suspended solids measured in the Colusa Basin Drain have been biologically re-suspended in this manner.
- Erosion and sedimentation models (such as RUSLE) predict 90% of the observed (measured) variation in sediment concentrations. (*Note by this author: This tends to validate the applicability of the previous, theoretical discussion*).

The location of this study suggests that its findings are applicable throughout the Sacramento Valley rice growing areas, for the following reasons:

- At 1 million acres, the Colusa Basin contains a large proportion of the Sacramento Valley's rice fields, so that the roles of these lands in watershed- and field-level sediment production and transport are directly captured and reflected in the study's results.
- The lowland areas of other large Sacramento Valley basins where rice is grown, such as the Butte, Natomas, and Sutter, have comparable properties to rice lands in the Colusa Basin.
- Factors known (and confirmed in the study) to influence sediment production and transport are quite consistent across all rice fields, due to
  - The need to maintain a permanent and uniform flood during the growing season.
  - The need to grow a productive crop and manage the residue from that crop.

Rice lands thus occupy a distinct position in the watershed from the standpoint of sediment production and transport. Best management practices that are most frequently cited to control water erosion and sediment production tend to be suited to more erodible surfaces found in uplands, and have limited application to most rice fields, which are level, and where sediment has ample time to settle as irrigation and drainage filters through them.

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Comment Letter 2

CALIFORNIA FARM BUREAU FEDERATION
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MAWong@waterboards.ca.gov

February 18, 2014

Margaret Wong
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

Re: Comments on the Tentative Draft WDRs/MRP for Rice Growers Within the Sacramento Valley

Dear Ms. Wong:

The California Farm Bureau Federation ("Farm Bureau") is a non-governmental, non-profit, voluntary membership California corporation whose purpose is to protect and promote agricultural interests throughout the state of California and to find solutions to the problems of the farm, the farm home, and the rural community. Farm Bureau is California's largest farm organization, comprised of 53 county Farm Bureaus currently representing more than 74,000 agricultural, associate, and collegiate members in 56 counties. Farm Bureau strives to protect and improve the ability of farmers and ranchers engaged in production agriculture to provide a reliable supply of food and fiber through responsible stewardship of California's resources.

Farm Bureau appreciates the opportunity to provide comments on the tentative draft of the Waste Discharge Requirements and Monitoring and Reporting Program for Rice Growers in the Sacramento Valley (collectively "Tentative WDR") and respectfully presents the following remarks. Many of the comments raised in Farm Bureau's previous letter on the Draft WDR, dated September 13, 2013, are still pertinent, and are incorporated and reiterated herein.

General Order Page 1, Finding 1—Definition of "Waste"

2-1 The Draft WDR seeks to regulate discharges of "waste" from irrigated lands. As referenced in the footnote to Finding 1, Attachment E defines the term "waste" to not only include the statutory definition found in Water Code section 13050(d), but also adds additional language to include the regulation of "earthen materials…, inorganic materials…, organic materials such as pesticides, and biological materials" as wastes which "may directly impact beneficial uses…or may impact water temperature, pH and dissolved oxygen." (Tentative WDR, Attachment E, p. 6.) No rationale is provided for the overly broad expansion of a statutorily defined term; as such, the term "waste" should be limited to its definition found in Water Code section 13050(d). To provide clarity and conformance with

Comment Letter 2

Water Code section 13050(d), Farm Bureau offers revising the second sentence of the definition of "waste" to read (additions are underlined):

> "Potential examples of wastes from irrigated lands that may conform to this definition include, but are not limited to, earthen materials (such as soil, silt, sand, clay, rock), inorganic materials (such as metals, salts, boron, selenium, potassium, nitrogen, phosphorus), organic materials such as pesticides, and biological materials, such as pathogenic organisms."

General Order Page 1, Finding 3—Regulation of Water Quality

2-2

The Tentative WDR amends the scope of regulatory coverage by not including specific provisions limiting the regulation of water traveling through particular structures. (Tentative WDR, p. 1.) The current scope of coverage causes concern regarding the regulation of on-farm conveyances and between-farm conveyances, causing potential ambiguity regarding the point of demarcation for regulation; as currently written, the regulation could be read to regulate any water that leaves the root zone whether or not it reaches saturated groundwater. In order to provide clarity, Finding 5 should be revised.[1]

General Order Pages 9-10, Findings 29-33—Compliance with the California Environmental Quality Act

