LEADERSHIP COUNSEL FOR JUSTICE & ACCOUNTABILITY
CLEAN WATER FUND
COMMUNITY WATER CENTER
EL CENTRO COMUNITARIO POR EL AGUA
ENVIRONMENTAL LAW FOUNDATION

May 7, 2018

[SENT VIA EMAIL: GLENN.MEEKS@WATERBOARDS.CA.GOV]

Glenn Meeks
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670

RE: Amendments to the Water Quality Control Plans for the Sacramento River and San Joaquin River Basins and the Tulare Lake Basin (Basin Plans) to Incorporate a Central Valley-wide Salt and Nitrate Control Program (SNMP)

Dear Mr. Meeks:

The undersigned organizations, as well as la Asociación de Gente Unida por el Agua (the "AGUA coalition") and Protectores del Agua Subterránea ("Protectores") write in opposition to the Amendments to the Water Quality Control Plans for the Sacramento River and San Joaquin River Basins and the Tulare Lake Basin (Basin Plans to Incorporate a Central Valley-wide Salt and Nitrate Control Program (the "Basin Plan Amendments" or the "Amendments"). We request that the Central Valley Regional Water Quality Control Board (the "Regional Board") decline to adopt the Amendments, and will ask that the State Water Resources Control Board (the "SWRCB") refuse to approve them. (*See* Water Code § 13245.)

Given that the Basin Plan Amendments are very similar to the SNMP itself, our prior comment letters submitted on February 21, 2017 remain largely unaddressed, and are attached and incorporated herein by reference. Additionally, we have attached several supporting studies and reports, which we request be incorporated into the administrative record:

- Attached as Exhibit A is a report entitled *Review and Analysis of CV SALTS Salt and Nitrate Management Plan*, prepared by Andrew N. Safford, P.E., dated February 17, 2017, as well as the curriculum vitae of Mr. Safford;
- Attached as Exhibit B is a report by Dr. Alida Cantor et al. entitled *Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act*, dated March 2018;
- Attached as Exhibit C is a report by Dr. Maya Almaraz et al. entitled *Agriculture is a Major Source of NOx Pollution in California*, published in the journal Science Advances on January 31, 2017.
- Attached as Exhibit D is a report by Dr. Carolina Balazs et al. entitled *Social Disparities in Nitrate Contaminated Drinking Water in California's San Joaquin Valley*, published in the journal Environmental Health Perspectives in September 2011.

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- Attached as Exhibit E are the prior comment letters submitted by Leadership Counsel, Community Water Action and Community Water Center on February 21, 2017.

Consistent with our prior comments on the SNMP, these organizations oppose the Basin Plan Amendments for the reasons discussed previously and below. We note that our comments are focused on the fundamental issues with the Amendments, and that most if not all of the changes we suggest must be made in order for the Amendments to be legally compliant.

A. Process Concerns

Clean Water Fund, Community Water Center, and Leadership Counsel for Justice and Accountability have participated in the CV-SALTS process for over eight years. Throughout this process we have regularly attended monthly Coalition meetings, provided feedback both in the meetings and written on numerous documents on very tight timelines, and have worked outside of the monthly meetings with Regional Board staff and Coalition members. In short we have been active participants in this process. But the process itself limited our ability to influence the outcomes, primarily because decisions on difficult issues were continually postponed. The result was that decisions were made at the last minute with limited review time, and our comments and amendments were not given adequate consideration. Within the past year, with CV-SALTS finally wrapping up, the Coalition has realized they must meet their deadline for submission and the process has rapidly sped up, providing very little time for stakeholders to adequately participate.

We also take exception to the complaints of Regional Board staff and Coalition members about organizations which are only just now participating in CV-SALTS, and therefore discounting their comments and concerns. Participation within CV-SALTS over the years has been a huge undertaking, something none of our three organizations could have done alone. If CV-SALTS wanted adequate participation from a diverse group of stakeholders then there should have been adequate outreach to groups.

The draft basin plan amendment should have been made public with enough time for other stakeholders to read, meet with staff, and work with other stakeholders to ensure they are able to provide feedback that actually has a chance to influence the final basin plan amendment. As the process is currently set up, staff has already admitted they cannot make significant changes to this basin plan amendment, amendments that are absolutely necessary to ensure it will comply with the human right to water, Porter-Cologne, Antidegradation, the Sustainable Groundwater Management Act (SGMA), the public trust doctrine, CEQA, reasonable and beneficial use, and so many more important laws that protect our state's surface and groundwater from contamination.

Finally, there has been very little outreach to the people who will be most impacted by this amendment: communities reliant upon groundwater for their drinking water needs. Despite the fact that our organizations represent disadvantaged communities, we have not been included in the education and outreach committee. Communities will bear the primary responsibility, should this basin plan be adopted as currently written, to request assistance if and when their water becomes contaminated by nitrates. Communities will continue to bear the responsibility and costs associated with testing their wells. There should have been outreach to communities

throughout this process so they too know what is coming and how they will be impacted. Instead, except for the communities our organizations work directly with, Californians have been left in the dark.

B. SNMP Goals

We appreciate the stated goals for this program, but have generally found insufficient detail in the proposed basin plan amendment to understand how and whether those goals will be achieved. Moreover, the timelines for embarking on Goals 2 and 3 are uncertain. While we support the provision of safe drinking water as the number one goal of the program, implementation of the other Goals should not be delayed or ignored.

Goal 1) – Ensure a Safe Drinking Water Supply

We agree with the prioritization of this management goal and appreciate the language requiring an Early Action Plan as part of both the Management Zone and Individual compliance process. However, the implementation language is lacking in specifics, including:

- How ongoing identification of impacted wells will occur;
- A requirement that those subject to management zone plans, alternative compliance projects and offset projects have a duty to continually look for and test potentially impacted wells and provide safe drinking water to newly discovered impacted residents in a timely fashion;
- Written assurances of how and when permanent drinking water solutions will be provided;
- A requirement that communities who are paying for nitrate treatment receive assistance or be reimbursed;
- An acknowledgement that the application of assimilative capacity on a large scale will result in pollution hot spots and a requirement that these hot spots will be identified and potentially impacted wells tested.

While public water systems can be easily and promptly identified through the water quality data they submit to the Division of Drinking Water, a significant population in the Central Valley is not served by a public water system. The Disadvantaged Community Water Study for the Tulare Lake Basin (2014) identified approximately 530 "communities" – defined as clusters of at least 15 homes, the minimum number of connections that meet the definition of a public water system. A quarter of these communities, 135, are not served by a public water system. Additionally, the US Geological Survey in 2010 developed estimates of those served by domestic wells in California. Based on their estimates approximately twenty percent of the population on the Valley floor relies on domestic wells.

Recommendation: Include a clear requirement in Management Zone Plans, Individual Compliance plans, Offsets and Exceptions to proactively and comprehensively identify and address newly discovered or reported contaminated wells, provide long-term as well as interim solutions and assume the nitrate treatment cost of systems that are already treating their water supplies. Include requirement in approval of assimilative capacity to target those areas susceptible to disproportionate impacts and target wells in the area of impact for testing. Incorporate well testing plan and requirements into monitoring plan.

Goal 2) Achieve Balanced Salt and Nitrate Loading

The definition of balance in the basin plan amendments is appropriate for areas where nitrate concentrations have not yet exceeded the water quality objective. However, for areas already impacted by nitrate exceedances, this definitions conflicts with the requirements of the adopted Waste Discharge Requirements (WDRs) for the Irrigated Lands Regulatory Program (ILRP), which require that "Wastes discharged from Member operations shall not cause or contribute to an exceedance of applicable water quality objectives in the underlying groundwater, unreasonably affect applicable beneficial uses, or cause or contribute to a condition of pollution or nuisance." The WDRs provide a grace period of 10 years after adoption of a Groundwater Quality Management Plan. The terms and conditions of these orders have been negotiated through a lengthy process. It appears that the intent is now to essentially replace these requirements with a proposal to achieve balance within an undetermined timeline.

In fact the requirement to achieve balance is not even a requirement but is subject to an undefined determination that achieving balance is "reasonable and feasible." See below for a discussion of this term.

As written, this goal is unenforceable. Why, then, should it differ from the existing water quality goal in the ILRP WDRs?

Recommendation: Change Goal 2 to conform to the ILRP WDRs and require discharges to meet water quality objectives, with a 10-year extension for areas implementing an approved Groundwater Quality Management Plan.

Goal 3) – Implement Managed Aquifer Restoration where reasonable, feasible and practicable

We strongly support the goal of aquifer restoration, but as written, it seems more likely that this Goal will in practice be interpreted as encouragement to de-designate basins where compliance is expensive and inconvenient. The basin plan amendment continually repeats the mantra of "reasonable, feasible and practicable" without providing criteria for how or when this assessment would be made. It makes sense that aquifer restoration would be a large, expensive and uncertain process in some basins right now; but as source control efforts improve and impacts on the aquifer are better understood, a more specific plan and budget can be developed.

Unfortunately, as written, this appears to be an abdication of the Board's authority and responsibility to protect water quality for beneficial uses

Recommendation: Remove "where reasonable, feasible and practicable." Change goal to "Implement long-term managed aquifer restoration in a timely manner that ensures the long-term protection of beneficial uses."

C. Assimilative Capacity And Management Zones

1. Path A compliance

1. Assimilative capacity

We appreciate that the default requirement for calculating assimilative capacity for dischargers complying with the basin plan through the individual discharger path (Path A) is in the shallow groundwater, which is determined by looking at the depth of the shallowest 10% of domestic wells in an area. However, we are concerned that the alternative options for defining shallow groundwater for individual dischargers are not protective of water quality. (*See* Staff Report at 60.)

Further, we are concerned with the horizontal scope in which assimilative capacity is determined. Assimilative capacity for Path A dischargers is determined per discharger. This approach however, is not the most protective means as some discharger operations are quite large and not necessarily contiguous. This allows a discharger to allocate their assimilative capacity unequally across potentially very large stretches of land, resulting in hot spots of nitrate contamination. These impacts will be felt most by communities of color reliant on domestic wells and small public water systems. (*See* Section K, *infra*.)

Recommendation: Remove the alternative options for defining shallow groundwater, and require that assimilative capacity for Path A dischargers be determined on the field-level rather than by discharger.

It appears that coalitions which are complying on behalf of their members and not operating as a management zone must follow Path A. However, what is not entirely clear is whether assimilative capacity is determined at the Coalition scale or the individual discharger scale. We assume it is at the individual discharger level (though we reiterate the need for field-level determination of assimilative capacity, rather than at the discharger level) rather than based off the entire Coalition's geographic scope but want to ensure this is clarified.

Recommendation: Clarify at what geographic scope assimilative capacity is to be determined when a Coalition is complying on behalf of its members as individuals.

2. Mitigation of impacts from discharge

We appreciate the fact that provision of replacement water is the number one goal of CV-SALTS and implementation of this begins with Early Action Plans. While we understand the need to prioritize communities currently being served nitrate contaminated water, other communities who have an active source of nitrate contamination but which are treating the nitrates should also receive assistance. Dischargers should not be able to avoid mitigating the impacts of nitrate contamination on communities who have, often at high cost to their customers or to themselves, already begun treating their water. While the Basin Plan Amendment language does not specifically prevent such communities from receiving assistance in the future (unlike how those communities are excluded from assistance with the early action plans), it must be clear within the basin plan amendment that they are included within the path towards a sustainable solution for all communities dealing with an active source of nitrate contamination.

Recommendation: Clarify that communities with an active, but treated, source of nitrates are provided assistance after early action plans have begun to be implemented.

2. Management Zones

a. Assimilative capacity

i. Horizontal averaging

The Basin Plan Amendments allow for the determination of assimilative capacity to be made across the entire management zone. They also allow a management zone to be as large as a basin or subbasin, resulting in a very large area to average all discharges. Across the Central Valley there are basins where one side of the basin has relatively low nitrate levels and the other has nitrate levels averaging above the MCL. Allowing for basin-wide averaging means that the portions of the basin already impacted by unsafe levels of nitrates will not only continue to have unsafe levels of nitrates but will progressively get worse. This is especially apparent when one looks at the science that shows that very little horizontal mixing actually occurs underground. (*See* Ex. A, EKI Report.) These impacts will be felt most by communities of color reliant on domestic wells and small public water systems. (*See* Section K, *infra*.)

Recommendation: Determine assimilative capacity at a smaller scale only where there is a scientific understanding that horizontal mixing will occur and water quality objectives will thus be met.

b. Groundwater Protection Targets

In February 2018, the State Water Board adopted the revised East San Joaquin Irrigated Lands Regulatory Program Order. Within the mostly precedential Order is a requirement for Coalitions to determine township level groundwater protection targets. These targets will look at a number of components, such as crop, soil type, and irrigation method, to determine how much nitrate can be added to a field before negative impacts to groundwater quality occur. While these targets (once created) will provide a much needed check on the application of nitrates in levels which impact groundwater quality, implemented on their own they will not adequately protect groundwater quality to ensure long-term sustainability. For one, groundwater quality targets will not be created until about 2021 and it will potentially be years after that before these targets will be enforceable, rather than used as a tool to educate growers and help groundwater managers. For another, townships are still large geographic areas in which nitrate hot spots can occur. Effective control of nitrates all across the basin without horizontal averaging is necessary to adequately protect groundwater quality. Finally, groundwater protection targets are only one means of source control and will not ensure restoration of the Valley's groundwater basins.

Recommendation: Ensure that groundwater protection targets within the ILRP orders are just part of the basin plan's tools to ensure adequate protection and remediation of groundwater. In order for the targets to successfully control nitrate discharges and prevent localized impacts, additional steps and source control measures are necessary.

c. Size and jurisdictional boundaries

The jurisdictional boundaries of management zones are not clearly defined. Unlike the somewhat comparable process of SGMA and groundwater sustainability agencies (GSAs), management

zones have no requirement that prevents white areas and no corresponding protection from communities who may be left out of the process. We acknowledge that the staff report does state that communities can request that the Regional Water Board reconsider proposed or even approved management zone boundaries, however this provision only helps where communities are aware of CV-SALTS and what the potential benefits to their community are. As we have stated above, such essential outreach is missing from the CV-SALTS process. A community which is unaware of the process either through willful or inadvertent exclusion from an outreach program, will have no such protection. Further, the Regional Board will have no means of ensuring all impacted communities are included either as uncovered areas are not necessarily a sign of an excluded community.

Recommendation: Place common sense requirements upon the creation of management zones such as requiring that management zones provide justification for why the boundaries were drawn and why areas which are not covered by any other management zone do not need to be included in a management zone.

Management zones in no circumstance should be larger than a subbasin. Even allowing a management zone to be as large as a subbasin will result in hot spots should assimilative capacity be determined at this scale. If a discharge is on one side of the subbasin and dischargers elect to complete an offset project on the other side, the chances of mixing occurring within the lifetime of anyone involved in the project is almost non-existent. (Ex. A, EKI Report.) The Staff Report and Basin Plan Amendments both state that a management zone can be no larger than a basin[1] AND can be larger than a basin[2]. Obviously these are conflicting provisions. We understand that the CV-SALTS Coalition in the last few months has discussed allowing for governance structures to be larger than a basin, which when used only to allow for more effective allocation of resources and not for calculation of assimilative capacity may be acceptable, but as written this is not consistently the case.

Recommendation: Clarify that management zones cannot be larger than a subbasin. If the Regional Board wants to allow for a governance structure that covers multiple management zones which spans more than one basin or subbasin then this must be clarified within the basin plan amendment.

D. <u>Early Action Plans</u>

The requirement for an Early Action Plan as part of the Notice of Intent is appropriate, but the title itself is misleading, as this is currently the <u>only</u> Action Plan pertaining to Management Goal 1. The Early Action Plan itself, with its requirement to identify impacted wells, conflicts with the rest of the Notice of Intent, which only requires the use of "readily available" groundwater quality data. As noted above, domestic well information is <u>not</u> readily available nor is water quality testing of domestic wells.

Of more concern is that the Early Action Plan does not address <u>permanent</u> provision of safe drinking water to impacted residents, nor is there a provision in the Management Zone proposal

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[1] PDF p 63
[2] PDF p 85

to do so. Nor is there a requirement that water systems and residents already paying for nitrate treatment be offered assistance. This is inequitable, as many of these residents are paying more than they can afford to ensure safe drinking water for their families. They should not be penalized for doing so.

Recommendation: In addition to Early Action Plan, require development of a Safe Drinking Water Plan for Management Zone and Alternative Compliance Plans. The Safe Drinking Water Plan will include provisions to continually identify, test and address newly contaminated wells, assist communities already paying for alternative supplies or treatment of nitrate contaminated water and ensure both emergency, interim and long-term assistance to residents impacted by nitrate contamination.

E. Alternative Compliance Projects

Alternative compliance projects (ACPs) are presented as a means to achieve the three goals of CV-SALTS: provision of safe drinking water, balance of nitrate loading, and restoration of the basins. While the provision of safe drinking water to impacted communities should absolutely be the first priority, ACPs must also look towards the long-term sustainability of the Valley. This means continual outreach to communities, frequent well testing for private well and state small water system communities, efforts to ensure all communities with an active source of contamination (whether it is currently being treated or not) are included in mitigation plans, and plans for how dischargers will achieve balance and restoration.

Recommendation: Alternative compliance projects must include language not only around identification of communities currently impacted by nitrates contamination, but also a plan for ongoing outreach to communities who may be impacted by nitrates contamination in the future and those communities not identified within an early action plan, as well as frequent well testing for residents reliant on domestic wells and state smalls.

Recommendation: On PDF page 248, the Staff Report states an ACP must prioritize the provision of drinking water to communities "where there are significant nitrate water quality concerns in groundwater." The use of "significant" is not appropriate here because the focus is on water which exceeds drinking water standards. We propose that the language be amended to say, "...where nitrates in the groundwater exceeds or threatens to exceed drinking water standards."

Recommendation: ACPs must address all communities impacted by nitrate from current and historic sources of nitrates discharges. There is nothing in the current language which clearly shows that ACP participants have to address past impacts, thus the language should be clarified to ensure that communities whose drinking water source was contaminated by a previous landowner/discharger are also included in these plans.

Recommendation: ACPs must include clear requirements for how participants will achieve balance and restoration as well as an appropriate expected timeline for when such projects will begin and be completed.

F. Exceptions

The Exceptions Policy, as presently formulated, does not comply with the Porter-Cologne Water Quality Control Act, the State Antidegradation Policy, the Nonpoint Source Policy or the other laws and policies discussed below.

While the legal implications of the exceptions policy are discussed in more detail in Section H.a., *infra*, we also note that the Policy should be rejected on the ground that it swallows what little water quality protection the Basin Plan Amendments otherwise provide.

As applied to nitrate, the Exceptions Policy requires that an application for an exception include certain information, the most relevant of which are:

> (a) An explanation/justification as to why the exception is necessary, and why the discharger is unable to ensure consistent compliance with existing effluent and/or groundwater/surface water limitations associated with nitrate at this time;
>
> (b) A description of the alternative compliance project(s), Early Action Plan (EAP) or other implementation measures that the applicant will implement or participate in, consistent with the Nitrate Permitting Strategy of this Basin Plan for individual or collective groups of dischargers;
>
> …
>
> (c) A work plan to provide an interim and permanent water supply for any person living in the area adversely affected by the discharge under the requested nitrate exception. The water supply work plan shall include a schedule of milestones and a description of financial commitments to assure completion of the interim and permanent water supply. Performance bonds may be required to assure timely implementation.
>
> (d) A detailed plan of how the proposed implementation measures will further the long-term management goals of the Nitrate Control Program.