2-3

The Tentative WDR relies upon the environmental analysis conducted in the Program Environmental Impact Report ("PEIR") and concludes that "[a]lthough the Order is not identical to any of the PEIR alternatives, the Order is comprised entirely of elements of the PEIR's wide range of alternatives." (Tentative WDR, p. 9, ¶ 30. *see also id*. at ¶ 31.) Relying on such analysis, the Tentative WDR further concludes "the PEIR identified, disclosed, and analyzed the potential environmental impacts of the Order" and the "potential compliance activities undertaken by the regulated Dischargers…fall within the range of compliance activities identified and analyzed in the PEIR." (*Id*. at ¶ 30.) However, the Tentative WDR, or its estimated costs, is not within the realm of alternatives analyzed within the PEIR, but rather goes beyond those alternatives by including provisions substantially different from elements in those alternatives, especially alternatives 3 through 5. These new components, such as provisions creating end-of-field discharge limitations, as well as the farm management performance standards, in addition to the associated costs, do not represent merely a "variation" on the alternatives in the PEIR, but rather are elements that were not thoroughly considered previously and are likely to result in the imposition of new burdens on irrigated

[1] Finding 5 could be potentially revised to state: "This Order is not intended to regulate water in agricultural fields, including, but not limited to, furrows, beds, checks, and ancillary structures, contained on private lands associated with agricultural operations. This Order is not intended to address the lawful application of soil amendments, fertilizers, or pesticides to land." Additionally or in the alternative, the following phrase, "from which there are discharges of waste that could affect the quality of any waters of the state," could be added to Finding 5 to clarify that the WDR is not regulating water that moves past the root zone when there is no threat to waters of the state or that the movement of water below the root zone is a de facto discharge of waste.

Comment Letter 2

agricultural operations that will have a significant and cumulatively considerable impact on the environment. Thus, reliance on the PEIR for CEQA compliance is inappropriate.[2] In order to comply with CEQA, the Regional Board should prepare a supplemental EIR that analyzes the new elements along with revised cost estimates.

General Order Pages 11-12, Finding 36-37—California Water Code Sections 13141 and 13241

2-4 Pursuant to the Water Code, the Regional Board is obligated to consider costs associated with the entire Long-Term Irrigated Lands Regulatory Program, as well as each individual general order, such as the Rice Growers WDR. (Wat. Code, § 13141.) Finding 36 incorrectly concludes that any new cost analysis is unnecessary given that "the Basin Plan includes an estimate of potential costs and sources of financing for the *long-term irrigated lands program*." (Tentative WDR, p. 11, ¶ 36, emphasis added.) Although the Basin Plan was amended to include costs associated with the *long-term irrigated lands program*, the Basin Plan Amendment did not include specific costs associated with the Rice Growers WDR as it was not in existence at the time nor were the specific program requirements analyzed (such as the templates and individual reporting summarized by the third-party). Given that this Tentative WDR proposes new costly regulatory components not previously analyzed during the environmental review stage or when adopted in the Basin Plan, the Regional Board must analyze, evaluate, and estimate all of the costs of these new regulatory requirements.

General Order Page 18, Provisions III. A and III. B—Discharge Limitations

2-5 The use of "shall not cause *or contribute*" to an exceedance of applicable water quality objectives is overly expansive and can create an unreasonable standard holding growers liable for even the smallest de minimus contribution. Although Provision C was added to the Tentative Draft to provide additional clarity, the language in Provision A and B still creates an unreasonable standard. Accordingly, a qualifier should be added before "contribute," or the discharge limitations for both surface water and groundwater should be rewritten to state "wastes discharged from Grower operations shall not cause an exceedence of applicable water quality objectives in surface water [or the underlying groundwater], unreasonably affect applicable beneficial uses, or cause a condition of pollution or nuisance."

General Order Page 20, Provisions IV. B. 13—Inspection

Farm Bureau appreciates the addition of footnote 20 specifying "the inspection of Grower's facilities and rice lands does not include the Grower's private residence."

General Order Page 26, Provision VIII. B—Template Requirements for Farm Evaluations and Nitrogen Management Plans

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[2] Farm Bureau also questions the Regional Board's authority to require mitigation measures within the Tentative WDR for farm level activities. Implementation of management practices at the farm level, which is the heart of the WDR, is not subject to a discretionary approval by the Regional Board. (See Pub. Resources Code, § 21080, CEQA generally applies only to discretionary projects.) Mitigation measures that cannot be legally imposed need not be proposed or analyzed. (CEQA Guidelines, § 15126.4(a)(5).)

Farm Bureau appreciates the inclusion of language to allow the California Rice Commission the ability to develop or modify the templates due to commodity-specific issues, including geographic area, known water quality impairments, the propensity to impact water quality, and irrigation practices. Such tailoring will allow the Regional Board to obtain the most relevant information specific to the area being regulated while also allowing growers to minimize costs.

Attachment A, Information Sheet, Page 44—Spatial Resolution of Farm Evaluation Information; Attachment B, MRP, Page 6, Reporting Component 22

Reporting Component 22 outlines the process in which the California Rice Commission will collect management practice information from members and report the aggregate data to the Regional Board at the township level. As currently drafted, Farm Bureau supports the aggregate reporting of summarized information at the township level. Reporting at the township level allows the third-party group the ability to properly compare crop data, evaluate management trends, and manage the data in an efficient and effective manner.