(*Id.* at pp. 102-103.)

If an application for an exception is approved, the Exception Policy permits ten year (or longer) exceptions to meeting the water quality objective for nitrate that may be renewed for up to fifty years (or longer). Specifically, as described in the Staff Report, the Exceptions Policy allows dischargers to violate the water quality objective for nitrate for periods which "will not generally exceed 10-years," except where "necessary to further the management goals of the Salt or Nitrate Control Programs." (Staff Report, pp. 24, 100.) Even more concerning, exceptions may be renewed "for one or more additional terms, the length of which shall be determined by the Regional Water Board but may only exceed 50 years if the management practices under the

exception is resulting in significant, measurable and continuing improvements in water quality." (*Id.*) Requests for exceptions may be made either by an individual discharger under Path A, or by an entire management zone under Path B. (*Id.* at pp. 70, 100.) The Regional Board only has authority to rescind an exception after notice and hearing, and on the ground that the "applicant(s) are not complying with the terms and conditions that are part of the exception." (*Id.* at p. 100.)

To summarize, the Exceptions Policy relieves a discharger of its legal obligation to meet the water quality objective for nitrate for an undefined period of time where it can show it is providing replacement water to residents adversely affected by the discharge or nitrate (but not necessarily residents affected by past discharges), that it is "unable" to meet water quality objectives, and that it is progressing toward "balance" and "restoration" where reasonable, feasible and practicable. Even assuming for sake of argument that the Regional and/or State Boards had the authority to adopt such an approach—though they do not—exceptions of undetermined length undermine efforts over the past several decades to improve nitrogen-related management practices.

What is the incentive to maximize improvements to management practices, to alter crop selection, to complete restoration projects, and take the other potentially costly but necessary actions to meet water quality objectives if the Regional Board has granted a fifty-year (or longer) exception that necessarily entails a finding that the discharger is "unable" to do so? An exception of this kind provides the perverse incentive to make measurable but slow progress toward making water quality objectives, while never making the changes necessary to actually meet those objectives. Our organizations do not believe that dischargers are incapable of meeting water quality objectives for nitrate, and the agency tasked with requiring compliance should not adopt a policy that posits certain failure as its central premise.

Recommendation: Either remove the exceptions policy, or draft a policy that complies with the Porter-Cologne Water Quality Control Act, meaning at a minimum that the policy must implement water quality objectives on a time schedule for the actions to be taken that is as short as practicable, not to exceed ten years, and that management zones must not be permitted to apply for an exception on behalf of all dischargers in the relevant zone.

G. <u>Offsets</u>

As recognized in the Staff Report, "[o]ffset projects, by their very nature, will result in localized degradation." (Staff Report at 338.) Localized degradation is unacceptable and legally prohibited. Hot spots cause significant harm to communities, the environment, employees of the dischargers, and even the dischargers themselves. Localized degradation just trades one area of degradation for another, passing around the basin contamination which harms so many people. The staff report does state that offsets can "not result in unmitigated localized impairments…" however this is simply not strong enough. What is considered adequate mitigation of localized impacts is not clear, though the provision of bottled water to impacted communities seems likely to meet this requirement. However, bottled water, tanked water, and even point-of-use treatments are not sustainable solutions as they are expensive and can require not insignificant follow-up and maintenance that the homeowner must complete. No community should ever have to rely

upon such unsustainable measures to ensure they are able to access something which is a basic human right.

The Basin Plan Amendments do not require any proven hydrologic connection between the area of discharge and area of offset project (offsets can be located anywhere inside or even outside of the basin where the discharge is located (Staff Report at 107.)) This will result in negative impacts to portions of the basin. Impacts that will harm communities reliant upon groundwater for their domestic needs for now and far into the future. These disparate impacts will be felt most by communities of color reliant on domestic wells and small public water systems. (*See* Section K, *infra*.)

We do appreciate the general requirement that the benefit of an offset project must be greater than 1:1. However, we are concerned with the allowance for offsets that provide less than a 1:1 benefit should the Regional Board find that the offset complies with the Antidegradation Policy.

Recommendation: Offsets must have a hydrologic connection to the site of the discharge such that the discharger complies with water quality objectives.

Recommendation: Offsets must also be time limited and have regular status reports to the Regional Water Board to ensure the discharger is diligently working towards meeting water quality objectives and no longer needing that offset. The Basin Plan Amendment language currently only requires that offsets be time limited but that "[t]he length of that period will be specified by the Central Valley Water Board when the offset is approved." (p 108) Offsets cannot be granted for a period of time longer than ten years at a time, and if disproportionate impacts appear likely over time, a shorter period of time must be required. Further, offset project proponents must provide an update on the project at a minimum every five years so the Regional Water Board can ensure the project is meeting its goals and not causing disproportionate impact to sources of drinking water.

Recommendation: An applicant for an offset must include as part of their monitoring plan, domestic well and state small water system testing to ensure vulnerable communities are not harmed by an offset project. The frequency for such testing shall mirror the requirements placed upon public water systems, including more frequent testing when nitrates exceed 75% of the MCL.

We do appreciate that the staff report does state that while contribution to a mitigation fund may be part of an offset project, it cannot be considered the entirety of an offset project. We support this determination as the purpose of offsets is to result in, "...meaningful efforts to reduce nitrate loading." (Staff Report at 338.)

H. <u>The Regional Board Does Not Have The Legal Authority To Adopt The Proposed Basin Plan Amendments.</u>

1. The Basin Plan Amendments Do Not Comply With The Porter-Cologne Water Quality Control Act.

a. The Proposed Basin Plan Amendments Do Not Conform To The Policies Set Forth In Water Code § 13000 et seq.

Water Code § 13240 requires regional boards to "formulate and adopt water quality control plans for all areas within the region" and that the basin plans "conform to the policies set forth in Chapter 1 (commencing with Section 13000) of this division and any state policy for water quality control."

Chapter 1 of the Water Code contains several relevant policies which basin plans must "conform to": (a) "The Legislature finds and declares that the people of the state have a primary interest in the conservation, control, and utilization of the water resources of the state, and that the quality of all the waters of the state shall be protected for use and enjoyment by the people of the state."; (b) "The Legislature further finds and declares that activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible."; (c) "The Legislature further finds and declares that the health, safety and welfare of the people of the state requires that there be a statewide program for the control of the quality of all the waters of the state..."; (d) "...the state must be prepared to exercise its full power and jurisdiction to protect the quality of waters in the state from degradation originating inside or outside the boundaries of the state…" (Water Code § 13000.)

The Proposed Basin Plan Amendments do not conform to these policies. The Amendments do not protect groundwater for the use and enjoyment of the people of the state, and in adopting the Amendments, the Regional Board will not be regulating water quality to "attain the highest water quality which is reasonable." Rather, the Amendments permit degradation of groundwater quality caused by discharges of nitrate which could be avoided by changes in management practices, crop selection and control technology such as upgraded dairy lagoon liners.

Another highly relevant policy for water quality control is set forth by Water Code § 106, which states that "[i]t is hereby declared to be the established policy of this State that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation." ([effective August 4, 1943]; *see also Meridian, Ltd. v. San Francisco* (1939) 13 Cal.2d 424, 450 ["The highest use in accordance with the law is for domestic purposes, and the next highest use is for irrigation."]; *see also* Water Code § 106(a) ["It is hereby declared to be the established policy of the state that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."].)

Contrary to state policy, the proposed Basin Plan Amendments elevate the importance of irrigation and other non-domestic uses of water above that of the domestic use of water for drinking and cooking. While the Basin Plan Amendments purport to require the provision of safe drinking water to those impacted by nitrate discharges, it does not provide the means to

promptly identify newly impacted households, nor does it account for the cost of frequent well testing that would be necessary to detect exceedances in domestic wells. Moreover, in the likely event that the policies set forth in the Basin Plan Amendments cause or allow nitrate problems to continue to spread, we have significant doubts about the long-term sustainability of a regulatory program that allows degradation of Central Valley groundwater basins in exchange for provision of replacement water. The cost to protect the quality of our groundwater basins may well be significant, but the cost to treat an ever-increasing portion of the primary drinking water supply relied upon by Central Valley residents is certain to be even more substantial.

b. The Regional Board Cannot Decline To Regulate "De Minimis" Discharges.

The proposed Basin Plan Amendments create a new category of discharges of nitrate which cause degradation but which would not be regulated under the Amendments. Specifically, the "de minimis" category is defined to include discharges in which:

> The average nitrate concentration in the Shallow Zone is better than the applicable water quality objective, and, over a 20-year planning horizon:
>
> - The effect of the discharge on the average nitrate concentration in the Shallow Zone is expected to use less than 10% of the available assimilative capacity in the Shallow Zone; and
> - The discharge, in combination with other nitrate inputs to the Shallow Zone, is not expected to cause average nitrate concentrations in the Shallow Zone to exceed a nitrate trigger of 75% of the applicable water quality objective."

(Staff Report, p. 61.)

No provision of Porter-Cologne (Water Code § 13000 et seq.) authorizes the Regional Board to abandon its duty to regulate discharges by categorizing certain discharges as "de minimis" and thus unworthy of regulation. Rather, § 13241 requires the Regional Board to establish water quality objectives, and § 13242 requires that Basin Plans contain a program of implementation plan, which must include: (a) "A description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private"; (b) "A time schedule for the actions to be taken"; and (c) "A description of surveillance to be undertaken to determine compliance with objectives." Section 13242 does not permit an implementation program that fails to regulate discharges that are likely to cause exceedances at some point in the future merely because degradation is presently occurring slowly (e.g., an exceedance in twenty-one years).

c. The Proposed Amendments Violate The Requirement That Basin Plan Amendments Require Compliance With Water Quality Objectives And Contain A Program Of Implementation.

As noted above, Water Code § 13242 requires that a program of implementation within a Basin Plan contain a description of the actions "which are necessary to achieve" water quality

objectives, including "appropriate action" to be taken, a "time schedule for the actions," and a description of the surveillance to be "undertaken to determine compliance." The proposed Basin Plan Amendments, in sharp contrast to these requirements, allows for horizontal and vertical averaging rather than compliance with water quality objectives by any specific discharger at any specific location. (*See* Section C, *supra*.) It further allows for legally-impermissible and potentially very lengthy exceptions to meeting water quality objectives, as well as offsets that may take place far from the location of the discharge. (*See* Sections F, G, *supra*.) There is no legal authority for the exceptions policy as drafted, and merely citing to an existing temporary exceptions policy for salinity (which itself referenced no legal authority) does not rectify the issue.

In short, the proposed Amendments to the relevant basin plans do not represent a "program of implementation for achieving water quality objectives" that complies with § 13242. (*See also* Cal. Code Regs., tit. 23, § 2231 [setting forth regulatory requirements for time schedules].)

2. The Basin Plan Amendments Do Not Comply With the Nonpoint Source Policy.

As noted above, basin plan amendments, such as those at issue here, must be consistent with state water policies. (Wat. Code §§ 13146, 13240; *Asociacion de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Bd.* (2012) 210 Cal.App.4th 1255, 1263.) One such policy is the Policy for Implementation and Enforcement of the Nonpoint Source Control Program ("Nonpoint Source Policy" or "NPS Policy"), adopted by the SWRCB in 2004.

The Nonpoint Source Policy contains five mandatory Key Elements that all nonpoint source pollution control implementation programs must comply with. (NPS Policy at 11.) As "an overarching framework for managing salt and nitrate in the Central Valley," the Basin Plan Amendments clearly are a nonpoint source pollution control program, and thus must comply with all five Key Elements. (See Draft Staff Report at 5.)

Key Element 1 states in part that "[a]n NPS control program must, at a minimum, address NPS pollution in a manner that achieves and maintains water quality objectives and beneficial uses, including any applicable antidegradation requirements." (Nonpoint Source Policy at 12.) And Key Element 3 recognizes that compliance with ambient groundwater quality objectives is not always immediately possible, but requires that any time schedule to achieve WQOs contain "quantifiable milestones designed to measure progress toward reaching the specified requirements." (Nonpoint Source Policy at 13.)

The Basin Plan Amendments violate the policy because they allow discharges of nitrate to continue indefinitely at levels that cause or contribute to exceedances of water quality objectives and because they allow the Regional Board to simply abandon restoration of contaminated groundwater basins (p. 53-54, *supra*).

a. Under the Nonpoint Source Policy, Discharges Must Not Cause or Contribute to Exceedances.

The Basin Plan Amendments fail to require dischargers to discharge nitrate at rates that do not cause or contribute to water quality objective exceedances. The program requires limitations on nitrate loading to groundwater below those rates only if such limitations are "reasonable, practicable and feasible." (E.g., Staff Report at 31, 53, 54, 73, 358.) In circumstances where the discharger or the Regional Board determines that it is not reasonable, practicable, or feasible to make such reductions, the discharger may seek an exception from complying with the water quality objectives.[3]

But the Nonpoint Source Policy does not permit a nonpoint source pollution control program to exempt dischargers from meeting receiving waters limitations based on considerations of cost.[4]Rather, the Policy requires program must demonstrate that it has high a likelihood of achieving and maintaining water quality objectives and beneficial uses. Under the Policy, therefore, the Regional Board has no authority to refuse to limit discharges simply on the basis that the reduction is not "reasonable," "feasible," or "practicable."

The Staff Report improperly concludes that CV SALTS complies with the Nonpoint Source Policy. (Staff Report at 358-59.) Discussing compliance with Key Element 1, the report requires the Regional Board "to work towards achieving balanced salt and nitrate loading." (Staff Report at 358.) But the policy requires much more than working towards a goal; it requires a high likelihood of success. By failing to require achievement of water quality objectives, the program fails to comply with the Policy.

b. Under Porter-Cologne, The Sources of Drinking Water Policy, And The Nonpoint Source Policy, The Regional Board May Not Abandon Groundwater Basins.

Likewise, the Regional Board may not abandon groundwater basins when it determines that restoration of such basins is difficult or costly. The Nonpoint Source Policy requires nonpoint source pollution control programs to have a high likelihood of achieving and maintaining water quality objectives. But the Basin Plan Amendments propose to allow groundwater basins to exceed water quality objectives indefinitely.

> Further, the proposed Amendments recognize that it may not be reasonable, feasible or practicable to achieve balanced loadings or fully restore groundwater in some basins/subbasins. For other basins, it may take multiple decades to

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[3] The terms "reasonable," "feasible," and "practicable" are nowhere defined in the Staff Report. It is unclear how the Regional Board and/or dischargers will analyze any given discharge limitation to determine whether it is "reasonable," "feasible," or "practicable."

[4] Porter-Cologne gives Regional Boards the authority to consider "economic considerations" when establishing WQOs. (Wat. Code § 13241, subd. (d).) Once the Board sets WQOs, however, the Nonpoint Source Policy requires pollution control programs that achieve them without considering economic considerations such as whether achievement is "reasonable," "feasible," or "practicable." CV SALTS does not disturb the WQO for nitrate in groundwater, 10 mg/L-N. (Staff Report at 9.)

> achieve the goals of the Nitrate Control Program. In some limited cases, where restoration of the groundwater basin for MUN uses may not be reasonable, feasible or practicable it may be necessary for the Regional Water Board to consider de-designating MUN beneficial use designations from that groundwater basin. (Staff Report at 53.) And in discussing compliance with the Nonpoint Source Policy, the Staff Report states that the program "will require all permittees, including NPS permittees, to implement long-term, managed restoration of impaired water bodies, *where reasonable, feasible and practicable*."

(Staff Report at 359 (emphasis added); see also Section F, *supra*.) While it is true that groundwater restoration will not happen overnight, these passages represent a dramatic shift in California water policy. Rather than protect and restore aquifers contaminated by decades of unchecked agricultural pollution, this proposal creates sacrificial aquifers where that pollution would prevent any current use of the water for domestic use. And, by dedesignating the MUN use from a groundwater basin, Staff would abandon any hope of restoration in the future.

Such a dedesignation would also violate the Sources of Drinking Water Policy, Policy No 88-63. The policy designates all groundwaters of the state as suitable for drinking water. The policy contains three exceptions for dedesignating groundwater, none of which apply here. Notably, Exception 2, which applies to contaminated groundwater, only allows dedesignation when the water cannot be reasonably treated using "Best Management Practices or best economically achievable treatment practices" to achieve WQOs. In the case of nitrate pollution of groundwater, processes such as reverse osmosis are capable of treating the water to achieve drinking water standards. Exception 2 does not address dedesignation when restoration cannot be reasonably achieved. Thus any dedesignation of the MUN use in a groundwater basin on the basis that restoration is unreasonable, infeasible, or impracticable would violate the Sources of Drinking Water Policy.

The Nonpoint Source Policy does not allow abandonment of groundwater basins. In fact, Key Element 3 addresses the situation of a "severely degraded waterbody" directly. (Nonpoint Source Policy at 13.) In such a situation, the nonpoint source pollution control program is to adopt a specific time schedule, not "longer than that which is reasonably necessary to achieve" WQOs. (*Id.*) The time schedule should include "quantifiable milestones designed to measure progress toward reaching the specified requirements." The refusal to set a time schedule for basin restoration violates the Nonpoint Source Policy. (*See also* Section H.1.c., *supra*.)

The Staff Report states that permitting under CV SALTS will comply with Key Element 3 because the Regional Board will make "determinations as to whether or not a permittee's treatment or control management practices will reasonably [be] expected to ensure attainment of the Salinity and Nitrate Control Program's stated purposes on a timeline that is as short as practicable at the time the permits are issued." (Staff Report at 359.) This is the wrong standard. Key Element 3 requires a time schedule that will achieve "water quality requirements," not CV-SALTS's "stated purposes." To the extent that CV-SALTS's "stated purposes" include considerations other than meeting WQOs, the program does not comply with the Nonpoint Source Policy.

The abandonment of groundwater restoration also represents a policy determination that profits from agriculture are a higher priority for this Regional Board than protecting the groundwater of

the state. The Legislature has declared that it is the "established policy of this State that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation." (Wat. Code § 106.) Yet the decision to sacrifice certain groundwater basins so that the agriculture industry may pollute at will privileges irrigation over domestic users. This reversal of state policy is particularly galling as the primary users of shallow groundwater in the Central Valley are low-income communities of color, many of whose residents are employed on the very farms profiting off of the proposed dedesignation. Further, in a changing climate, cities and towns throughout the Central Valley may become increasingly reliant on groundwater. Dedesignating these basins would prevent their use in the future.

3. The Basin Plan Amendments Do Not Comply With The State Antidegradation Policy.

a. The Analysis Applies The Wrong Legal Standard.

The State Antidegradation Analysis (Staff Report, pp. 323-345) supporting the proposed Basin Plan Amendments wholly fails to apply relevant legal standards. Of particular note, the Analysis fails to mention or apply *Asociacion de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Bd.* (2012) 210 Cal.App.4th 1255, 1256 (hereinafter "*AGUA*").