2-6

In addition to aggregating and summarizing information collected in the Farm Evaluations at the township level, Reporting Component 22 further requires the California Rice Commission to provide the individual data records to the Regional Board. (Attachment B, p. 6 (*note, page numbers for Attachment B are out of order).) No explanation is given within the MRP or WDR to support the necessity of needing the individual data records. The comparison of data at the field level, with or without the identification of a member's parcel, is not supported and would not result in an efficient use of resources or the ability to assess and evaluate trends. Rather, the summary of management practices provided by the California Rice Commission will be more meaningful than the individual data records and will include the appropriate analysis needed by the Regional Board. Thus, Farm Bureau questions the need for the California Rice Commission to submit individual data records and suggests this addition to the management practices information reporting component be removed.

Thank you for the opportunity to provide our comments and concerns. We look forward to further involvement and discussion with the Regional Board on the WDR and MRP for Rice Growers within the Sacramento Valley.

Very truly yours,

Kari E. Fisher
Associate Counsel

KEF:pkh

City of
SACRAMENTO
Department of Utilities

Comment Letter 3

February 18, 2014
140055:EC

Ms. Margaret Wong
Central Valley Regional Water Quality Control Board
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Rancho Cordova, CA 95670-6114

Sent via e-mail to MAWong@waterboards.ca.gov

Subject: Sacramento River Source Water Protection Program Comments on ILRP Tentative WDRs General Order for Sacramento Valley Rice Growers

Dear Ms. Margaret Wong:

On behalf of the Sacramento River Source Water Protection Program (SRSWPP), thank you for the opportunity to provide comments on the Irrigated Lands Regulatory Program (ILRP) Tentative Waste Discharge Requirements General Order for Sacramento Valley Rice Growers (Rice Order). The SRSWPP is sponsored by the City of Sacramento and the Sacramento County Department of Water Resources; this program is coordinated with other agencies that draw their drinking water from the Sacramento River (or have plans to do so), including the City of West Sacramento, East Bay Municipal Utility District, and the Woodland-Davis Clean Water Agency. We serve drinking water to more than 600,000 people in Northern California.

Watershed management programs are essential for preserving the high quality of the Sacramento River watershed. The Central Valley Regional Board and other regulatory agencies, regulated communities, and educational organizations have made significant strides. We appreciate the substantial efforts of the ILRP and the California Rice Commission (CRC) to protect water quality. The SRSWPP supports the overall framework of the tentative Rice Order. We support adoption of the Tentative Rice Order with minor - but important - modifications to the Monitoring and Reporting Program, which are specified below.

The SRSWPP seeks to maintain the high quality of the Sacramento River drinking water supply for the current and future generations. It is our responsibility as water utilities to ensure that our water is both healthful and free of any unpleasant taste, odor, or other aesthetic effects. We have been actively providing stakeholder input during the development of the Long-Term Irrigated Lands Regulatory Program (ILRP) orders, because they have the potential to impact source water quality for current and future water quality constituents of interest.

Source water protection is part of a "multi-barrier" approach to providing safe drinking water. Drinking water treatment alone cannot always be successful in removing contaminants. Even in cases where treatment is an option, treatment can be substantially more costly than source water protection. We rely on management programs, including the Long-Term ILRP, as part of the source water protection in the Sacramento Valley.

Over the last two decades, on many occasions the City of Sacramento and City of West Sacramento have detected pesticides at our water treatment plant intakes on the Sacramento River that are used only on rice. The presence of rice pesticides at our intakes demonstrates that there are pathways for water pollutants in rice discharges to reach downstream water supplies. In addition, our ongoing drinking water source assessments continue to identify agriculture as a significant potential contaminating activity in our watershed. We appreciate the efforts of the rice industry and regulatory agencies through the Rice Pesticide Program, which have resulted in significant reductions in frequency and detected levels of thiobencarb in the Sacramento River. We support the continued management of thiobencarb through the existing Rice Pesticides Program, as noted in the tentative Rice Order.

Agriculture, including rice cultivation, has the potential to contribute numerous constituents of interest to our source water. Our key interests for the Sacramento River drinking water supply, in addition to pesticides, include turbidity, organic carbon, and pathogens. Historical data collected as part of the ILRP indicates that these constituents are contributed by agriculture, so we support their inclusion in this long-term Order by monitoring and implementing control measures, as appropriate.

Our comments on the Tentative Rice Order include the following three remaining issues on the Attachment B Monitoring and Reporting Program (MRP), with corresponding suggested modifications. We recognize that there may be other solutions to address the issues, and we welcome those ideas and further discussion.

1. Limited Representative Monitoring during Non-Irrigation Season

Limited monitoring for field measurements and general physical parameters is requested during the non-irrigation season at the four primary monitoring sites. We request that the assessment and modified assessment monitoring be modified to add the winter drainage of a significant acreage of rice, which typically occurs in mid-February or March. This information will fill an important data gap for organic carbon and related constituents.

Total organic carbon (TOC) in the water column is a surrogate measure of disinfection by-products (DBP) precursor material in water. TOC levels in either source or treated water are used to determine treatment requirements in the Stage 1 Disinfectant/Disinfection By-Product Rule (D/DBP Rule). 3-1
Disinfectants used in drinking water treatment can react with the naturally-occurring portion of organic carbon in the water to form byproducts, such as trihalomethanes and haloacetic acids, which are both defined by EPA as carcinogens, and may pose health risks. Organic carbon is recognized in the chemical constituents narrative of the Basin Plan, as per the Delta Drinking Water Policy, and therefore must be evaluated as part of the Long-Term ILRP. Protection of the municipal and domestic beneficial use should include looking at the cumulative effects of watershed activities and ensuring that reasonable efforts are made to prevent degradation in the long-term.

Please see **Attachment 1** for suggested modifications to the MRP and additional supporting information for this request.

2. Annual Monitoring Report (AMR) to include discussion of trends of degradation that may be occurring.

It is important that the AMR requirements include review for trends of degradation and discussion, to help ensure protection of beneficial uses and to protect the high quality of the Sacramento River water supply. We request that the AMR include a similar review as in Report Component No. 18 – Evaluation of Monitoring Data, in the Sacramento River Watershed Tentative Order.[1] We believe that a frequency of two years out of the five year monitoring cycle should be sufficient evaluation to identify trends, unless there have been any water quality objective or trigger limit exceedences in any given year. 3-2

We refer to page 3 of our September 13, 2013 comments on the Administrative Draft Order for discussion of the importance of the monitoring program design to detect degradation and provide response mechanisms. We believe that review of trends of degradation in the AMR support this important need.

3. Clarification of discussion of Table 7 to provide for future adaptability

We understand that Table 7, Basin Plan Numeric Water Quality Objectives for the Sacramento River Watershed, provides the current numeric water quality objectives which Board staff have evaluated and determined may be applicable to this order. We request clarification of the discussion of Table 7 to ensure adaptability to address the potential for future additional constituents of interest.

The text on page 35 currently states that "Table 7 of this MRP lists Basin Plan numeric water quality objectives and NTR/CTR criteria for constituents of concern that may be discharged by Growers. We request that a sentence be added immediately after this sentence, stating that there may be other constituents with numeric water quality objectives that could be present in the discharge and those objectives apply as well. 3-3

We appreciate the efforts of Regional Board staff and the CRC to meet with us and discuss our comments and interest. We also would like to take this opportunity to provide our recognition and support of some of the key changes that are included in the Tentative Rice Order.

---

[1] See the Sacramento River Watershed Tentative Order Attachment B – MRP, page 31:

> **Report Component No. 18 — Evaluation of Monitoring Data**
> The third-party must evaluate its monitoring data in the Monitoring Report in order to identify potential trends and patterns in surface and groundwater quality that may be associated with waste discharge from irrigated lands. The third-party must specifically determine whether there are any trends in degradation that may threaten applicable beneficial uses. As part of this evaluation, the third-party must analyze all readily available monitoring data that meet program quality assurance requirements to determine deficiencies in monitoring for discharges from irrigated agricultural lands and whether additional sampling locations or sampling events are needed or if additional constituents should be monitored. If deficiencies are identified, the third-party must propose a schedule for additional monitoring or source studies. Upon notification from the Executive Officer, the third-party must monitor any parameter in an area that lacks sufficient monitoring data (i.e., a data gap should be filled to assess irrigated agriculture's effects on water quality).
> The third-party should incorporate pesticide use information, as needed, to assist in its data evaluation. Wherever possible, the third-party should utilize tables or graphs that illustrate and summarize the data evaluation.

- Pesticides Monitoring

We appreciate the addition of the following language on the pesticide monitoring evaluation process (*shown in italics*) on page 4 of the MRP:

> "The CRC shall propose the pesticides[6] to be monitored in their Annual Monitoring Report and provide the rationale for their proposal. *The pesticides to be monitored shall be reviewed as part of a rice-specific process by Water Board staff that includes input from qualified scientists and coordination with the Department of Pesticide Regulation.* Once the list is approved by the Executive Officer, the CRC shall monitor the list of pesticides in accordance with the terms and conditions of this MRP.
>
> [6]Pesticides may include environmentally stable degradates of the registered active ingredient if acceptable analytical methods to detect the degradate are available (acceptable analytical methods are defined in Attachment C, Order No. R5-2010-0805 Monitoring and Reporting Program for California Rice Commission, Quality Assurance Project Plan Guidelines (QAPP Guidelines), and any revisions thereto approved by the Executive Officer). Potential degradates to evaluate will be identified through Central Valley Water Board and CRC consultation with the Department of Pesticide Regulation."