In *AGUA*, the court considered whether a general waste discharge order issued by the Central Valley Regional Water Control Board in 2007, which purported to prohibit further degradation of groundwater from existing dairy farms, was consistent with the antidegradation policy. (*Id.* at 1258-59.) In concluding that it was not, the court noted that a conclusory prohibition on further degradation was not sufficient to comply with the antidegradation policy. (*Id.* at 1259.) Instead, the *AGUA* court held that the Regional Board, in order to comply with the Antidegradation Policy, must affirmatively "demonstrate" compliance with the Policy. (*Id.* at 1278.)

This affirmative requirement is accomplished through a "two-step process" for "determining whether a discharge into high quality waters is permitted." (*Id.* at 1278, 1282.) The first step of the process is for the Regional Water Board to make three (3) "specified findings": that the "change in water quality (1) will be consistent with maximum benefit to the people of the State, (2) will not unreasonably affect present and anticipated beneficial use of such water, and (3) will not result in water quality less than that prescribed in state policies…" (*Id.* at 1278.)

The finding that a change in water quality will be "consistent with the maximum benefit to the people of the State" must be made on a "case-by-case basis…based on considerations of reasonableness under the circumstances at the site." (*Id.* at 1279.) In making this "case-by-case" finding, the Board must consider the following factors "(1) past, present, and probable beneficial uses of the water (specified in Water Quality Control Plans); (2) economic and social costs, tangible and intangible, of the proposed discharge compared to the benefits, (3) environmental aspects of the proposed discharge; and (4) the implementation of feasible alternative treatment or control methods." (*Id.*)

The second step of the AGUA process is a finding "that any activities that result in discharges to such high quality waters are required to use the best practicable treatment or control of the discharge necessary to avoid a pollution or nuisance and to maintain the highest water quality consistent with the maximum benefit to the people of the State." (*Id.*)

AGUA goes on to further clarify the standards to be applied in making the affirmative site-specific findings required for a proper Antidegradation analysis. As the Staff Report fails to make these findings and consider relevant factors, it does not affirmatively demonstrate compliance with the State Antidegradation Policy.

b. The Staff Report Makes No Attempt At A Baseline Analysis.

"When undertaking an antidegradation analysis, the Regional Board must compare the baseline water quality (the best quality that has existed since 1968) to the water quality objectives." (*Id.* at 1270.) Then, "[i]f the baseline water quality is equal to or less than the objectives, the objectives set forth the water quality that must be maintained or achieved" and "the antidegradation policy is not triggered." (*Id.*) On the other hand, "if the baseline water quality is better than the water quality objectives, the baseline water quality must be maintained in the absence of findings required by the antidegradation policy." (*Id.*)

The Antidegradation Analysis here acknowledges that the proper baseline is the best water quality that has existed since 1968. (Staff Report at 325.) However, it does not discuss available data to determine what percentage of waters in the Central Valley are high quality and which will be degraded under this proposal. In fact, the Antidegradation Analysis makes only an implicit finding that the degradation allowed by the proposed Amendments will degrade high quality waters, without making any express finding on the matter. (*See*, e.g., Staff Report at 335 ["Although additional degradation will occur while the Nitrate Control Program strategies are developed and implemented, impacts due to this degradation will be mitigated through programs designed to provide drinking water to individuals and communities whose wells have been rendered unusable because of nitrate pollution."]; 339 ["However, the proposed Nitrate Control Program would allow the Board to allow nitrate impairments to persist for years, if not decades…"], ["This degradation would nonetheless would be consistent with the maximum benefit to the people of the state..."].)

The State Antidegradation policy requires more. Specifically, the Regional Board must consider available data (much of which is cited by the Staff Report and appendices with respect to other issues) and make an affirmative finding that the Basin Plan Amendments will permit degradation of high quality waters. Then, the Board must make a thorough and honest attempt to determine what portion of waters in the relevant area (here the Central Valley) are high quality with respect to nitrate, which must inform the discussion regarding how significant the degradation of high quality waters will be under the proposed Amendments. Without such an analysis, it is impossible to properly balance the costs and benefits of the proposed Basin Plan Amendments, which brings us to "maximum benefit."

c. The Staff Report Fails To Affirmatively Demonstrate "Maximum Benefit."

As noted above, the finding that a change in water quality will be "consistent with the maximum benefit to the people of the State" must be "affirmatively demonstrated" and made on a "case-by-case basis…based on considerations of reasonableness under the circumstances at the site." (*AGUA*, 210 Cal.App.4th at 1279.)

In making this "case-by-case" finding, the Board must consider the following factors "(1) past, present, and probable beneficial uses of the water (specified in Water Quality Control Plans); (2) economic and social costs, tangible and intangible, of the proposed discharge compared to the benefits, (3) environmental aspects of the proposed discharge; and (4) the implementation of feasible alternative treatment or control methods." (*Id.*) As the Antidegradation Analysis here does not consider those factors, and because those factors weigh against a maximum benefit finding, the proposed Basin Plan Amendments do not comply with the State Antidegradation Policy.

i. Past, Present, And Probable Beneficial Uses Of The Water (Specified In Water Quality Control Plans).

The past, present and probable beneficial uses of water in the project area are varied and diverse. The Municipal and Domestic Supply Beneficial Use in particular has the potential for being severely impacted by degradation of groundwater due to nitrate discharges, even if that degradation is "short-term" or "localized." This is especially true given that "95% of the [San Joaquin] valley's population relies on groundwater for drinking." (CAROLINA BALAZS ET AL., SOCIAL DISPARITIES IN NITRATE-CONTAMINATED DRINKING WATER IN CALIFORNIA'S SAN JOAQUIN VALLEY (Environmental Health Perspective 2011), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3230390/.)

As significant degradation is acknowledged to potentially result from the Basin Plan Amendments for "years" or "decades," and as the vast majority of residents of the San Joaquin Valley rely on groundwater for drinking water, this factor weighs against a maximum benefit finding. While the Basin Plan Amendments require provision of replacement water to impacted residents and communities, they do not provide requirements for frequent testing of domestic wells or unregulated public water systems, and thus do not provide the means of detecting water quality impacts to be mitigated. Further, it is unlikely that a regulatory system that authorizes degradation of subbasins and basins, and only requires restoration where reasonable and feasible, will be sustainable with respect to drinking water replacement or treatment. As such, requirements to provide drinking water do not eliminate the impacts to past, present and probable beneficial uses of groundwater in the project area.

ii. Economic And Social Costs.

In considering "economic" costs, the Regional Board must consider "both costs to the discharger and the affected public," and in doing so, "[c]ost savings to the discharger, standing alone, absent a demonstration of how these savings are necessary to accommodate 'important social and economic development' are not adequate justification" for permitting degradation. (*Id.*) In considering "social" costs, consideration must be given to whether a lower water quality can be abated through reasonable means. In other words, the lower water quality should not result from inappropriate treatment facilities or less-than-optimal operation of treatment facilities." (*Id.*)

Discussing the "economic" costs first, the Basin Plan Amendments would allow degradation for years or decades, followed by requirements of "balance" and undefined remediation measures, where reasonable and feasible at some unspecified point in the future. Further, certain localized impacts will persist beyond that undefined point in time, given the conclusion that remediation of

localized degradation will not always be feasible. (Staff Report at 377 ["because the No Project Alternative would allow localized areas of groundwater basins/subbasins that are near or over the applicable water quality objective to be further degraded in the future until corrective actions are taken, and because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions, the No Project Alternative (like the Proposed Project) would contribute considerably to adverse future cumulative conditions of salts and nitrate in some localized areas of basins/subbasins within the Central Valley Region."].)

Short-term and permanent degradation of groundwater will have significant economic impacts on the public at large that arenot considered in the Staff Report. Specifically, there are at least two unsupported assumptions: (a) that dischargers will be able to promptly identify residents impacted by nitrate exceedances; and (b) that a program that permits permanent and widespread degradation to groundwater can be operated sustainably over the long-term as replacement water and treatment costs rise. With respect to identifying nitrate exceedances, significant challenges are presented by domestic wells and public water systems that are not presently required to test for nitrate. The Basin Plan Amendments do not require comprehensive and frequent domestic well testing, and thus as nitrate problems spread dischargers will not be able to identify who must receive drinking water. With respect to the second assumption, if drinking water problems expand to the point that dischargers can no longer fund drinking water solutions, residents of the Central Valley will be left in an even more precarious position than they are today.

At a minimum, the Staff Report must be revised to consider the costs associated with the consumption of drinking water that exceeds the nitrate MCL for those who rely on domestic wells and small public systems for which no comprehensive testing program exists. That economic analysis must include associated health care costs, loss of employment/population, and other impacts of drinking contaminated water.

Weighed against these costs to the public are the cost savings to the discharger under the proposed Basin Plan Amendments. However, as there is no reasoning or facts supporting the proposition that cost savings to the dischargers "are necessary to accommodate 'important social and economic development," the costs savings standing alone do not support an "economic" benefit finding. Any statements to the contrary in the Antidegradation Analysis are based on pure speculation and underemphasize the interest in protective the broader economic interests of the people of the State of California relative the interests of the regulated community. (*See* Staff Report at 335 [alleging, without factual support, that "...despite significant advances in wastewater treatment technology, widespread adoption of agricultural practices that reduce nitrogen inputs, and increasing efforts to refine management practices at concentrated animal facilities, many permittees are unable to consistently meet permit limits designed to protect the MUN beneficial use in groundwater."], 382 [Under the no project alternative, acknowledging that "The future compliance costs for these dischargers cannot be quantified because these costs will be case-specific and information supporting such an analysis has not been developed by CV-SALTS and is not otherwise available. It is unknown if future compliance costs will drive growers to fallow or retire land as a means to balance the cost of compliance with maintaining viable agricultural operations."].)

Turning to "social" costs, the question is whether the additional significant degradation can be abated by alternate means. The answer to that question is in the affirmative. The Regional Board could decline to adopt the Basin Plan Amendments, and instead continue to enforce and strengthen waste discharge requirements and exceptions under the present regulatory framework. Moreover, analysis related to improper crop selection for agriculture, improvements to existing lagoon and conveyance liners for dairy operations, and alternative treatment measures for other dischargers, have not taken place in a comprehensive manner to date. As such, the conclusion that dischargers cannot reply with water quality objectives, so should not be required to, is without factual support and must be rejected.

Based on the above discussion, the "economic" and "social" costs factor weighs against a maximum benefit finding.

iii. Environmental Aspects Of The Proposed Discharge

As discussed more fully elsewhere in this letter, the Staff Report fails to properly consider several environmental aspects of the nitrate degradation authorized by the Basin Plan Amendments, including: short-term, long-term and permanent degradation to groundwater; surface water impacts due to its interconnection with groundwater (Section H.4., *infra*); and impacts to air quality due to overapplication of nitrogen fertilizer (*Section* I.4.b., *infra*.). As these environmental aspects were not analyzed, the Antidegradation Analysis is incomplete.

iv. The Implementation Of Feasible Alternative Treatment Or Control Methods

As discussed herein, alternative control methods are available, and are already in effect. Specifically, the currently operative regulatory framework provides more protection to groundwater. As such, this factor also weighs against a maximum benefit finding.

* * * * *

Because all four (4) factors weigh against a finding that adoption of the Basin Plan Amendments is consistent with the "maximum benefit to the people of the State," the Amendments are inconsistent with State Antidegradation Policy.

d. The Basin Plan Amendments Will Unreasonably Affect Present And Anticipated Beneficial Use Of High Quality Waters Of The State.

Even if the discharges permitted by the Basin Plan Amendments were consistent with the maximum benefit to the people of the State – though they are not – the Amendments still would not satisfy the "first step" of an Antidegradation Analysis because they will unreasonably affect present and anticipated beneficial use of high quality waters of the State. As discussed in above, the Amendments will permit nitrate-related degradation for "years" or "decades," and restoration of those impacted areas will not always be reasonable or feasible according the the Staff Report. Though no locations or time periods are specified, it is likely that this degradation will in some areas restrict present beneficial uses of groundwater for "years," "decades" or indefinitely. This impact is unreasonable, especially given that alternative regulatory structures exist and are presently in effect that better protect groundwater, and the negative economic impacts on dischargers are speculative.

The Staff Report does not really contest this conclusion, stating that the Nitrate Control Program merely "...protects present or probable future beneficial uses to the maximum extent practicable" and will result in meeting "the drinking water MCL ***or the highest quality water technically and economically achievable***." (Staff Report p. 340 [emphasis added].) As the Basin Plan Amendments thus do not require compliance with drinking water standards, and as groundwater is the primary source of drinking water in the Central Valley Region, the Basin Plan Amendments will unreasonably affect present, and anticipated beneficial uses of high quality waters.

e. The Basin Plan Amendments Are Not Consistent With State Policies.

As discussed above, the proposed Basin Plan Amendments will result in exceedances of water quality objectives for nitrate in groundwater, and also violate related water quality policies. This is acknowledged by the Staff Report several times. (*See*, e.g., Staff Report at 377 ["because the No Project Alternative would allow localized areas of groundwater basins/subbasins that are near or over the applicable water quality objective to be further degraded in the future until corrective actions are taken, and because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions, the No Project Alternative (like the Proposed Project) would contribute considerably to adverse future cumulative conditions of salts and nitrate in some localized areas of basins/subbasins within the Central Valley Region."].)

However, the Staff Report seeks to avoid the result by redefining the spatial and temporal boundaries under which consistency with water quality objectives is measured. Regarding spatial boundaries, the Basin Plan Amendments permit horizontal and vertical averaging of water quality, and based on that average the Staff Report concludes that permittees under the Nitrate Control Program must "conduct a comprehensive antidegradation analysis that must include demonstration that 'there is sufficient assimilative capacity to ensure that the proposed discharge, together with discharges from participants to the same management zone, including discharges to recharge projects, will not cause the volume-weighted average water quality in the appropriate zone underlying the management zone to exceed the applicable Basin Plan objective(s).'" (Staff Report at 337.) The standard for determining compliance with water quality objectives has never been, and has not been revised to, a "volume-weighted average water quality" in a large (and as of yet undefined) horizontal and vertical area.

For temporal averaging, the Staff Report states, "[u]ltimately, the requirements in the Nitrate Control Program, as implemented through the Board's issuance of permits to effectuate the program, will ensure that any changes to high quality waters will not result in water quality less than water quality objectives when evaluated and considered over the long-term." (Staff Report at 341.) Again, this is a wholly new and legally unsupported interpretation of the water quality objective for nitrate and state policies requiring its implementation. Water users cannot show compliance with water quality standards by showing that average quality over a period of years or decades is below the maximum contaminant level for nitrate. Rather, an exceedance is determined at the time that water is to be delivered to the public. For water quality objectives to support the MUN beneficial use, temporal average of water quality cannot be sanctioned.

Along the same lines, the Staff Report states that "[t]he compliance time schedules authorized under the Nitrate Control Program are well within the Board's statutory authority and consistent with all applicable policies." (*Id.*) These organizations respectfully disagree. One need only look to the exceptions policy, which authorizes indefinite non-compliance with water quality objectives without any cap. No statutory authority or applicable policy that we are aware of authorizes indefinite exceptions that may exceed fifty (50) years. (*See*, e.g., Cal. Code Regs., tit. 23, § 2231 [setting forth regulatory requirements for time schedules].)

f. The Basin Plan Amendments Will Not Result In BPTC Necessary To Avoid Pollution Or Nuisance.

As noted, the second step of the AGUA process is a finding "Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the ***best practicable treatment or control*** of the discharge necessary to ***assure that (a) a pollution or nuisance will not occur*** and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained." (Resolution 68-16 [emphasis added]; *see also AGUA*, 210 Cal.App.4th at 1279.)

As noted above, the Basin Plan Amendments will not result in best practicable treatment and control. Both existing regulations and the alternatives proposed by these organizations (some of which are included in the Staff Report) represent treatment and control methods that are practicable and more protective of groundwater.

Moreover, the degradation allowed by the Basin Plan amendments will result in pollution and nuisance, both in terms of water quality and related to air pollution. Of note, guidance from the SWRCB confirms that "nuisance" for purposes of the Antidegradation Policy is not limited to water quality impacts. (*See* Questions and Answers, Resolution 68-16, p. 4 (1995) ["To comply with Resolution No. 68-16, the activity that results in the discharge may not cause a nuisance. … Nuisance may include, for example, dust, odors, or noise associated with the discharge of wastes, such as during a cleanup or from sewage discharges. Nuisance considerations under the CWC are not limited to water quality impacts."].) As such, the Antidegradation Policy requires cessation of the nuisance caused by significant NOx emissions related to overapplication of nitrogen fertilizer, which will continue under the proposed Nitrate Control Program. (*See also* Section I.4.b., *infra*.)

4. The Basin Plan Amendments Do Not Comply With The Federal Antidegradation Policy

The Staff Report does not analyze or make any findings with respect to the Federal Antidegradation Policy, stating only that the "Nitrate Control Program solely geared towards rectifying and addressing issues related to nitrates in groundwater." (Staff Report at 342.) However, at least some surface water is hydrologically connected to surface water in the Central Valley Region. (Alida Cantor, Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act (March 2018), Ex. B.) As such, the Regional Board is required to analyze the impact of authorizing discharges of nitrate on surface water quality. (*See* Preamble, NPDES Permit Regulations for Storm Water Discharges, 55 FR 47990 ["…discharges to ground waters are not covered by this rulemaking (unless there is a

hydrological connection between the ground water and a nearby surface water body)."]; *McClellan Ecological Seepage Situation (MESS) v. Weinberger* (E.D.Cal. 1988) 707 F.Supp. 1182, 1196; *Exxon Corp. v. Train* (5th Cir. 1977) 554 F.2d 1310, 1312 n.1.)

5. The Basin Plan Amendments Do Not Comply With The Reasonable And Beneficial Use Doctrine.

The "reasonable and beneficial use" doctrine is codified in the California Constitution, requiring that "the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare." (Cal Const, Art. X § 2; *see also United States v. State Water Resources Control Bd.* (1986) 182 Cal.App.3d 82, 105 ["…superimposed on those basic principles defining water rights is the overriding constitutional limitation that the water be used as reasonably required for the beneficial use to be served."].)

The reasonable and beneficial use doctrine applies here given the impacts of the Basin Plan Amendments on groundwater quality, which are likely, if not certain, to make significant quantities of groundwater in the Central Valley Region unsuitable for the MUN beneficial use. Despite these impacts, the Staff Report does not mention, analyze or comply with the reasonable and beneficial use doctrine.

6. The Basin Plan Amendments Do Not Comply With The Public Trust Doctrine

The "public trust" doctrine applies to the waters of the State, and states that "the state, as trustee, has a duty to preserve this trust property from harmful diversions by water rights holders" and that thus "no one has a vested right to use water in a manner harmful to the state's waters." (*United States v. State Water Resources Control Bd.,* 182 Cal.App.3d at 106; *Nat'l Audubon Soc'y v. Superior Court* (1983) 33 Cal.3d 419, 426 ["before state courts and agencies approve water diversions they should consider the effect of such diversions upon interests protected by the public trust, and attempt, so far as feasible, to avoid or minimize any harm to those interests."].) The "public trust" doctrine has recently been applied to groundwater, at least where there is a hydrological connection between the groundwater and a navigable surface water body. (*Envtl. Law Found. v. State Water Res. Control Bd. No.* 34-2010-80000583 (Cal. Super. Ct July 15, 2014).)