- MRP Revisions

  We appreciate the language on page 1 of the MRP that, along with other portions of the Rice Order, clarifies the Regional Board's ability to modify the monitoring program to adapt to future needs:

  > *The Central Valley Water Board or Executive Officer may revise this MRP as it applies to the CRC or Growers governed by the Order. The Central Valley Water Board or Executive Officer may rescind this MRP and issue a new MRP as it applies to the CRC or Growers governed by the Order.*

- Proposed Surface Water Limitations

  We appreciate the language on page 16 of the WDRs to include a trend of degradation (*shown in italics*):

  > III. Receiving Water Limitations
  > A. Surface Water Limitations
  >
  > 1. Wastes discharged from Grower operations shall not cause or contribute to an exceedance of applicable water quality objectives in surface water *or a trend of degradation* that may threaten applicable Basin Plan beneficial uses, unreasonably affect applicable beneficial uses, or cause or contribute to a condition of pollution or nuisance.

Our comments on the Tentative Rice Order follow up on our prior comments on the Administrative Draft Order, submitted on September 13, 2014. We request inclusion in the record the discussion on antidegradation provided on pages 2-4 of our September 13, 2013 comment letter, as this discussion may be important for the Regional Board to consider further during the long-term implementation of this order.

We appreciate the opportunity to discuss our stakeholder perspectives with Regional Board staff and the CRC. If there are significant changes made to the Rice Order or its attachment, prior to the March 27 or 28 public hearing, we request another public comment period.

Thank you for considering our comments and requests. We appreciate the public outreach efforts of the Regional Board on the ILRP, and the thoughtful discussions and responses to our stakeholder input.

Please contact Elissa Callman at 916-808-1424 if you have any questions or would like to discuss our comments. We look forward to working cooperatively with Regional Board staff on the completion of this order, and we look forward to working with your staff and the CRC during the implementation of the order.

Sincerely,

Sherill Huun

Sherill Huun
Supervising Engineer

Cc:
Joe Karkoski, Central Valley Water Board
Susan Fregien, Central Valley Water Board
David Duncan, CDPR
Nan Singhasemanon, CDPR
KayLynn Newhart, CDPR
Ali Rezvani, CDPH
Dave Brent, Director
Joe Robinson, Senior Deputy City Attorney
Bill Busath, Engineering & Water Resources Manager
Michael Malone, Operations & Maintenance Manager
Pravani Vandeyar, Water Quality Superintendent
Dave Phillips, Water Treatment Superintendent
Forrest Williams, Sacramento County Department of Water Resources
Vicki Butler, Sacramento County Department of Water Resources
Dan Gwaltney, Sacramento County Department of Water Resources
Dan Mount, City of West Sacramento
Hubert Lai, EBMUD
Elaine White, EBMUD
Jacques DeBra, Woodland-Davis Clean Water Agency
Tim Johnson, CRC
Roberta Firoved, CRC

Attachment 1. Additional Information on Comment 1

The following are requested modifications to Attachment B – MRP:

Pages 2-3, items B.1 and 2. *Suggested additions shown in italics.*

III. Surface Water Monitoring Requirements

1. Assessment monitoring
Assessment monitoring shall include field and general parameters, nutrients (nitrate + nitrite as nitrogen and total ammonia as nitrogen), at least two pesticides identified by CRC after evaluation and assessment as specified in Section III.C., and water column and sediment toxicity testing (Table 3). The Executive Officer may require monitoring of more than two pesticides if the Executive Officer determines that insufficient information is available to assess the potential threat to water quality of a pesticide or that available information suggests there could be a water quality threat associated with a pesticide. The pesticides shall be monitored twice during their peak use month and twice in the following month. Sediment toxicity, sediment TOC and grain size testing shall occur once during the pre-harvest drainage. The monitoring schedule for each pesticide shall be tailored to the peak use and/or time periods when the pesticides (respectively) are likely to be discharged to surface water. Water column toxicity testing with Ceriodaphnia dubia and Pimephales promelas shall occur during two monthly events when pesticides are monitored. For Selenastrum capricornutum, toxicity testing shall start during the month when pesticides are first applied and continue for a total of three months. Assessment monitoring shall begin when most rice fields start pesticides application and end with the *pre-*harvest drainage *and then re-start to include the winter drainage period, monitoring only the field measurements and general physical parameters at the primary sites during this period (see Table 3).*

2. Modified assessment monitoring
Modified assessment monitoring shall include the field and general parameters, nutrients, and two pesticides (Table 3) selected based on results from the prior assessment year. The two selected pesticides shall be monitored twice during their peak use month and twice in the following month. The monitoring schedule for each pesticide shall be tailored to the peak use and/or time periods when the respective pesticides are likely to be discharged to surface water. The monitoring period shall be for at least two months of the growing season *and then re-start to include the winter field drainage period, monitoring only the field measurements and general physical parameters at the primary sites during this period (see Table 3).*

The following is additional supporting information:

Total organic carbon (TOC) monitoring in the water column is currently included in the Tentative Rice Order in assessment and modified assessment monitoring, which will occur twice monthly during the irrigation season (April/May through August) for two out of every five years, at seven sites. The addition of monitoring at the four primary sites in the timeframe of the February or March winter discharge that occurs for a significant amount of acreage planted to rice will provide important up to date representative data on this important water quality constituent. The field measurements and other general physical parameters listed in Table 3 of the MRP will all provide useful data.