At least some groundwater in the Central Valley Region has a hydrogeological connection to surface water. Degradation of surface water caused by nitrate discharges to hydrologically connected groundwater triggers the public trust doctrine. However, the Staff Report does not mention, let alone properly apply and analyze, the public trust doctrine.

I. <u>Environmental Analysis</u>

The Environmental Analysis contained in the Staff Report and Appendix K is in many ways similar or identical to the analysis previously provided with the SNMP. Our prior comments are thus incorporated by reference and resubmitted. (Ex. E.)

The following comments are offered in addition to those previously submitted.

1. Legal Standards

The California Supreme Court has held that "[t]he foremost principle under CEQA is that the Legislature intended the act 'to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language.'" (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 390 (*hereinafter* "*Laurel Heights*") quoting *Friends of Mammoth v. Board of Supervisors* (1972) 8 Cal.3d 247, 259 disapproved on other grounds by *Kowis v. Howard* (1992) 3 Cal.4th 888; *Mountain Lion Foundation v. Fish & Game Com.* (1997) 16 Cal.4th 105, 112.)

The purpose of an environmental impact report ("EIR") is to "provide public agencies and the public in general with detailed information about the effect which a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project.'" (*Laurel Heights*, 47 Cal.3d at 390 citing Pub. Resources Code § 21061; CEQA Guidelines, § 15003, subds. (b)-(e).)

The phrase "significant effect on the environment" means "a substantial, or potentially substantial, adverse change in the environment." (Pub. Resources Code § 21068; *Laurel Heights*, 47 Cal.3d at 390.)

The same principles apply to an SED. Basin Planning is a "certified regulatory program," and therefore requires development of an SED pursuant to CEQA. (*California Sportfishing Protection Alliance v. State Water Resources Control Bd.* (2008) 160 Cal.App.4th 1625, 1631.) In the SED, the Central Valley Regional Quality Control Board the ("Regional Board") must comply with CEQA's mandate to disclose the environmental effects of a proposed change to a basin plan and must "identify the environmental effects of projects, and then to mitigate those adverse effects through the imposition of feasible mitigation measures through the selection of feasible alternatives." (*Sierra Club v. State Bd. of Forestry* (1994) 7 Cal.4th 1215, 1233.)

Pursuant to Public Resources Code § 21159(a),[5] an SED must "at a minimum" include all of the following:

> (1) An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
> (2) An analysis of reasonably foreseeable feasible mitigation measures.
> (3) An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation.
>
> …

Section 21159(d) further explains that an SED must "take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites."

Though § 21159 does not require the preparing agency to engage in "speculation or conjecture," an SED must consider the environmental effects of future actions that might result from a project

[5] Cited by the subject SED as applicable authority. (Staff Report at 137.)

if: "(1) it is a reasonably foreseeable consequence of the initial project; and (2) the future expansion or action will be significant in that it will likely change the scope or nature of the initial project or its environmental effects." (*Laurel Heights*, 47 Cal.3d at 396; *Center for Biological Diversity v. County of San Bernardino* (2016) 247 Cal.App.4th 326, 349; *Paulek v. Department of Water Resources* (2014) 231 Cal.App.4th 35, 46.)

2. The Staff Report Does Not Properly Analyze A Reasonable Range Of Alternatives.

In order to comply with the "analysis of alternate means of compliance" requirement of § 21159, an SED must include "[a]lternatives to the activity and mitigation measures to avoid or reduce any significant or potentially significant effects that the project might have on the environment." (Cal.Code Regs., tit. 14, § 15252(a); *see also Conway v. State Water Resources Control Bd.* (2015) 235 Cal.App.4th 671, 680 [holding in the context of a basin plan amendment that "[t]he document used as a substitute for an EIR must include a description of the proposed activity with alternatives to the activity and mitigation measures as well as written responses to significant environmental points raised during the evaluation process."].)

The "alternatives" discussion must include "a reasonable range of alternatives to the project, or to the location of the project, which could feasibly attain the basic objectives of the project and evaluate the comparative merits of the alternatives." (*Laurel Heights*, 47 Cal.3d at 400; Guidelines, § 15126(d).) Moreover, "[t]hese alternatives must be discussed, 'even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly.'" (*Id.*)

Just as in the SNMP, the Environmental Analysis here analyzes only two alternatives: a No Project Alternative and the Proposed Project. (Staff Report at 368.) This is not a "reasonable range of alternatives to the project" as is required.[6] Taking no action, while clearly an alternative, does not encompass all "reasonably foreseeable" alternatives.

The California Supreme Court's opinion in *Laurel Heights* is instructive. (47 Cal.3d at 376.) In *Laurel Heights*, a draft EIR analyzed only three (3) alternatives for the site for research facilities at the University of California, San Francisco: "no project anywhere, alternative sites on the UCSF Parnassus campus, and alternative sites off-campus." (*Id.* at 403.) In analyzing the alternatives, the EIR made the conclusion that the no project alternative would have no environmental effects, and then stated merely that "no alternative sites on [the Parnassus] campus were evaluated…" (*Id.*) The court concluded that "[t]his is not a sufficient discussion of on-campus alternatives; it is merely an admission that such alternatives were not considered." (*Id.*) With respect to consideration of other off-campus sites, *Laurel Heights* held that the discussion in the EIR was "equally deficient" because the discussion simply entailed a statement that none of the off-campus properties owned by UCSF "had space available of sufficient size to accommodate the School of Pharmacy units that are to be moved." (*Id.*) The court thus held that "[i]t defies common sense for the Regents to characterize this as a discussion of any kind; it is barely an identification of alternatives, if even that. (*Id.*)

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[6] Though the Staff Report in Section 4 describes certain "alternatives" and "options," those options are not subjected to environmental analysis and thus do not constitute an "analysis" of alternatives.

The discussion of alternatives in the instant SED falls short of even the Regents' "discussion" in *Laurel Heights*. While the Regents' at least identified, albeit in a cursory manner, alternatives in addition to a "no project" alternative, the SED here *only* subjects a "No Project" alternative to environmental analysis. This is facially insufficient, and does not satisfy one of the primary purpose of CEQA, i.e., to "demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implications of its action." (*Bay Area Citizens v. Association of Bay Area Governments* (2016) 248 Cal.App.4th 966, 996.)

Many of the alternatives and options that should have been subjected to environmental review are set forth in Section 4 of the Staff Report. Other options and alternatives are set forth above.

Additionally, even if the "No Project Alternative" by itself constituted a "reasonable range of alternatives" – though it clearly does not – the Environmental Analysis would still be deficient because it does not discuss the implications of the No Project Alternative in a sufficiently careful and factual manner. The Regional Board should not engage in "speculation or conjecture." Along the same lines, "[c]onclusory comments in support of environmental conclusions are generally inappropriate." (*Laurel Heights*, 47 Cal.3d at 404 citing *People v. County of Kern* (1974) 39 Cal.App.3d 830, 840; *see also Bay Area Citizens*, 248 Cal.App.4th at 997 ["As a general matter the EIR must present facts and analysis, not simply the bare conclusions or opinions of the agency."].)

In contrast to these requirements, the Environmental Analysis here engages in speculation and conjecture, and relies on conclusory comments in support of environmental conclusions related to the No Project Alternative. For example, the Staff Report states that the No Project Alternative does not achieve the goals of the SNMP because:

> If the water quality objective exceedances could not be addressed by the end of the time schedule, then those permittees could potentially be required to cease discharging. Degradation of groundwater salt and nitrate levels that is occurring under existing conditions would continue to occur in some areas of the Central Valley Region for a period of time before necessary actions to stop degradation could be implemented. The ultimate result of such actions, if feasible, would be water quality similar to existing conditions in some areas and somewhat more degraded in other areas, because restoration back to existing conditions is not anticipated to occur in all areas. However, a requirement for many agricultural dischargers to cease discharging entirely (i.e., cease irrigating crops, cease all growing activities) would be expected create widespread economic devastation in broad areas of the Central Valley, and the economic resources available to mitigate results of any historic practices would be lost.

(Staff Report at 375.) The argument thus appears to be that some dischargers will not be able to meet water quality objectives without the Basin Plan Amendments, causing widespread cease and desist orders, causing economic devastation and loss of resources that could be used for restoration. This is pure speculation beginning with the unsupported premise that many or most dischargers cannot meet water quality objectives under current regulations, and ending with the

unsupported assumption that the Basin Plan Amendments will result in significant restoration efforts (even though only required where reasonable, feasible and practicable).

The speculation continues along the same lines:

> For the No Project Alternative, potential resulting actions of having to cease agricultural discharges could result in a **potentially significant impact** on agricultural resources, such as the conversion of farmland to a non-agricultural use (e.g., land fallowing). The loss of agriculture could, in turn, result in the displacement of people that support the agricultural industry (those working directly on farms and those that work for businesses that provide agricultural products and services), which would result in the need for housing elsewhere. This would be a **potentially significant impact** to population and housing. Further, there would be significant economic impacts from conversion of agriculture to non-agriculture use, as described in the SNMP Economic Analysis (Larry Walker Associates, 2016a).

(Staff Report at 376 [emphasis in the original].) This dystopian view of the future without the implementation of the Basin Plan Amendments does not represent careful environmental analysis.

The EKI Report also concludes that the "No Project Alternative" is not adequately evaluated in the SED. (Exhibit A.) Specifically, the Report concludes that:

> The strategies assessed by CV-SALTS do attribute some nitrogen reductions to the dairy and irrigated lands WDRs, but do not evaluate nitrogen reductions that are being attained or are possible with best management practices ("BMPs"). LWA [Larry Walker Associates, Luhdorff and scalmanini Consulting Engineers, PlanTierra, and Formation Environmental] states it applied a "relatively arbitrary 20% estimate of potential future reductions in N application rates" to the irrigated lands WDRs. Thus, simulation results for the No Project (i.e., Scenario 3) scenario presented in the Economic Analysis are not based on actual or anticipated nitrogen reductions and may not reflect how groundwater nitrate concentrations will really change in response to BMPs.

(p. 4.)

3. The SED Does Not Adequately Discuss Enforceable And Feasible Mitigation Measures.

The Regional Board must identify "feasible mitigation measures." (*Laurel Heights*, 47 Cal.3d at 402.) "Mitigation" may include "(a) Avoiding the impact altogether by not taking a certain action or parts of an action; (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment; (d) Reducing or eliminating the impact over time by preservation and

maintenance operations during the life of the action; [and] (e) Compensating for the impact by replacing or providing substitute resources or environments." (Cal. Code Regs., tit. 14, § 15370.) In this context, the term "feasible" means "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." (Cal. Code Regs., tit. 14, § 15364.)

Additionally, "[f]ormulation of mitigation measures should not be deferred until some future time." (*Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 92 quoting CEQA Guidelines, § 15126.4(a)(1)(B).) An EIR is inadequate if "[t]he success or failure of mitigation efforts may largely depend upon management plans that have not yet been formulated and have not been subject to analysis and review within the EIR." (*Communities for a Better Environment*, 184 Cal.App.4th at 92)

Here, the Staff Report fails to discuss feasible mitigation measures. For example, the Staff Report concludes that the Basin Plan Amendments will have a "potentially significant and unavoidable" impact on groundwater quality. (Staff Report at 374.) However, no feasible mitigation measures are identified or discussed with respect to these potentially significant impacts, though such measures are available as demonstrated by CV-SALTS technical memoranda. (*See*, e.g., Alta Irrigation District Management Zone: Aggressive Restoration Alternative Modeling Scenario Results, p. 13 ["Localized efforts in areas that are of high priority (based on proximity to communities and existing ambient conditions) may be potentially ideal for restoration activities that may include on farm recharge, other artificial recharge efforts, and pump/treat/reinject efforts."]; EKI Report p. 7 [same].) The failure to discuss feasible mitigation measures, and deferral of specific discussions to future plans, renders the SED non-compliant with CEQA.

4. The Conclusions In The SED Are Not Supported By Substantial Evidence, And The SED Is Not Sufficient As An Informational Document.

The conclusions contained in an SED are subject to judicial review to determine "whether they are supported by substantial evidence and whether the EIR is sufficient as an informational document." (*Laurel Heights*, 47 Cal.3d at 407.) "Argument, speculation, unsubstantiated opinion or narrative, [or] evidence which is clearly erroneous or inaccurate…does not constitute substantial evidence." (Cal. Code Regs., tit. 14, § 15384(a).) Moreover, a conclusion is not supported by substantial evidence, and an SED is not sufficient as an information document, if its conclusions and discussions are internally inconsistent or contradictory. (*See Communities for a Better Environment*, 184 Cal.App.4th at 89 ["For the foregoing reasons, we agree with the trial court that the EIR fails as an informational document because the EIR's project description is inconsistent and obscure as to whether the Project enables the Refinery to process heavier crude. … Due to these errors, the EIR failed its informational purpose under CEQA."].)

a. The "Less Than Significant Impact" Finding Related To Groundwater Supplies Is Not Supported By Substantial Evidence.

The Staff Report and Appendix K conclude that there will be a less than significant impact on groundwater supplies because the proposed project does not call for construction of "facilities that would rely on extraction of groundwater supplies" and does not affect groundwater recharge. (Appx. K at 21.) However, the Staff Report does not consider or discuss the fact that

reduction in groundwater quality has a substantial effect on groundwater supplies for relevant beneficial uses, and that the Proposed Project will have a significant impact on groundwater quality. As such, the "less than significant" impact finding is not supported by substantial evidence and the Staff Report fails as an informational document.

b. The "Less Than Significant Impact" Findings For Greenhouse Gas Emissions And Air Quality Issues Is Not Supported By Substantial Evidence.

The Staff Report acknowledges that "[n]itrate in soil can be converted to nitrous oxide, a greenhouse gas" and that "[n]itrogen fertilization practices contribute significantly to nitrous oxide production; nitrous oxide emissions increase dramatically when fertilization exceeds crop usage…" (Staff Report, Appx. K at 16-17.) However, the Staff Report concludes that the Proposed Project will have a "less than significant" impact on greenhouse gas emissions because "fertilizer application rates in the future would be expected to be no greater than under existing conditions. Because the rate at which nitrate is applied to soils with the Proposed Project is expected to be no greater than existing conditions, the generation of nitrous oxide with the Proposed Project is expected to be no greater than existing conditions." (Staff Report, Appx. K at 17.) It similarly concludes that there will be a "less than significant impact" on air quality standards, criteria air pollutants, and populations sensitive to air pollutants. (Staff Report, Appx. K at 7.)

Nitrous oxide is a primary component of air pollution, and the Central Valley contains some of the most polluted air basins in the country. Further, a recent study, which we request be included in the record, concludes that nitrous oxide from irrigated agriculture contributes between 25 and 41 percent of total NOx emissions in California. (Maya Almaraz et al., Agriculture is a major source of NOx pollution in California, Science Advances (January 31, 2017), Ex. C.)

These impact findings are incorrect and not supported by substantial evidence because the Staff Report is answering the wrong question. The Proposed Project alters existing regulations related to nitrate loading, waste discharge requirements, and exceptions. The correct question, then, is not whether fertilizer application rates in the future are expected to be greater than current fertilizer application rates, but whether rates will be greater in the future under the Proposed Project or the No Project Alternative.

Further, as the Staff Report acknowledge, the Basin Plan Amendments will allow the Board to allow nitrate impairments to persist for years, if not decades…" (Staff Report at 339.) To be clear, this degradation for "years, if not decades" as it relates to irrigated agriculture is related to overapplication of nitrogen fertilizer. Under the no project alternative, as well as the alternatives proposed by these organizations, overapplication of fertilizer will not be authorized to the same degree as the Proposed Project. As such, the Proposed Project will have significant greenhouse gas and air quality impacts.

J. <u>Economic Analysis</u>

As the Staff Report merely summarizes and incorporates the economic analysis prepared by Larry Walker Associates and previously submitted in support of the SNMP, our comments on the economic analysis are incorporated here by reference and resubmitted. We also submit again

and request incorporated into the record the report on the SNMP prepared by EKI. (Ex. A.) Additionally, we note reliance on the economic analysis prepared by a third party retained by a coalition of dischargers appears to be an improper delegation of the Regional Board's authority and duties. (*See* Ex. E, p. 3.)

K. The Basin Plan Amendments Will Have Disparate Negative Impacts On Protected Classes.

State law provides that no person shall, on the basis of race, national origin, ethnic group identification, and other protected classes, be unlawfully denied full and equal access to the benefits of, or be unlawfully subjected to discrimination under, any program or activity that is conducted, operated, or administered by the state. (Gov. Code § 11135). Furthermore, the state's Fair Employment and Housing Act guarantees all Californians the right to hold and enjoy housing without discrimination based on race, color, or national origin. (Gov. Code § 12900 et seq.)

Small, majority-Latino communities within the San Joaquin Valley are disproportionately impacted by nitrate contamination of groundwater from agricultural waste. Latinos are more likely to have higher levels of nitrates in their drinking water than the population at large. (*See*, e.g., Carolina Balazs et al., Social Disparities in Nitrate Contaminated Drinking Water in California's San Joaquin Valley, Environmental Health Perspectives, 19:9 (September 2011), pp. 1272-78, Ex. D

.) The Balazs study finds that with other variables held constant, in communities served by small water systems, increases in the percentage of Latinos were associated with increases in nitrate levels. (*Id.*at 1276). For example, Balazs studied a sample size of almost 3 million people on small water systems and found that of the 5,000 people who relied on water that exceeded the MCL for Nitrates, 50% were Latino while less than 40% of the sample size as a whole was Latino. (*Id.*at 1276.) Moreover, Latino and low-income communities are less likely to have access to adequate healthcare, water treatment, and substitute water sources, which further aggravates these disparate impacts. (*Id.*at 1273;*see also* Harter Report at 17.)

The Basin Plan Amendments authorize waste discharges without requiring the means to locate residents and communities in the Central Valley served by domestic wells or unregulated small systems with nitrate exceedances. The impact of this policy will be disparately and negatively felt by communities of color, and are thus discriminatory and in violation of state law.

Moreover, the failure to adequately protect groundwater violates California's Fair Employment and Housing Act, California Government Code 12900, et seq., which guarantee all Californians the right to hold and enjoy housing without discrimination based on race, color or national origin. (See also Gov. Code § 65008 [Any discriminatory action taken "pursuant to this title by any city, county, city and county, or other local governmental agency in this state is null and void if it denies to any individual or group of individuals the enjoyment of residence, land ownership, tenancy, or any other land use in this state…"]; Government Code §§ 12955, subd. (l) [unlawful to discriminate through public or private land use practices, decisions or authorizations].)

* * * * *

For the foregoing reasons, the Regional Board should not adopt the proposed basin plan amendments.