The Tentative Rice Order includes the chemical constituents narrative water quality objective per Information Sheet (Att A), Section XV – Water Quality Objectives, and this objective is explained with regards to how to be interpreted in the Monitoring and Reporting Program (MRP) (Att B) Section VII – Water Quality Triggers.

The Regional Board's Delta Drinking Water Policy specifically determined that organic carbon is to be included in the chemical constituents narrative as follows:

> Finding 12 - The proposed Amendment modifies Basin Plan Chapter III (Water Quality Objectives) to clarify the existing Water Quality Objective for Chemical Constituents. The clarification will appear as a footnote stating that the existing objective applies to drinking water chemical constituents, such as organic carbon.
>
> Footnote for existing Chemical Constituents narrative objective:
> Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.*
> *This includes drinking water chemical constituents of concern, such as organic carbon.

The Delta Drinking Water Policy work group's work on organic carbon concluded that additional data for agriculture would be useful; data for the Colusa Basin Drain was utilized in the organic carbon modeling work as representative of rice agriculture.

<u>Rice Cultivation Summary</u>:

The CRC prepared a Groundwater Assessment Report (GAR), dated July 2013, that presents general information on rice farm management. The timing varies each year based on weather and other growing conditions. Here is the summary which includes information that rice growers are implementing agricultural practices during the non-irrigation season (October through March).

> "A continuous flood is maintained after stand establishment (approximately April through September) until draining for harvest. After harvest, about one-third to one-half of the fields is again flooded in the winter (from October through February)... Key events in the rice-farming cycle are field preparation, planting, fertilizer and pesticide (mainly herbicide) application, irrigation flooding, field drainage, harvest, winter flood-up, and winter drainage."

Further, page 2-6 of the report provides a comparison of cultural practices for rice and shows that once water is applied for irrigation season, it is maintained at approximately five inches of depth until lowering for pesticide application or drainage for harvesting. Considerable work is done on the fields to prepare for straw management. Fields are chopped, stomped, and flooded for decomposition, while some is baled/removed or burned. It states that about one-third to two-thirds of the acreage is winter flooded between harvest (October) and drydown for spring field preparation (March).

Therefore, we believe that monitoring should be conducted during this period at the primary monitoring sites, in a timing that would ideally follow as best practical the February or March winter discharge.

<u>Historical ILRP Monitoring Data</u>:

Non-irrigation Season for CRC Order -

Non-irrigation season (October through March) monitoring has been very limited during the Rice Waiver Program. There has been no regular TOC monitoring required during the non-irrigation season, but turbidity was sampled periodically in 2006, 2007, and 2008. Since 2009 no additional non-irrigation season monitoring has been conducted for any constituents. In 2006, turbidity samples were collected at the primary sites in March (50 – 200 NTU) and October (20 NTU). In 2007, turbidity samples were collected at the primary sites in February (60 NTU) and October (20-70 NTU). In 2008, turbidity samples were collected at the primary sites in March (30 – 90 NTU) and October (20 – 50 NTU).

UC Davis ILRP Monitoring Projects, Phase II -

The Aquatic Ecosystems Analysis Laboratory at the UC Davis John Muir Institute of the Environment monitored surface for numerous constituents including organic carbon from 2004 through 2007. Because the study was designed to evaluate seasonal and temporal changes in water quality, it included irrigation season and storm season monitoring. It is possible that the study collected some data that may be representative of conditions after the winter rice field discharges.

UC Davis Edge of Field Study –

The first study was brief, running from September to December 2005. The TOC of the rice field outlets ranged from 3.7 to 47.3 mg/L.

The CRC participated in another UC Davis study, the Edge of Field Study, as part of their MRP requirements, to compare discharge quality of flooded fields and burned fields (Study Component 1) and evaluate the difference between field outlets and downstream peripheral drains (Study Component 2). This study included sampling of TOC and other general constituents in the rice field outlets and downstream peripheral drains (100 feet downstream) and was summarized in the 2009 Annual Monitoring Report (pp. 5-46 – 5-76). Data was collected between May 2006 and April 2008, for both growing (June – September) and winter (November – March) seasons. There were 457 TOC/DOC (dissolved organic carbon) samples collected during the study period for rice outlet locations. There were 1,278 TOC/DOC samples collected during the study period for peripheral drains.

- Field Outlets – TOC 0.8 – 84.82 mg/L, median 11.46 mg/L, DOC 0.01 – 77.34 mg/L, median 9.28 mg/L
- Peripheral Drains – TOC 0.005 – 107.2 mg/L, median 8.8 mg/L, DOC 0.005 – 84.89 mg/L, median 7.3 mg/L
- Supply Canals – ND – 13.6 mg/L, median 1.7 mg/L

Winter TOC/DOC was higher than growing season. Incorporated straw fields were higher than burned fields. Outlet levels were much higher than inlet levels. TOC levels were similar in outlet and peripheral drain samples. TOC/DOC levels were much higher in the outlets during the winter.

We understand that the results of this study do not represent the levels that may be detected in downstream receiving waters, like the primary monitoring sites. However, the results do show the potential for rice winter discharges to contribute to downstream organic carbon levels.

Other Historical Agricultural Monitoring Studies/Reports:

The following papers include discussion of winter conditions and organic carbon:

Ruark et al. Seasonal Losses of DOC and TDS from Rice Production System in Northern California. 2010.

> "Based on our data, it is evident that the export of DOC from these fields can contribute to increased DOC concentrations in the Sacramento River, but rice fields may not be the cause of peak DOC concentrations typically observed later in the winter season."

Oh et al. The Role of Irrigation Runoff and Winter Rainfall on DOC in an Agricultural Watershed. 2013. Willow Slough Watershed, 2006 – 2008.

> "More than 80% of field crops in California are flood irrigated (Cooley et al., 2009) including alfalfa and rice, and thus the field could act as a temporary wetland releasing DOC from soils and plant residue to flooded water until the irrigated water is discharged to the stream. This transient flood period and low irrigation water discharge can result in high DOC concentrations for several months (Fig. 4)."

Krupa et. Al. Control on DOC Composition and Export from Rice Dominated Systems. 2011.

> "Rice straw residues are a potentially important DOC source, as Ruark et al. (2010) found that the burning of rice straw in the winter, versus the widespread practice of rice straw incorporation into the soil by plowing, significantly lowered DOC concentration and flux in rice field outflow. This is also important to the THMFP of DOC leaving these systems, because vascular plant materials are highly aromatic DOC sources (Hernes et al. 2008; Spencer et al. 2009, 2010)."

Comment Letter 4

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18 January 2014

California Regional water Quality Control Board Central Valley Region, Order R5-2014-XXXX
Waste Discharge Requirements General Order
For
Sacramento Valley Rice Growers
(Order)

As stated the scope attempts to address "irrigated lands" discharges of sort as "The discharges result from runoff or leaching of irrigation water and/or stormwater from irrigated lands."

This is a formidable effort to reduce water contamination of sort. Two issues come to mind. One, as you state in item 44 "The United States Department of Agricultural Natural Resources Conservation Service (NRCS) administers a number of programs related to water quality. Considering what the NRCS does, it would make sense for the State to cooperate with the NRCS to enhance the overall results of the NRCS efforts. Second, your department's efforts center about regulation with no remedy but to transfer money from the land owner as a form of a taking.

Considering page 14, statement 49, "This Order does not authorize violation of any federal, state, or local law or regulation" under the GENERAL FINDINGS heading, how will this Oder be implemented as it appears to violate a host of Federal law? Reference the following issues:

I noted page 7, item 25 attempts to justify a "control" program of NPS (non-point source) discharges. If the State truly wants to assist the farmers of California, they can join efforts with the NRCS and do so. But the State cannot lawfully "control" anything unless they operate within the confines of the US Constitution. This Order being of control and punishment does not do so. Reference Miranda v. Arizona, 384 U.S. 436 (1966) "Where rights secured by the constitution are involved, there can be no rule making or legislation which would abrogate them." Also, Miller vs. U.S., 230 F. 486, 489 "The claim and exercise of a constitutional Right cannot be converted into a crime."

This Order is in direct conflict with a United States Act of Congress. Reference the Clean Water Act; Title 33 USC; Section 1362-Definitions; (14) The term "point source" means..... This term does not include agricultural stormwater discharges and return flows from irrigated agriculture." That means it is not lawful for this Order to stand as written for it attempt to control what is exempted by Federal Law. The Congress of the United States has been consistent with the intent to protect "production" for they have historically recognized production as the foundation of our form of society and without it there is no society. The intent of Congress to protect agriculture from unlawful regulation is confirmed with Friends of the Everglades, Florida Wildlife Federation and Fishermen Against Destruction of the Environment v. South Florida Water Management District; "Congress even created a special exception to the definition of 'point source' to exclude agricultural storm water discharges and return flows from irrigation, despite their known, substantially harmful impact on water quality."

This Order also violates the US Constitution for the Order makes a crime of a Constitutional Right. These rights are with Amendment IV; V; VII; VIII: IX and XIV Section 1. As well, it violates the Clean Water Act as mentioned. Several Supreme Court cases confirm the violations of this Order. Ref. Miranda v. Arizona, 384 U.S. 436 (1966) "Where rights secured by the constitution are involved, there can be no rule making or legislation which would abrogate them."Miller vs. U.S., 230 F. 486, 489 "The claim and exercise of a constitutional Right cannot be converted into a crime."