Respectfully submitted,

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EXHIBIT A

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17 February 2017

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Subject: Review and Analysis of CV-SALTS
Salt and Nitrate Management Plan
(EKI B70030.00)

Dear Ms. Seaton:

This letter provides Erler & Kalinowski, Inc.'s ("EKI's") responses to questions that the Leadership Counsel for Justice and Accountability posed to us regarding the Central Valley Salinity Alternatives for Long-Term Sustainability ("CV-SALTS") *Central Valley Region Salt and Nitrate Management Plan*, dated December 2016 ("SNMP"). CV-SALTS has provided the SNMP to the Central Valley Regional Water Quality Control Board ("Regional Board") for consideration.

CV-SALTS SNMP GOALS

CV-SALTS' SNMP has three goals:

1. Ensure a safe drinking water supply.
2. Achieve balanced salt and nitrate loadings.
3. Implement a managed aquifer restoration program.

The SNMP proposes to achieve these goals by having the Regional Board amend the Basin Plan to adopt various management strategies, policies, and guidance described in the SNMP, which comprise the Proposed Project. 1/ The Economic Analysis and its supporting studies indicate that the Proposed Project is incapable of achieving the third goal of the SNMP. According to CV-SALTS, this goal "focuses on restoring the beneficial use where **reasonable and feasible**, but also seeks to minimize or prevent further degradation of ground waters that are currently meeting

1/ Larry Walker Associates ("LWA"). October 2016. *Central Valley Salt and Nitrate Management Plan Economic Analysis*. ("Economic Analysis") pp. 67-68.

water quality objectives to avoid future impairment." 2/ The technical evaluation performed on behalf of CV-SALTS shows that the Proposed Project does not offer appreciable improvement in groundwater nitrate concentrations over the No Project alternative.

SNMP Concludes Restoration of Basin and Subbasin Groundwater Quality is Not "Reasonable and Feasible"

LWA 3/ conducted a Management Zone Archetype Analysis of the Alta Irrigation District ("AID"), which is situated in the Tulare Lake Basin. LWA states:

> The Archetype Analysis evaluated what is needed in order to establish a management area consistent with the expected framework for developing a local Salt and Nitrate Management Plan and tested the application of selected policies, data analysis methods, and salt and nitrate management approaches that are being considered by CV-SALTS. 4/

The Management Zone Archetype Analysis and follow-on effort, described as the Aggressive Restoration Alternative Modeling Scenario, 5/ evaluated numerous management scenarios for the AID. Scenarios considered in the Economic Analysis for scale up to the Central Valley include:

- **No Project** (i.e., Scenario 3) incorporates some reduction in nitrate applied to agricultural fields due to implementation of existing regulatory programs such as the Waste Discharge Requirements ("WDRs") for dairies and irrigated lands, and National Pollutant Discharge Elimination System ("NPDES") permits for municipalities. 6/

- **Plan A** augments the No Project scenario by attempting to reduce groundwater nitrate concentrations by recharging aquifers with surface water from nearby streams and rivers during winter months.

2/ CV-SALTS SNMP. p. ES-4.

3/ The LWA Team consists of Larry Walker Associates, Luhdorff and Scalmanini Consulting Engineers ("LSCE"), PlanTierra, and Formation Environmental.

4/ LWA. May 2016. *CV-SALTS Management Zone Archetype Analysis: Alta Irrigation District*. ("Management Zone Archetype Analysis") p. 1.

5/ LSCE/LWA. 29 September 2016. *Alta Irrigation District Management Zone: Aggressive Restoration Alternative Modeling Scenario Results*. ("Aggressive Restoration Scenario Memorandum") Technical Memorandum from Vicki Kretsinger Grabert, Barbara Dalgish, and Karen Ashby to Daniel Cozad, Central Valley Salinity Coalition ("CVSC") Executive Director, and Richard Meyerhoff, CV-SALTS Technical Project Manager.

6/ See assumptions on pages 74 through 79 of LWA Management Zone Archetype Analysis and page 3 of LSCE/LWA Aggressive Restoration Scenario Memorandum.

- **Plan B**, **Plan C**, and **Plan D** add groundwater extraction, treatment, and reinjection to Plan A at progressively higher flow rates to maintain or restore groundwater quality.

Exhibits A and B attached hereto present Figures 13 and 14 from the Economic Analysis. These figures display simulated changes in nitrate concentrations at various depths within portions of the AID aquifer. Reductions in groundwater nitrate concentrations are consistently achieved only for Plan B, Plan C, and Plan D scenarios that include "pump-and-treat." However, based on the findings by CV-SALTS and others, pump-and-treat options are not "reasonably foreseeable feasible mitigation measures" for the Proposed Project, as required by Section 21159(a)(2) of the California Public Resources Code.

LSCE/LWA state "[a]pplying pump, treat, and reinject designs to large regional areas is not practicable." 7/ They also conclude:

> Restoration is not likely feasible on the scale of the Central Valley. It appears to be unrealistic even on the scale of AID, as it would likely take on the order of thousands of new wells to pump, treat, and reinject clean water back into the system while intercepting surface mass loadings before they migrate down into the Production Zone. 8/

The California Nitrate Project reached similar conclusions regarding pump-and-treat:

> Full, basin-scale application of pump-and-treat (PAT) methods is not practical, due to the prohibitively high costs associated with the required construction and operation of a vast network of contaminant capture wells for decades, possibly centuries. Moreover, vast amounts of groundwater would have to be treated and reinjected. The construction and energy costs alone would be enormous. 9/

In essence, both CV-SALTS 10/ and the California Nitrate Project find that it is not "reasonable and feasible" to restore an aquifer to its beneficial uses once groundwater nitrate concentrations

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7/ LSCE/LWA Aggressive Restoration Scenario Memorandum. p. 12.

8/ *Id*. p. 13.

9/ King, A., V. Jensen, G.E. Fogg, and T. Harter. July 2012. G*roundwater Remediation and Management for Nitrate. Technical Report 5 in: Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater*. Report for the State Water Resources Control Board Report to the Legislature. Center for Watershed Sciences, University of California, Davis. p. 38.

10/ On page 4-25 of the SNMP, CV-SALTS reiterates LSCE/LWA's findings that groundwater basins and subbasins cannot be restored to beneficial uses.

are greater than the drinking water standard. 11/ The Proposed Project allows for continued lowering of groundwater quality even though the SNMP concludes aquifer restoration is not possible.

The Nitrate Permitting Strategy in the SNMP states "there may be discharges of nitrates that are above the drinking water standard, and there is no available assimilative capacity. In these circumstances, it may be appropriate for the Central Valley Water Board to grant an exception to meeting the water quality objective rather than prohibiting the discharge." 12/ The discharge can be authorized under the Proposed Project provided drinking water is delivered to communities with nitrate-impaired wells. 13/, 14/

SNMP Does Not Adequately Assess Other Groundwater Protection and Restoration Strategies

The Agricultural Expert Panel convened by the State Water Resources Control Board recommends nitrogen source control through implementation of educational/awareness programs, irrigation water and nitrogen management plans, and monitoring. According to the Panel, "[h]aving a well-designed and implemented irrigation water and nitrogen management plan is a fundamental and good farming practice." 15/ Education, nitrogen management plans, and monitoring are core elements of the existing dairy and irrigated lands WDRs.

The strategies assessed by CV-SALTS do attribute some nitrogen reductions to the dairy and irrigated lands WDRs, but do not evaluate nitrogen reductions that are being attained or are possible with best management practices ("BMPs"). LWA states it applied a "relatively arbitrary

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11/ Irrespective of this finding, the feasibility of using pump-and-treat technology to mitigate basin-wide nitrate impacts probably merits greater scrutiny. The technology is being used to address elevated nitrate and salt concentrations in groundwater within the Chino Subbasin at much lower costs than those estimated for the AID in the Economic Analysis. The total annualized capital, and operation and maintenance ("O&M") expenses of the Chino Basin Desalter Authority pump-and-treat system are roughly $25 million compared with total annualized capital and O&M expenses in the range of $615 million to $773 million for the AID pump-and-treat system. Although the AID (130,000 acres) is smaller than the Chino Subbasin (154,000 acres), the projected costs in the Economic Analysis are at least 20 times greater than costs experienced for the Chino Subbasin pump-and-treat system. See Chino Basin Desalter Authority Adopted Budget for Fiscal Year 2016/17, http://chinodesalter.org/DocumentCenter/View/89 Accessed 9 February 2016, and page 118 of LWA Economic Analysis.

12/ CV-SALTS SNMP *Nitrate Permitting Strategy*. Attachment A-2. p. A2-15.

13/ *Id*. p. A2-6.

14/ LWA Economic Analysis. pp. 133-134.

15/ Irrigation Training & Research Center. 9 September 2014. *Conclusions of the Agricultural Expert Panel: Recommendations to the State Water Resources Control Board Pertaining to the Irrigated Lands Regulatory Program*. In fulfillment of SBX 2 1 of the California Legislature. p. 35.

20% estimate of potential future reductions in N application rates" to the irrigated lands WDRs. 16/ Thus, simulation results 17/ for the No Project (i.e., Scenario 3) scenario presented in the Economic Analysis are not based on actual or anticipated nitrogen reductions and may not reflect how groundwater nitrate concentrations will really change in response to BMPs.

For instance, the bulk of agricultural land appears to have been simulated assuming grapes, almonds, oranges, corn silage, and corn are grown on the land, as summarized in attached Table 1. 18/ Nitrogen use efficiencies ("NUEs") assigned to these crops do not appear to represent levels that are sustainable or possible with BMPs. 19/ Review of inputs and outputs for the No Project (i.e., Scenario 3) scenario indicates that NUEs for vineyards and corn silage fields are greater than one, which suggests nitrogen will be ultimately depleted as it is mined from soil. 20/ Conversely, NUEs for almond and orange orchards assumed by LWA are less than 0.5 and do not seem to capture good farming practice. 21/ The Global Partnership on Nutrient Management states "While it is very difficult to establish hard and fast NUE goals, we can generalize that when NUE [is less than] <0.5, there is probably a large opportunity for improving NUE." 22/ As confirmation, the California Almond Board finds that 0.7 or greater NUE is a viable goal in well-managed almond orchards. 23/

Accurately assessing the effect that reduced nitrogen loads have on groundwater quality is critical because this is the primary strategy embodied in both the No Project alternative and Proposed Project for protecting and restoring groundwater to beneficial uses. Yet, examination of scenarios involving nitrogen load reductions did not lead to better groundwater quality. CV-SALTS states:

> The findings from these various scenarios showed that salt and nitrate concentrations did not improve significantly over different time periods (5, 10, 20,

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16/ LWA Management Zone Archetype Analysis. p. 78.

17/ See Exhibits A and B hereto.

18/ See Table B-4 of LWA Management Zone Archetype Analysis.

19/ NUE reflects the amount of nitrogen recovered in a crop relative to the amount of nitrogen applied to the field upon which the crop is grown. LWA. 3 December 2013. *CV-SALTS Initial Conceptual Model: Tasks 7 and 8 – Salt and Nitrate Analysis for the Central Valley Floor and a Focused Analysis of Modesto and Kings Subregions Final Report*. p. 8-7.

20/ LWA Management Zone Archetype Analysis. Table B-4.

21/ *Id*.

22/ Global Partnership on Nutrient Management. 2015. *Position Paper: Nitrogen Use Efficiency and Nutrient Performance Indicators*. Technical Paper 01/2015. p. 8.

23/ Silva, S.S., M. Saiful, B. Sanden, E. Laca, and P. Brown. 2013. *Almond Early-Season Sampling and In-Season Nitrogen Application Maximizes Productivity, Minimizes Loss: Protocol for Early-Season Sampling and In-Season Nitrogen Budgeting*. Almond Board of California. p. 5. http://fruitsandnuts.ucdavis.edu/files/165544.pdf. Accessed 9 February 2017.

> 30, 40, 50 75 and 100 years). In fact, water quality declined in some cases a[s] legacy salt and nitrate loads moved through the groundwater. 24/

Consequently, no technical basis has been provided for the conclusion in the SNMP and SED that the "Proposed Project is expected to have a beneficial impact on the future cumulative nitrate conditions at the basin and subbasin level." 25/, 26/ Indeed, the Management Zone Archetype Analysis indicates that the Proposed Project may not attain SNMP goals throughout the Central Valley:

> Importantly, the AID archetype demonstrated that attainment of water quality objectives in ambient groundwater may not always be possible (which may impact the ability [to] meet Central Valley SNMP management goals to achieve balance and restore the aquifer), assimilative capacity may not be available, management philosophies may vary, and the regulatory framework must be adapted to legacy conditions in some areas of the Central Valley. 27/

PROPOSED PROJECT WILL LIKELY RESULT IN LOWER GROUNDWATER QUALITY

The SNMP allows lower groundwater quality relative to the No Project alternative:

> Overall, the SNMP recommends that the Central Valley Water Board be predisposed to allocate assimilative capacity, and allow lower water quality, where doing so assures a significantly better outcome for the people of California than would requiring strict compliance with default WDRs/Conditional Waivers. 28/

Groundwater quality in a basin or subbasin will likely decline because the default position of the SNMP is to allocate assimilative capacity based on nitrate concentrations throughout the basin/subbasin. 29/ The prospect for improving groundwater quality after the Regional Board has allocated assimilative capacity is limited given basin/subbasin restoration is not practicable.

24/ CV-SALTS SNMP. p. 4-27.

25/ *Id*. p. 6-14.

26/ Robertson-Bryan, Inc. October 2016. *Central Valley Salt and Nitrate Management Plan Substitute Environmental Document*. ("SED") Prepared for CV-SALTS in association with CDM Smith. p. 116.

27/ LWA Management Zone Archetype Analysis. p. ES-25.

28/ CV-SALTS SNMP. p. 4-45.

29/ *Id*. p. 4-29.

Further, the SNMP discusses the possibility that groundwater quality may not be restored even within "localized areas" of a basin/subbasin. 30/ The SNMP finds:

> Because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions, implementation of the Preferred Alternative would contribute considerably to adverse future cumulative conditions of nitrate in some localized areas of basins/subbasins within the Central Valley. 31/

The SNMP does not specify protocols for identifying nitrate "localized impacts" or "hot spots" nor does it describe criteria for determining when it is "reasonable and feasible" to remediate them. Depending on local hydrogeologic conditions, and the depths and pumping rates of nearby wells, the size of a source area may range from a few acres to many tens of square miles, and it often includes many potential nonpoint and point sources of groundwater pollution. 32/

USE OF ASSIMILATIVE CAPACITY DOES NOT PREVENT NITRATE IMPACTS

Assimilative capacity is generally regarded to exist when receiving waters are able to absorb increased pollutant loads without exceeding applicable Basin Plan objectives. In other words, the nitrate assimilative capacity of an aquifer can be defined as the cumulative effect of all biologic and hydraulic processes that keep nitrate mass flux or concentration below a limit set for a particular water body.

However, "the flow of groundwater does not promote mixing and any mixing that does occur is over very long periods of time." 33/ Lack of rapid mixing leaves open the possibility that groundwater nitrate plumes will form and persist despite the availability of assimilative capacity on a basin/subbasin scale. The SNMP does not indicate the permissible size of such nitrate plumes and is ambiguous as to the portion of an aquifer that may be affected.

The SNMP proposes to calculate assimilative capacity as the volume-weighted average of nitrate concentrations in the Upper Zone. 34/ The depth of this zone will be established from well construction information, but the well sets that will be used are not identified and terms, such as

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30/ *Id*. p. 6-14.

31/ *Id*. pp. 6-14 and 6-15.

32/ Harter, T. 2003. *Groundwater Quality and Groundwater Pollution*. University of California, Division of Agriculture and Natural Resources. Publication 8084. p. 3.

33/ Karkoski, J. and C. Rodgers. 21 August 2012. *Irrigated Lands Regulatory Program Monitoring: Surface Water and Groundwater*. Presentation at Central Valley Regional Water Quality Control Board meeting. Slide 28.

34/ CV-SALTS SNMP. p. 4-30.

"farm virtual wells," 35/ are not defined. CV-SALTS states that the depth of the aquifer zone is "significant to the conceptualization of movement of water, salt, and nitrate for management purposes," 36/ and initially relied upon hydraulic factors (i.e., 20-year travel zone) to define aquifer zone depth. The SNMP does not provide a rationale for the proposed change.

HOUSEHOLD BOTTLED WATER USAGE RATE APPEARS LOW

The Economic Analysis obtained the value of 2.25 gallons of drinking water per household per day from the California Nitrate Project. This value assumes 3.3 persons per household, which equates to a per capita usage rate of approximately 0.7 gallons per day ("gal/day") or 2.6 liters per day ("L/day"). 37/ This rate appears to correspond to the average Adequate Intake ("AI") of drinking water and beverages necessary to maintain sufficient hydration in young men and women between the ages of 19 to 30 years.

The AI for total water from a combination of drinking water, beverages, and food is 3.7 L/day for men and 2.7 L/day for women, which corresponds to an average AI of 3.2 L/day. 38/ Drinking water and beverages represents approximately 81 percent of total water intake with food consumption accounting for the remainder. 39/. Thus, an individual must drink an average of 0.81 x 3.2 L/day = 2.6 L/day of water and beverages to stay sufficiently hydrated.

However, a water usage rate of 2.6 L/day per person is too low for estimating costs to provide bottled water to households in the Central Valley. This rate represents temperate conditions. Summer temperatures routinely reach 90°F or higher throughout the Central Valley. As a result, daily water requirements can reach 5 L/day or more in hot weather. 40/ Moreover, the water usage rate in the Economic Analysis does not consider water used for other purposes such as washing foodstuffs, cooking, and oral hygiene. U.S. EPA states 1 gal/day per person is a plausible emergency planning number, consistent with the Federal Emergency Management Agency and

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35/ *Id*. p. 3-27.

36/ *Id*. p. 3-4.

37/ Honeycutt, K., H.E. Canada, M.W. Jenkins, and J.R. Lund. July 2012. *Alternative Water Supply Options for Nitrate Contamination. Technical Report 7 in: Addressing Nitrate in California's Drinking Water with A Focus on Tulare Lake Basin and Salinas Valley Groundwater*. Report for the State Water Resources Control Board Report to the Legislature. Center for Watershed Sciences, University of California, Davis. p. 75.

38/ U.S. Institute of Medicine. 2005. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*. Panel on Dietary Reference Intakes for Electrolytes and Water, Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food and Nutrition Board. pp. 73-74.

39/ *Id*.

40/ *Id*. p. 155.

American Red Cross estimates for drinking, food preparation, and hygiene related to health and safety. 41/

Table 11 in the Economic Analysis indicates that roughly 3.5 persons comprise a household within areas of the Central Valley affected by nitrate in groundwater. The bottled water usage rate is at least 3.5 gal/day per household if each person uses 1 gal/day, but this is an overly restrictive water usage rate because it is for emergencies that last only days or weeks. The Economic Analysis contemplates household bottle water use could be 20 years or more before "long-term" actions are implemented. 42/ A study of basic water requirements indicates that an average of 10 to 20 L/day (2.6 to 5 gal/day) per person appears to be used for cooking and dishwashing in addition to volumes for human consumption. 43/ Accordingly, a more appropriate water usage rate for estimating bottled water costs is 10 to 20 gal/day per household, not 2.25 gal/day per household.

Please call if you have any questions or wish to discuss this matter in detail.

Very truly yours,

ERLER & KALINOWSKI, INC.

Andrew N. Safford, P.E.
Vice President

41/ U.S. EPA. June 2011. *Planning for an Emergency Drinking Water Supply*. Prepared for U.S. Environmental Protection Agency's National Homeland Security Research Center by American Water Works Association and CDM. p. 7.

42/ LWA Economic Analysis. pp. 67-68.

43/ Gleick, P.H. 1996. *Basic Water Requirements for Human Activities: Meeting Basic Needs*. Water International. Vol. 21. pp. 83-92.

TABLE 1
ASSUMED SOIL AND WATER ASSESSMENT TOOL NITROGEN USE EFFICIENCES
FOR CV-SALTS ALTA IRRIGATION DISTRICT ("AID") MANAGEMENT ZONE ARCHETYPE (a)

SWAT Plant Code	Land Use Description (b)	Area (acres); (c)	Nitrogen Applied (lb/ac-yr); (d)	Nitrogen Uptake (lb/ac-yr)	Nitrogen Use Efficiency (e)
GRAP	Grape (?)	123,450	36	45	1.3
ALMD	Almond (?)	97,810	230	100	0.4
ORAN	Orange (?)	49,354	146	53	0.4
CSIL	Corn silage	31,285	889	936	1.1
CORN	Corn	24,974	309	261	0.8
RNGE	Range-grasses	20,539	-	7	-
ALFA	Alfalfa	11,305	-	744	-
COTS	Upland cotton	8,286	157	136	0.9
PAST	Pasture	4,983	27	39	1.4
OLIV	Olive (?)	3,829	47	85	1.8
WWHT	Winter wheat	3,351	231	210	0.9
APPL	Apple	3,207	150	40	0.3
ORCD	Orchard	2,790	196	68	0.3
LIMA	Lima beans	1,167	82	47	0.6
WPAS	Winter pasture	878	148	109	0.7
LETT	Head lettuce	800	193	184	1.0
SGHY	Sorghum hay	798	261	266	1.0
AGRR	Agricultural land-row crops	791	324	291	0.9
TOMA	Tomato	772	396	414	1.0
BROC	Broccoli	513	171	188	1.1
FESC	Tall fescue	505	166	141	0.8
WMEL	Watermelon	413	151	57	0.4
CAUF	Cauliflower	404	238	158	0.7
SGBT	Sugar beet	249	264	188	0.7
SPOT	Sweet potato	242	202	398	2.0
EUCA	(?)	225	20	18	0.9
PEPR	Bell pepper	132	346	275	0.8
ONIO	Onion	109	33	29	0.9
STRW	Strawberry	99	193	214	1.1
CABG	Cabbage	53	190	166	0.9
FLAX	Flax	21	232	141	0.6
RICE	Rice	14	130	73	0.6
CRRT	Carrot	14	216	69	0.3
GRSG	Grain sorghum	13	121	108	0.9
CANA	Spring canola-Argentine	10	122	138	1.1
POTA	Potato	4	202	195	1.0
CLVR	Red clover	2	-	164	-

TABLE 1
ASSUMED SOIL AND WATER ASSESSMENT TOOL NITROGEN USE EFFICIENCES
FOR CV-SALTS ALTA IRRIGATION DISTRICT ("AID") MANAGEMENT ZONE ARCHETYPE (a)

Notes:

(a) Soil and Water Assessment Tool ("SWAT") input and output values for No Project (i.e., Scenario 3) scenario compiled from Table B-4 in Larry Walker Associates. ("LWA") May 2016. *CV-SALTS Management Zone Archetype Analysis: Alta Irrigation District* . p. B-16.

(b) Common name of plant that corresponds to Soil and Water Assessment Tool ("SWAT") plant code that appears in Appendix A-1 of Arnold, J.G., J.R. Kiniry, R. Srinivasan, J.R. Williams, E.B. Haney, and S.L. Neitsch. 2012. *Soil & Water Assessment Tool: Input/Output Documentation* . Texas Water Resources Institute. TR-439. pp. 564-566. Queried ("?") where SWAT plant code does not appear in document.

(c) The total area listed as SWAT input is approximately 390,000 acres, which suggests the modeled area is greater than the reported size of the AID, which consists of a total area of 130,000 acres of agricultural and urbanized lands. See Kapheim, C.M. and J. Wegley. *Transition from a Traditional Irrigation District to a Regional Water Resource Agency.* http://www.altaid.org/images/pdf/Final%20USCID%20%209-27-12.pdf Accessed 13 February 2017.

(d) Nitrogen applied and nitrogen uptake are expressed in units of pounds of nitrogen per acre per year.

(e) Nitrogen use efficiency reflects the amount of nitrogen recovered in a crop relative to the amount of nitrogen applied to the field upon which the crop is grown. LWA. 3 December 2013. *CV-SALTS Initial Conceptual Model: Tasks 7 and 8 – Salt and Nitrate Analysis for the Central Valley Floor and a Focused Analysis of Modesto and Kings Subregions Final Report* . p. 8-7.

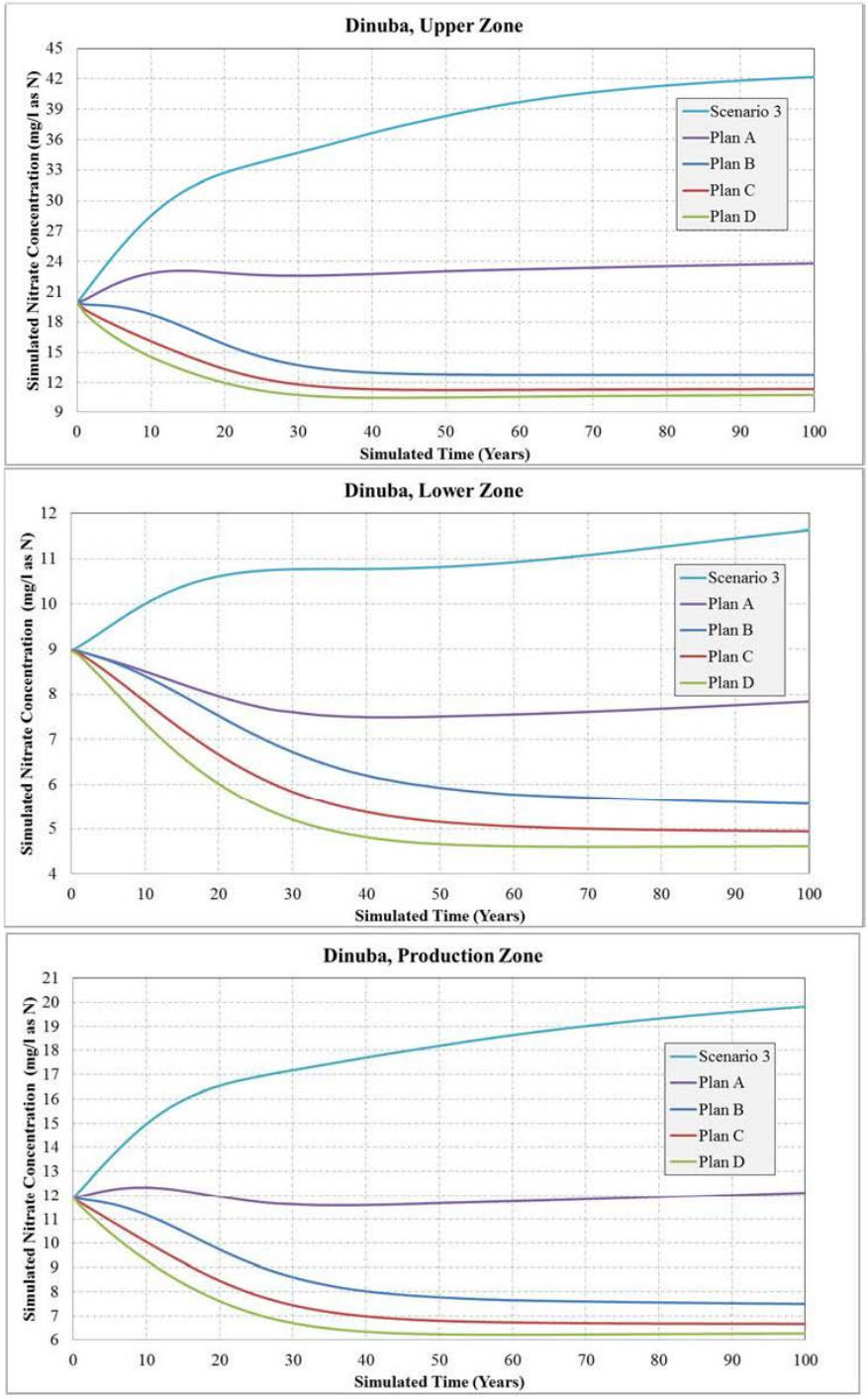


Exhibit A: Time Series Plots of Simulated Nitrate Concentrations for the AID Dinuba Area under Different Restoration Plans (Figure 13 from LWA Economic Analysis)

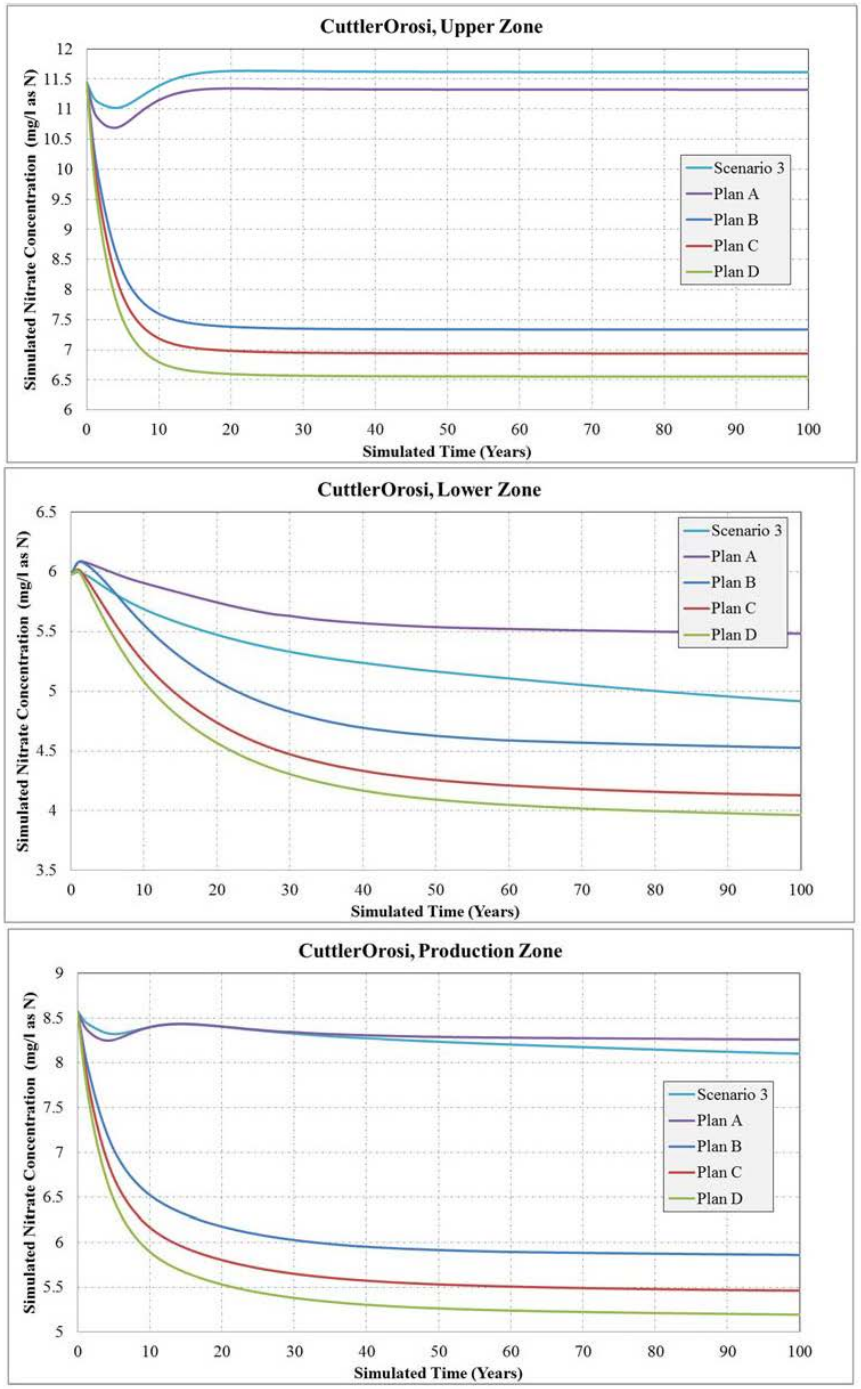


Exhibit B: Time Series Plots of Simulated Nitrate Concentrations for the AID Cutler-Orosi Area under Different Restoration Plans (Figure 14 from LWA Economic Analysis)

Andrew N. Safford, P.E.

Vice President/ Chemical Engineer

Education

- Stanford University, M.S. Civil Engineering, 1991
- University of California, Davis, B.S. Chemical Engineering, 1984

Registrations/Certifications

- Professional Chemical Engineer in California (CH #4577)
- Professional Civil Engineer in California (C #56084)
- ARB Lead Verifier of Greenhouse Gas Emission Data
- ARB Refinery Sector Specialist
- Forty-hour Hazwoper Training Course
- Eight-hour Health and Safety Training Course for Supervisors

Summary of Experience

Mr. Safford is a registered professional chemical and civil engineer with over twenty-eight years of practice. He has performed engineering studies, and evaluated and implemented remedial actions or pollution controls at operating manufacturing facilities, food processors, and at other sites where salinity impacts and other environmental issues arise. Mr. Safford provides quality control review of many EKI projects involving chemical processes and advanced wastewater treatment, as well as detailed engineering cost estimation. In support of these remedial actions, Mr. Safford has evaluated the manner in which the environmental standard of care has evolved in response to passage of state and federal regulations, including the Federal Water Pollution Control Act of 1972, Safe Drinking Water Act of 1974, Clean Water Act (CWA) of 1977, Resource Conservation and Recovery Act (RCRA) of 1976, Hazardous and Solid Waste Amendments (HSWA) of 1984, and Clean Air Act (CAA) of 1970. Examples of the types of projects with which Mr. Safford has been involved are provided below.

Detailed Experience

- EKI assisted the City of Turlock with implementation of its Salinity Source Study and Salinity Source Control Plan, which is specified in the National Pollutant Discharge Elimination System permit issued for the City's wastewater treatment facility. Mr. Safford directed the estimation of salt loads for the City's Significant Industrial Users (SIUs) and assessment of potential means to cost effectively reduce these loads. Work on this project has included the performance of water and salt mass balances, and wastewater testing to distinguish the fractions of SIU loads that are attributable to mineral salts versus charged organic matter.
- Mr. Safford conducted a salt and nutrient mass balance on a rendering plant. The resulting mass balance identified major sources of salts and nutrients that led to process changes enabling our client to meet Central Valley Regional Water Quality Control Board Waste Discharge Requirements.
- Mr. Safford co-authored a study describing a mass balance approach to evaluate salinity sources in the Turlock Sub-basin. The evaluation included a salt mass balance as the first step to effective salt management in the Turlock Sub-basin. Mr. Safford worked closely with the Turlock Irrigation District to identify key data, issues, and questions prior to publishing the study. Data was compiled and evaluated from multiple sources including agricultural and municipal pumping records, imported surface water records, land use maps, water quality data, and dairy, municipal, and food processing operational and waste management practices and data. The mass balance approach was proposed as an accessible and transparent method to facilitate coordination among stakeholders and to identify productive avenues for policy development without the need for basin-wide groundwater flow and solute transport modeling.
- Mr. Safford helped with development of the CV-SALTS 5-Year Work Plan and conceptual model for understanding salts and nitrates in the Central Valley. For CV-SALTS, he has prepared scopes for

technical studies needed to determine appropriate beneficial uses of designated archetype water bodies, including constructed agricultural drains and the Tulare Lake Bed groundwater subbasin.

- Mr. Safford assisted a group of private companies, a collection of water agencies, and several military branches that have received draft Cleanup and Abatement Orders from the Regional Board to address domestic supply wells on numerous private residences in the Chino Subbasin that have become contaminated with salts, nitrate, and chlorinated organic solvents. Mr. Safford and others from EKI served on a technical subcommittee that consists of representatives from the companies, municipalities, and military. EKI prepared the Remedial Investigation (RI) and devised the remedies presented in the feasibility study (FS) for the groundwater contamination plume that simultaneously fulfill the objective of the municipalities and water agencies to increase local water supplies. EKI also prepared remedy cost estimates. Collaboration amongst the stakeholders promotes opportunities for the municipalities and water agencies to pursue and secure state and federal funding to financially support the implementation of the project. This project will facilitate pumping and treatment of additional groundwater to provide much needed water for drought-plagued California.

- Mr. Safford is assisting a chemical producer with renewal of its point source National Pollutant Discharge Elimination System (NPDES) permit. U.S. EPA lowered the ambient water quality criterion for hexacholorobenzene to 0.000079 µg/L. The cost of treating the effluent to this level is estimated to be $100 million dollars or more. As an alternative, EKI is developing a laboratory method to demonstrate to the permitting agency that hexachlorobenzene in the effluent is bound to anthropogenic forms of organic carbon and, thus, not bioavailable. If testing shows this to be the case, the agency has agreed that no reasonable potential exists for the discharge to exceed the hexachlorobenzne state water quality standard and no treatment for this chemical will be required.

- He is currently assisting a different chemical producer in West Virginia with its point source NPDES permit. The Ohio River Valley Water Sanitation Commission (ORSANCO) recently eliminated mixing zones for bioaccumulative chemicals of concern, which include mercury and hexachlorocyclohexane. Mr. Safford is assisting the client with modifying its diffuser from a single port to a multi-port design to accomplish rapid and complete mixing in the Ohio River, which will support issuance of a NPDES permit with higher Water Quality Based Effluent Limits (WQBELs) than those allowed with a mixing zone.

- Mr. Safford has overseen the RCRA facility assessment (RFA) and RCRA facility investigation (RFI), and is presently supervising the corrective measures study (CMS) of a large Midwestern chemical manufacturing plant. Soil and groundwater at the plant contain chlorinated solvents in the form of pooled and residual dense non-aqueous phase liquid (DNAPL) in fractured bedrock and unconsolidated sediments. The widespread presence of DNAPL in heterogeneous sediments makes groundwater restoration technically impracticable. U.S. EPA has agreed to consider a technical impracticability (TI) waiver for the plant. Consequently, a TI evaluation will be included as part of the CMS. Options to contain the DNAPL and dissolved constituents in groundwater will be the focus of the CMS. The cost to implement the CMS is estimated be on the order of $100 million and subject to dispute between the current and formers owners of the plant. As a consequence of this dispute, Mr. Safford has evaluated how the environmental management system (EMS) evolved from 1952, when very few environmental regulations existed, to present day when the chemical manufacturing industry has become one of the most regulated and frequently inspected industries in the United States. He examined the use of unlined ponds and burn pits that were common in the 1960s and 1970s, but are now prohibited because of the recognition that these practices can cause substantial environmental harm. Similarly, he reviewed how and when chemical storage and handling (e.g., recordkeeping, inspections, secondary containment systems) practices changed to meet newly

promulgated environmental regulations and generally recognized practices that comprise the standard of care.