Considering the Supremacy Clause, Article VI, Clause II of the US Constitution, what definitive position does the State of California take with this Oder?

The State of California can not own water for the water has been allocated for the beneficial use of the land owners prior to the California State Constitution of 1876. Ref. HR 365, Mining Law of 1866, Section 9. *And be it further enacted*, That whenever, by priority of possession, rights to the use of water for mining, agriculture, manufacturing or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owner of such vested rights, shall be maintained and protected in the same; ....
As well water from forest lands is designated to irrigation via the Organic Administrative Act of 1897; "No public forest reservation shall be established, except to improve and protect the forest within the reservation, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States; but it is not the purpose or intent of these provisions, or of the Act providing for such reservations, to authorize the inclusion therein of lands more valuable for the mineral therein, or for agricultural purposes, than for forest purposes." "... All waters on such reservations may be used for domestic, mining, milling or irrigation purposes, under the laws of the State wherein such forest reservations are situated, or under the laws of the United States and the rules and regulations established thereunder. Note, this relates to law prior to the Act. As well, these waters are not to have a reserved right for aesthetic, recreational, wildlife preservation, and stock watering purposes." United States v. New Mexico, 438 U.S. 696 (1978). Land Patent allodial title also "grants" the water to the land owner, his heirs and assigns "forever" which is granted by the US Constitution's Article IV, Section 3, Clause II known as the property clause and Acts of Congress.

Considering allodial title of properties by land owners via the constitutional contract known as the Land Patent as authorized in the US Constitution Article IV, Section 3, Clause II known as the property clause, a number of Acts of Congress which nullify all statutes and regulations implemented after the date of the Land Patents, where does the Order derive its "jurisdiction" over a Land Patent?

Considering State and or County Governments have no authority over properties it does not own, is the Order "voluntary"? Or is it "mandatory"? If it is mandatory, please site all law that is not unconstitutional that authorizes it to be so. The Supreme Court's decision with City of Dallas v. Mitchell, 245 S.W. 944, 945-46 (Tex. Civ. App. –Dallas 1922) establishes "The rights of the individual are not derived from governmental agencies, either municipal, state or federal, or even from the Constitution. They exist inherently in every man, by endowment of the Creator, and are merely reaffirmed in the constitution, and restricted only to the extent that they have been voluntarily surrendered by the citizenship to the agencies of government. The people's rights are not derived from the government, but the government's authority comes from the people…."

Considering the California Constitution, Article III Section 1 recognized the US Constitution as the supreme law of the land, please explain how this Order as written can stand in regard to each of the conflicts with the US Constitution as referenced in this notice.

I also question the "fee" and most sorely contest the potential unreasonable fines. These are no more than extortion not to mention it violates the US Constitution amendment VIII, "Excessive bail shall not be required, nor excessive fines imposed….". The agents of the Water Quality Control Board are already being paid by the farmers via taxation of many sources, too many to know. Considering the definition of "extortion" in the United State Code Title 18 Section 1951- Interference with commerce by threats of violence (2)- The term "extortion" means the obtaining of property from another, with his consent, induced by wrongful use of actual or threatened force, violence, or fear, or under color of official right." Money is considered the "property" of the person who earns it, any enforcement action taken in violation of the US Constitution while acting under the "color of law", (that is, the Order) and the threat of unreasonable fines can be defined as extortion as defined here. How do you relate the context of your Order to USC Title 18 Section 1951 as described here?

Item 53 eludes to discharging into waters of the State as a privilege. First, considering not the State but the People of the State own the water, where is it you believe the State owns the water? Reference HR 365, the Mining Act of 1866. Second, considering the Federal Clean Water Act which clearly states "does not include agricultural stormwater discharges and return flows from irrigated agriculture" is conclusive it is a "right to discharge", again where is it you believe it is not a right?

Page 15,item 54 and page 18, item 13 requiring access is unlawful. Reference US Constitution Amendment IV, The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or Affirmation, and particularly describe the place to be searched, and the persons or things to be seized." This item must be offered as a voluntary agreement or such action taken by the agency is a violation of the US Constitution which acting under "color of law". How will this violation of the US Constitution fare if a suit against the agency and or agent under USC Title 42 Section 1983?

Having this notice, how will you defend any action taken by this agency under the color of law against a suit against the agency and or directly to an agent of the agency under the United State Code Title 42 Section 1983?

In conclusion, considering that the premise of identifying and reducing water pollution is laudable, if you started over with a new document based on the premise "how may we help you" versus "how may we stop you", the Order may receive a positive review. As it stands, the Order does not pass the smell test as it is held up to the light of freedom and the rights as recognized in the Declaration of Independence as preserved by the Founding Fathers with the most famous document ever penned by mankind, The Constitution of the United States, the contract as ratified between Government and the People.

Thanks you,

David Avila