- In 2015, U.S. Environmental Protection Agency (U.S. EPA) revised its definition of RCRA hazardous solid waste by incorporating four factors that constitute legitimate recycling. Mr. Safford is assisting a chemical manufacturer with reclamation of organic materials from above ground storage tanks and transfer of the materials to the chemical production process whereby the "closed loop recycling" exemption is achieved. By recycling the materials to the chemical process, the company avoids classifying the materials as RCRA hazardous solid waste, lessens environmental impacts, and saves hundreds of thousands of dollars in waste treatment and disposal costs.
- In connection with a threatened CWA citizen suit, Mr. Safford prepared a Spill Prevention, Control, and Countermeasure (SPCC) Plan and Storm Water Pollution Prevention Plan (SWPPP) for a power generation plant in Northern California. Both plans addressed operating procedures and control measures for fuel storage tanks, pipelines, oil-filled transformers, petroleum coke piles, and oil-water separators that took in account federal categorical pretreatment standards for steam electric power generating facilities. Potential issues associated with storage and use of petroleum products at the plant were successfully resolved during the 60-day "grace period," thereby preventing filing of a suit.
- Mr. Safford was involved in a separate threatened CWA citizen suit pertaining to a ready-mix concrete and hot-mix asphalt facility. The suit alleged Best Management Practices (BMPs) at the facility did not comply with federal categorical pretreatment standards for the paving and roofing (tars and asphalt) industry. Based upon his evaluation, BMP improvements were made and the SPCC Plan and SWPPP for the facility were revised. Notwithstanding these improvements, Mr. Safford demonstrated the categorical pretreatment standards did not apply because the facility mixed cement and asphalt and did not manufacture these products for which the standards were promulgated. No suit was filed.
- Mr. Safford has assessed and overseen the decommissioning and decontamination of semiconductor production facilities and other manufacturing sites. These efforts have included identifying and characterizing asbestos containing materials, lead-based paint, polychlorinated biphenyl (PCB) remediation waste, PCB bulk product waste, and PCB articles, containers and liquids. He also has characterized building components for proper disposal as RCRA hazardous debris, universal waste, state-specific hazardous waste, and non-hazardous waste. He has prepared specifications and managed contractors in cleaning lead, arsenic, cadmium and other metal-containing dust from affected building components and performed clearance sampling to comply with OSHA, State of California Construction Safety Orders and Safe Drinking Water and Toxic Enforcement Act (Proposition 65).
- Mr. Safford assisted in preparing an Oil Spill Contingency Plan (OSCP) and SPCC plans for a client's oil production facilities and refinery operations. The OSCP and SPCC plans, as well as improvements to secondary containment systems and spill response procedures, were developed and implemented under attorney-client privilege to address complaints filed by the U.S. EPA under the CWA.
- He has assisted industrial clients with evaluating and enhancing their process operations and EMSs. Representative projects include: waste minimization assessment and wastewater treatment evaluation for a pharmaceutical manufacturing facility and a photographic film and paper processing facility, development of volatile organic compound (VOC) emission reduction strategies for a commercial airline maintenance facility, and permitting supervision for a commercial laundry,

ice cream and frozen dessert manufacturer, powdered milk and butter manufacturer, cheese manufacturing and whey processing facility, and turkey processing and rendering operations.

- Mr. Safford performed a compliance audit of a vinyl chloride monomer plant on behalf of a prospective purchaser. Evaluated as part of the audit were the potential cost impacts of contemplated state and federal regulations and the effects of plant expansion on environmental regulatory compliance. These potential cost impacts were initially not considered in the transaction and resulted in a significant downward adjustment in the negotiated purchase price of the plant. As part of this project, Mr. Safford has supervised on-going compliance activities with the Kentucky Division of Air Quality, including compilation of the VOC emissions inventory and review of air quality data collected by the Kentucky Division of Air Quality.
- Mr. Safford managed various consultants in assessing the environmental liabilities of a polymer manufacturer with numerous production facilities in the United States, Canada, and throughout Europe. The assessment entailed review of manufacturing operations and waste handling practices to derive estimates of environmental costs that were used to establish the fair market value of the polymer manufacturer.
- Mr. Safford has performed numerous other environmental due diligence assessments related to acquisition and divestiture of manufacturing facilities, including semiconductor wafer fabricators; metal drum manufacturer; automobile manufacturer: industrial parts suppliers; and pump, valve, and seal manufacturers. He has estimated costs of significant environmental liabilities to help clients meet material financial disclosure requirements such as those prescribed by the Sarbanes-Oxley Act or outlined in ASTM Standard Guide for Estimating Monetary Costs and Liabilities for Environmental Matters.
- In 2012, Mr. Safford reviewed the regulatory compliance history of a cement manufacturer to identify potential environmental issues for a client seeking to redevelop the site. Limestone excavated from the on-site quarry was transported to an adjacent plant where the limestone was crushed and underwent calcination to form clinker. Upon grinding, the clinker was mixed with aggregate (i.e., sand and gravel), extenders (e.g., ground granulated blast furnace slag), and water to produce concrete slurry for delivery to customers. Mr. Safford examined chemical inventories; hazardous waste records; and NPDES and air permits. The potential liabilities associated with aerial deposition of metals, polychlorinated dibenzo-p-dioxins (i.e., dioxins), and polycyclic aromatic hydrocarbons (PAHs) from the cement kiln stack were evaluated. The costs of remedial actions to address releases of petroleum hydrocarbons and metals leaching from waste rock also were estimated.
- In 2002, U.S. EPA initiated enforcement actions against PVC manufacturers under the CAA, RCRA, the CWA, and the Emergency Planning and Community Right-to-Know Act (EPCRA). This multimedia enforcement approach was led by the National Enforcement Investigations Center (NEIC). Mr. Safford has assisted one PVC manufacturer in its evaluation and response to violations of environmental regulations alleged by NEIC.
- At several industrial facilities throughout the U.S., Mr. Safford has performed environmental compliance audits of air emissions to determine compliance with state and Title V CAA regulations. In addition, Mr. Safford has assessed VOC emissions inventories for compliance with operating permit limitations. For some of those assessments, Mr. Safford used TANKS 4.0 and WATER9 to confirm estimates of VOC emissions.
- At a petrochemical manufacturing plant, Mr. Safford performed an environmental compliance audit, including conformance with 40 CFR 61.340 National Emission Standard for Benzene Waste, 1990 CAA amendments for control of hazardous air pollutants (HAPs), and Title V requirements for

a major source of NOx, VOCs, and HAPs. The work was conducted under client-attorney privilege to assist our client in resolving claims brought by the Louisiana Department of Environmental Quality.

- In 2013, Mr. Safford helped a shipping company with its classification of used ink generated at several facilities in California. He reviewed information pertaining to the manner in which the used ink is generated and subsequently arranged for collection and laboratory testing of representative used ink samples. As a result of this work, the ink waste was demonstrated not to meet the criteria promulgated in Title 22 of the California Code of Regulations (CCR) for definition as a hazardous waste and, thus, can be managed and disposed of as a non-hazardous waste in California.
- In 2011, Mr. Safford performed a compliance audit of a garment manufacturer for a purchaser of the operations. The audit revealed the operations were not complying with Occupational Safety & Health Administration (OSHA) Chemical Hazard Communication requirements, an air permit was required for VOC emissions, and the facility had not been investigated for lead based paint. These issues were resolved prior to EKI's client acquiring the operations thereby limiting the liability associated with additional operational improvements, penalties, or claims that may arise in the future.
- Mr. Safford acted as Project Manager for evaluation and resolution of environmental issues associated with a major manufacturing company's divestiture of its 30 U.S. and international facilities. The project entailed facility walk-through inspections and interviews with corporate and plant-level environmental personnel related to chemical use and storage practices and EMSs Identified environmental issues were characterized and addressed by completing subsurface investigations and remedial actions, as necessary, and facilitating communications with regulatory agencies regarding closure actions.
- In 2013, he performed environmental and compliance audits of an automotive parts manufacturing facility to assist the company with determining whether the operations should be consolidated or maintained at the present facility. Cost estimates of complying with environmental requirements were prepared for options being considered by the parent corporation.
- Mr. Safford led efforts to obtain a variance from U.S. EPA land disposal restriction (LDR) treatment standards for oily sludge that was released at a historical oil recycling facility at the Oakland Army Base. On behalf of the City of Oakland and Army, he prepared a petition for a site-specific variance from RCRA LDR treatment standards pursuant to 40 CFR § 268.44(h) for the oily sludge. This sludge had elevated lead concentrations and/or low pH leading to designation as D008 and/or D002 RCRA hazardous waste with underlying hazardous constituents (UHCs), including PAHs and dioxin-like compounds. U.S. EPA approved the petition for the LDR variance in 2003, thereby avoiding the requirement to incinerate the oily sludge, which saved millions of dollars in the cost to treat and dispose of the oily sludge.
- Mr. Safford has assisted clients with characterizing and evaluating the reuse and disposal options for various types of wastes. For example, he designed and implemented a sampling plan to demonstrate that diatomaceous earth filter cake generated from a sugar refining facility in California did not meet the definition of a regulated non-hazardous waste, as contented by state regulatory agencies. Cost savings for our client resulted from the fact that the filter cake can be sold as a product as opposed to being disposed in a landfill as a regulated waste.

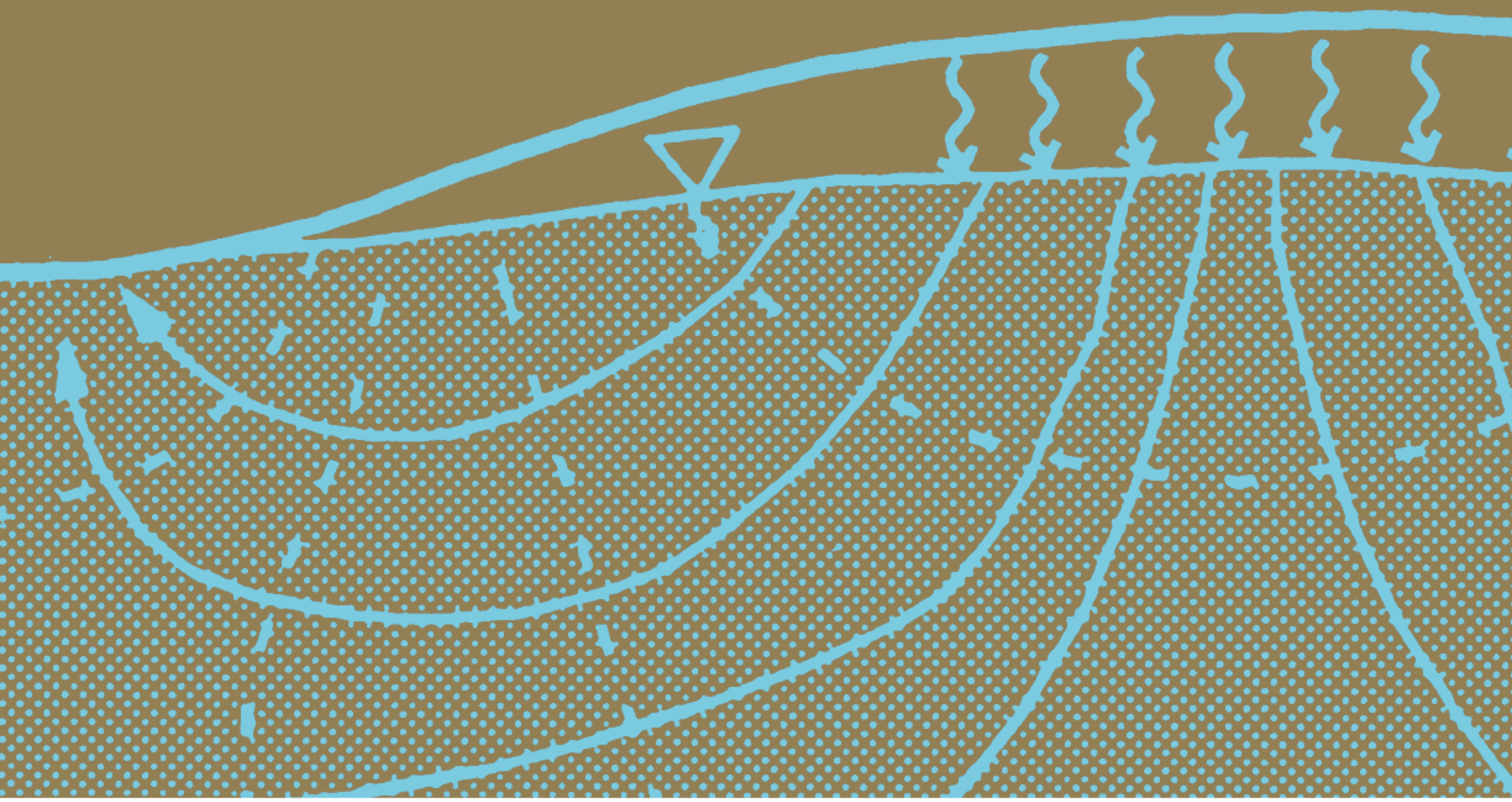
Societies

American Institute of Chemical Engineers

EXHIBIT B

MARCH 2018

Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act



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UC WATER
Security and Sustainability Research Initiative

Cantor, Alida, Dave Owen, Thomas Harter, Nell Green Nylen, and Michael Kiparsky.
2018. Navigating Groundwater-Surface Water Interactions under the Sustainable
Groundwater Management Act. Center for Law, Energy & the Environment,
UC Berkeley School of Law, Berkeley, CA. 50 pp.
Available at: https://doi.org/10.15779/J23P87 or law.berkeley.edu/gw-sw

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MARCH 2018

Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act

Alida Cantor, Dave Owen, Thomas Harter, Nell Green Nylen, and Michael Kiparsky

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Security and Sustainability Research Initiative

About the report and the workshop series

This report draws from a two-part workshop series held at UC Berkeley School of Law in June and July of 2017. The two day-long workshops brought together approximately twenty recognized thought leaders in hydrogeology, law, and policy, including key academics, practitioners, and decision makers. Participants were asked to discuss a range of legal and technical dimensions of groundwater-surface water interactions and water rights under the Sustainable Groundwater Management Act (SGMA). Topics included examples of conflicts between groundwater and surface water users and how conflicts have historically been resolved; how SGMA alters or should alter legal relationships between groundwater and surface water users; the tools needed to identify and address potential conflicts between groundwater and surface water uses; and the potential interactions between SGMA and other laws governing water use and environmental protection. Participants discussed these issues both in general terms and through the lens of specific case studies.

The authors synthesized content from the workshops and conducted additional legal analysis and technical and legal literature review to develop the policy-focused themes reflected in this report. This report strives to provide guidance for practitioners, including groundwater managers and state agency staff.

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Executive Summary

California's Sustainable Groundwater Management Act (SGMA), passed in 2014, recognizes and addresses connections between surface water and groundwater. The statute is California's first statewide law to explicitly reflect the fact that surface water and groundwater are frequently interconnected and that groundwater management can impact groundwater-dependent ecosystems, surface water flows, and the beneficial uses of those flows. As such, SGMA partially remedies the historically problematic practice of treating groundwater and surface water as legally distinct resources.

SGMA requires groundwater sustainability agencies (GSAs) to manage groundwater to avoid six undesirable results, including significant and unreasonable adverse impacts on beneficial uses of surface water. While this aspect of SGMA is clearly important, significant uncertainties exist regarding how GSAs will actually define and achieve this goal.

Addressing SGMA's requirements for groundwater-surface water interactions will be difficult. Defining the issues at stake in any given basin, let alone successfully balancing the range of uncertainties and potentially conflicting interests, will pose challenges for many GSAs. No clear, pre-defined formula exists to guide GSAs in determining what significant and unreasonable depletions of interconnected surface water will be, or whether planned actions will sufficiently avoid them. Yet they are required to do so. Many GSAs will face pressure to aggressively address impacts on surface water in their basin. Many will face equal or greater pressure not to draw the line. Nevertheless, it will fall to the GSAs to make a determination, and to defend it in their groundwater sustainability plans (GSPs). Therefore, GSAs will likely take on some level of risk—of successful political opposition to their GSP, of succesful legal challenges to their GSP, of their GSP performing ineffectively, or of all of these outcomes. Given the aggressive timeline inherent to SGMA, addressing this risk early will be crucial for preserving management options.

Challenges and risk are not the whole story, however. The process of addressing groundwater-surface water interactions also offers GSAs an opportunity to help communities and other stakeholders resolve, or avoid, difficult conflicts, and to do so in lasting ways. While California law has only recently begun to seriously address conflicts between surface and groundwater uses, those conflicts have been occurring for decades, and in some places for over a century. SGMA, in other words, did not create conflict between groundwater pumping and beneficial uses of surface water; instead it created an opportunity—as well as an obligation—to respond to those challenges. Embracing that opportunity will not be easy, but GSAs that take SGMA as an opportunity to resolve longstanding issues can do lasting good.

The research presented here examines some of the legal and institutional questions that will inevitably arise as GSAs seek to address groundwater-surface water interactions under SGMA. The core goal of this report is to help parties identify and address these questions, and ultimately to let GSAs and stakeholders manage groundwater-surface water interactions proactively and effectively.

KEY QUESTIONS FOR SGMA IMPLEMENTATION

While SGMA brings groundwater-surface water interactions into fresh focus, many open issues remain. This report focuses on several key unanswered questions:

1. How will surface water law and groundwater law interact under SGMA?

2. What constitutes a significant and unreasonable adverse impact on beneficial uses and users of interconnected surface water?

3. Which entities are responsible for addressing what aspects of the interactions between surface water and groundwater?

4. What might a process for effectively resolving groundwater-surface water issues and conflicts look like?

5. What legal and technical aspects of groundwater-surface water interactions under SGMA are unknown or uncertain, to what degree, and how and why might this uncertainty matter?

To begin to address these questions, UC Water and the Wheeler Water Institute convened two workshops at UC Berkeley School of Law in June and July 2017. These workshops brought together recognized thought leaders in hydrogeology, law, and policy, including key academics, practitioners, and decision makers. These discussions and additional research by the authors are the basis for this report.

We intend for this report to provide general guidance for SGMA's implementers and interested stakeholders, although definitive answers do not exist for every issue we raise. Addressing groundwater-surface water interactions in California is largely uncharted territory. Significant physical, legal, and technical uncertainties will need to be resolved over time. Further, the diversity and uniqueness of groundwater and surface water basins around the state suggest that one-size-fits-all solutions will rarely exist, and that on some issues, each GSA will need to chart its own course. And yet, SGMA's timeline dictates that GSAs and others need to make decisions and develop sustainability plans within the next few years. To assist these efforts, we examine the risks and benefits associated with different approaches for addressing groundwater-surface water interactions as part of SGMA implementation.

CONSIDERATIONS REGARDING GROUNDWATER-SURFACE WATER INTERACTIONS UNDER SGMA

Several overarching considerations emerged from our research. Below, we distill these considerations into a set of pointers to help GSAs and others structure their thinking about groundwater-surface water interactions.

1. **GSAs must strive to understand how groundwater management affects surface water and its uses.** This point is obvious but also important: SGMA tasks GSAs with avoiding depletions of interconnected surface water caused by groundwater extractions if those depletions have significant and unreasonable adverse impacts on beneficial uses of the surface water. Beneficial uses include consumptive and non-consumptive human uses and environmental uses (including by groundwater-dependent ecosystems). What it means to address groundwater-surface water interactions is less clear and will hinge on how GSAs define what is "significant and unreasonable"—a definition that must be backed up with evidence in the development of a GSP. But regardless of GSAs' decisions about which effects are significant and unreasonable, meeting SGMA's requirements will require GSAs to develop a working knowledge of the hydrogeology that controls the interconnections between surface water and groundwater within their basins. The nature and depth of understanding that will be required in any given basin will vary, as will the tools and methods needed. GSAs are not solely responsible for managing water supplies, but the basic task of developing this understanding is no longer optional.

2. **GSAs will need to consider how groundwater rights, surface water rights, environmental laws and regulations, and other relevant legal principles interact.** Understanding the ways groundwater management intersects with groundwater and surface water law is challenging,

particularly because many legal questions remain unresolved. But by taking on this task, GSAs can reduce the risk of legal challenge to their GSPs. To do so, they will need to develop an understanding of appropriative and riparian surface water rights, relevant environmental laws and regulations, and instream flow requirements within the basin. Table 1 summarizes some potential interactions between SGMA and specific areas of law and regulation relevant to groundwater-surface water interactions.

3. **GSAs must decide what is significant and unreasonable, and these local decisions will intersect with other laws.** Beyond just understanding how groundwater-surface water interactions intersect with other state and federal laws, GSAs also will need to make decisions that affect these intersections. Most importantly, GSAs must decide what counts as a significant and unreasonable impact upon beneficial uses of surface water. Those decisions will both affect and be affected by other legal requirements.

4. **Collaboration is important**. GSAs have significant authorities, but also must coordinate with others. Their purview for achieving sustainability is closely tied to the mandates of other local, state, and federal entities, as well as to consideration of the interests of a broad range of stakeholders, some of whom SGMA explicitly identifies. This is true of many aspects of SGMA, but coordination is particularly important for this particular undesirable result. Addressing surface water depletion means considering a wide range of stakeholder interests. Governance issues, including resources, capacity, and complexity, will be important and potentially limiting factors in determining what GSAs can achieve. Consequently, collaboration, negotiation, division of responsibilities, and other forms of engagement between GSAs and other entities will be crucial in most or all basins. However, questions remain about roles and responsibilities. Those questions will create challenges for GSAs but also offer opportunities to craft creative institutional arrangements.

5. **GSAs will need to develop management plans and make decisions despite significant legal and technical uncertainties.** Uncertainties include future climate variability, future legal developments, and technical uncertainties regarding the hydrogeology and ecology of the groundwater-surface water system. Legal and technical uncertainties will sometimes intersect, but GSAs will need to act even when neither the science nor the law is clear. An iterative approach may be appropriate: GSAs and other agencies and institutions must, in some cases, make proactive decisions as defensibly as possible in the face of uncertainty, yet must also be prepared to adapt as uncertainties are reduced through technical studies, institutional developments, and changes in the legal landscape.

SGMA's recognition of the hydrogeological reality of interconnected surface water represents a crucial step for California towards fully integrated water management. But this recognition does not on its own solve all of the existing legal and management challenges. Rather, new challenges arise when trying to implement the law, and many of these challenges flow from the various legal doctrines that will need to be reconciled.

In this report, we offer structure for those navigating the legal, technical, and institutional challenges that relate to groundwater-surface water interactions and that are likely to arise during SGMA implementation. The report enumerates key considerations developing innovative, place-based solutions that reflect SGMA's emphasis on local management. We highlight some of the roles and responsibilities of GSAs and others in addressing issues related to groundwater-surface water interactions. Our findings stress the importance of collaboration, not only among neighboring GSAs, but also with many other entities, in addressing the issues and challenges of managing groundwater-surface water interactions sustainably.

Table 1: Summary of key intersections between SGMA and other laws and regulations in the context of groundwater-surface water interactions

Area of law or regulation	*Key intersections between SGMA and other laws in the context of groundwater-surface water interactions*
Reasonable Use Doctrine	Groundwater use, like all water use in California, is subject to the reasonable use doctrine. But the practical implications of the doctrine are not entirely clear. Reasonable use is, by nature, a flexible and highly context-dependent concept that is based in part on value judgments.
Water rights	SGMA explicitly does not alter surface water or groundwater rights. However, the implications of bringing a groundwater basin's water budget into sustainable balance may bear directly on both. SGMA does not provide a formula for resolving conflicts between surface water and groundwater rights, but it does provide opportunity and a potential forum for doing so—if GSAs are ambitious.
Regulatory takings	Water rights in California are property rights, and surface or groundwater users may bring takings claims if they believe regulatory restrictions on use have effectively taken their property. However, inherent in those rights is susceptibility to reasonable regulation. GSAs can reduce the risk of takings liability by managing groundwater in a manner generally consistent with California water rights.
Public Trust Doctrine	If groundwater pumping within a GSA's jurisdiction draws water from aquifers that are tributary to surface waterways, the public trust doctrine is likely to be relevant.
Federal and State Endangered Species Acts (ESAs)	Endangered species laws apply to groundwater allocation decisions that may impact listed species. GSAs seeking to avoid consequences under the ESA should be aware of these species within the basin and explicitly address their needs when developing GSPs.
California Environmental Quality Act (CEQA)	The preparation and adoption of GSPs is specifically exempt from CEQA. However, implementation actions taken by a GSA under a GSP would remain subject to CEQA. Compliance with CEQA would include analyzing and mitigating potential negative impacts on interconnected surface waters.
Clean Water Act and Porter-Cologne Act	Although water quality is also addressed separately within SGMA, it is relevant to groundwater-surface water interactions, including through effects on streamflow volume and temperature.
Instream flow requirements	To avoid significant and unreasonable adverse impacts on surface water, minimize risk of litigation, and maximize their GSPs' defensibility, GSAs will need to be aware of instream flow requirements set by the State Water Resources Control Board and consider them when developing and implementing GSPs.

I. Introduction

Until recently, California largely adhered to the "legal fiction"[1] that groundwater and surface water are separate resources. This fiction was at odds with physical reality, for surface water and groundwater are frequently connected. Consequently, groundwater management can impact flows in rivers and streams, and affect the beneficial uses and users of those flows. But those interconnections, though long accepted by scientists, were not integrated into California water law.

With the passage of the 2014 Sustainable Groundwater Management Act (SGMA),[2] that is beginning to change. SGMA requires California's new groundwater sustainability agencies (GSAs) to manage groundwater to avoid significant and unreasonable adverse impacts on beneficial uses of interconnected surface water.[3] Thus, understanding and managing the interactions between groundwater and surface water is an essential part of SGMA implementation.

However, significant uncertainties exist regarding how exactly GSAs will achieve this goal. Those uncertainties include unresolved legal questions, technical questions about the nature of groundwater-surface water interactions in particular basins, and institutional questions about who is responsible for developing and implementing solutions. Nevertheless, GSAs must deliver credible groundwater sustainability plans (GSPs) within a few short years, and those plans must address this element—and other elements—of sustainability.

This report's goal is to articulate and examine key legal and institutional questions about the interactions between groundwater and surface water in California under SGMA, and to propose considerations for GSAs and other relevant stakeholders as they work to develop answers for their basins. The report strives to help various parties, including GSAs, state regulators, water users, and the legal community, identify important SGMA-related legal and institutional considerations involving groundwater-surface water interactions. While GSAs must decide what is significant and unreasonable, these decisions will be made in the context of other state and federal laws, which raises risks that a local GSA's decisions could be challenged or undermined. This report aims to help GSAs minimize that risk.

A. REPORT FOCUS AND KEY QUESTIONS

The report focuses on the intersections between surface water law and the emerging SGMA regime. The report also focuses on questions about how potential conflicts involving intersections between surface water and groundwater might be resolved. While SGMA brings groundwater-surface water interactions into fresh focus, many key questions remain unanswered. The following questions are particularly important, and are the focus of the remainder of this report:

1. **How will surface water law and groundwater law interact under SGMA?** What tensions might arise between surface water rights and groundwater rights, and how might these tensions be navigated? How does environmental regulation of surface water uses intersect with groundwater management?

2. **What constitutes a significant and unreasonable adverse impact on beneficial uses and users of interconnected surface water?** When will impacts to surface water uses—including both human and environmental uses—necessitate a response by groundwater managers? How might a GSA, or a state regulator, approach this determination?

3. **Which entities are responsible for addressing the interactions between surface water and groundwater?** Which responsibilities legally fall to GSAs and which to other entities (e.g., individual groundwater users, individual surface water users, other government agencies)? Legal obligations aside, what roles might GSAs and other entities play in addressing potential or identified problems?

4. **What might a process for effectively resolving groundwater-surface water issues and conflicts look like?** How might potential conflicts involving the interaction between surface water and groundwater be resolved fairly and efficiently in the context of SGMA?

5. **What legal and technical aspects of groundwater-surface water interactions under SGMA are still unknown or uncertain, and to what degree?** How do legal uncertainties and technical uncertainties intersect with one another? How and why might uncertainty matter?

For many of these questions, definitive answers do not yet exist. Thus, this report is intended to provide general guidance for those involved in SGMA implementation. SGMA implementation, and in particular, legally addressing groundwater-surface water interactions, is largely uncharted territory for California. Significant physical, legal, and technical uncertainties will need to be resolved over time, so many of the questions raised in the report simply do not, or do not yet, have clear answers. Further, the diversity and uniqueness of groundwater and surface water basins in the state suggests that one-size-fits-all solutions will never exist, and that each GSA will need to chart its own course. And yet, SGMA's timeline dictates that GSAs and others need to make decisions and move forward with developing their plans to achieve sustainability.

In light of the tension between lack of clarity and the need to act quickly, we discuss each element in terms of existing knowledge, unanswered questions, and potential risks that might arise for parties as they seek to move forward in the face of uncertainty. This approach offers structure to decision makers and interested parties for near-term decisions, as well as clarifying why adapting to future developments will be essential in the long term.

B. WHO SHOULD READ THIS REPORT?

The information and analysis in this report may be relevant to a range of audiences, including:

Groundwater Sustainability Agencies. Understanding and addressing groundwater-surface water interactions is now an obligation for GSAs. For many GSAs, avoiding this particular undesirable result presents a challenge. This report addresses legal issues, constraints, and opportunities that GSAs might face, and discusses how GSAs might go about navigating the uncertainties involved.

State and federal regulatory, water supply, and wildlife agencies. SGMA implementation raises questions about institutional responsibilities for addressing groundwater-surface water interactions. This report examines potential institutional roles and interactions between GSAs and other entities, including the California Department of Water Resources (DWR) and State Water Resources Control Board (SWRCB); state and federal water supply agencies including DWR and the United States Bureau of Reclamation (USBR); and state and federal wildlife agencies including the California Department of Fish and Wildlife (CDFW), the United States Fish and Wildlife Service (USFWS), and National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries), as well as the Bureau of Indian Affairs (BIA).

Other stakeholders involved in groundwater management. SGMA also affects other stakeholders with diverse interests, and the issues discussed in this report may be of interest to a number of other stakeholders including environmental groups, community groups, native American tribes, individuals and entities with surface or groundwater rights, technical consultants, and legal practitioners.

II. Understanding groundwater-surface water interactions

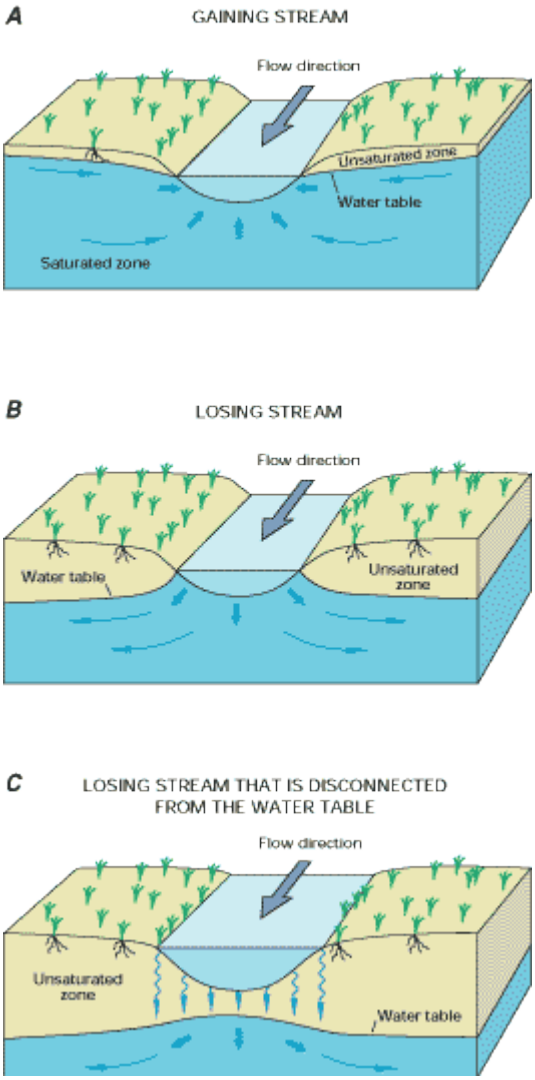
While this report focuses primarily on legal dimensions of groundwater-surface water interactions, one cannot understand those legal issues without some technical and scientific background. This section briefly explains the physical links between groundwater and surface water, the ecological consequences of those links, and the tools used to measure, characterize, and model the flows between groundwater and surface water.

A. LINKS BETWEEN GROUNDWATER AND SURFACE WATER

Groundwater and surface water are highly interconnected in many landscapes.[4] Streams, wetlands, and lakes can gain water from groundwater, lose water to groundwater, or do both at differnt locations or at different times of the year (Figure 1).[5] The relationship between groundwater and surface water largely depends upon the elevation of the water table relative to the elevation of the stream surface. If the water table is higher than the surface water, groundwater flows into the stream or water body, and the surface water body is characterized as gaining. If the water table is lower than the stream surface, but still connected to the stream by a saturated zone, the stream or water body loses water to the water table, and the surface water body is characterized as losing. In some cases, when the water table has dropped far enough in elevation that the surface water and groundwater are separated by an unsaturated zone, a stream is characterized as disconnected.

Groundwater plays an important role in many ecosystems.[7] Groundwater-dependent ecosystems (GDEs) are comprised of springs and seeps, wetlands and

Figure 1: Groundwater-surface water relationships: Gaining, losing, and disconnected streams. Source: USGS.[6]



associated vegetation, or stream flows from groundwater discharge (baseflow).[8] Groundwater pumping can impact these groundwater-dependent ecosystems; as groundwater is extracted, the water table drops, which can cause stream depletion via reduction in baseflow[9] and can impact groundwater-dependent ecosystems that receive less water as the water table lowers.[10]

It can be difficult to understand the precise nature of the connections between groundwater and surface water in a particular area because many groundwater basins have locally complex geology and ecology that complicates groundwater flow and groundwater-surface water dynamics. In the sedimentary basins currently subject to SGMA, groundwater-surface water interactions are shaped by stream geomorphology, subsurface structural discontinuities, and aquifer composition, including the distribution of bodies of sedimentary rock and flow characteristics throughout a given area.[11]

Impacts on streamflow and GDEs from groundwater pumping can be difficult to directly attribute to particular pumpers. One reason for this difficulty is that impacts are often time-delayed (by days, months, years, or even decades) and are complicated by temporal and spatial patterns of groundwater pumping, sometimes in conjunction with managed aquifer recharge.[12] Relationships between perched aquifer systems (those separated from underlying groundwater by a less permeable layer and an unsaturated zone) and regional pumping also are complex. While pumping of a regional aquifer may have an impact on surface waters at some point, stream reaches tied to perched aquifer systems are isolated from and not susceptible to groundwater pumping in the regional aquifer system below. Perched aquifer systems are also often important for GDEs, but may be difficult to manage from a regional perspective. Additionally, climate uncertainty and associated variability are likely to affect surface water availability, instream flows, and groundwater recharge,[13] presenting yet another set of complicating factors.

Groundwater-surface water dynamics, like groundwater flow, are complicated and rarely straightforward to understand and manage. Ecosystem dynamics can be complex, with many GDEs requiring different groundwater flow conditions at different times of year. Adequately understanding groundwater-surface water interactions may thus require substantial study.

B. TOOLS AND METHODS FOR UNDERSTANDING GROUNDWATER-SURFACE WATER INTERACTIONS

A range of tools and methods can be used to shed light on the complex relationships between groundwater and surface water.[14] There have been many technological advances in data collection, analysis, and modeling that contribute to a stronger knowledge of groundwater-surface water dynamics.[15] Table 2 summarizes a number of different tools and methods for monitoring and measuring stream-aquifer dynamics, ranging from simple to more complex methods, and summarizes some of the key factors that may be involved in deciding whether a tool is a good fit for use in a given basin.

These tools and methods have not been applied evenly across the state of California. For many basins throughout the state, significant uncertainty about groundwater-surface water interactions still exists.[16] Data collection, monitoring, and analysis remain limited in many areas. The uncertainty and limited availability of information regarding groundwater-surface water interactions present challenges for GSAs.

One challenge is related to maintaining GSA credibility with water users. Given limited information, groundwater users may not think that their pumping impacts surface water. For example, private pumpers five miles away from a river may not believe (or may refuse to believe) that their pumping could impact surface water. If these pumpers then dispute the basic factual premises for a GSA's management actions, and the GSA cannot respond with robust data, it will face credibility issues.

A second challenge is that GSAs will need to decide what amount of uncertainty is acceptable. As Table 2 outlines, there are a variety of tools and methods for

measuring groundwater-surface water interactions. These tools vary widely in terms of cost and accuracy. There is also wide variance in the depth and accuracy of data and information that will be needed to understand a given basin, given that the precise nature of groundwater-surface water connections differs greatly within and between groundwater basins. Determinations about what constitutes an adequate conceptualization of groundwater-surface water interactions—and the costs of obtaining the information deemed adequate—are thus likely to vary widely. Data acquisition and analysis come with costs, and questions will arise regarding the acceptable balance of uncertainty and expense.

Table 2: Tools and methods for monitoring and measuring stream-aquifer dynamics

	TOOL / METHOD	DESCRIPTION	BENEFITS	COSTS AND LIMITATIONS
FIELD SAMPLING AND MEASUREMENT METHODS	Groundwater level monitoring near streams[17]	Relies on monitoring water levels in wells on a seasonal or finer-scale basis. Well levels can be compared to surface water elevation to determine the direction of flow (into or out of the stream).	Simple; low cost (if existing network is adequate); relies on existing groundwater monitoring well network. Very useful for monitoring long term trends.	May be overly simple in many cases; does not provide a full picture of complex groundwater-surface water dynamics; existing well network may be inadequate.
	Streamflow gaging and hydrograph analysis[18]	Estimating baseflow by examining hydrographs to separate groundwater-derived flow from stormwater flows.	Relatively simple and low cost if streamflow gages already exist at appropriate locations. Provides a direct measure of streamflow contribution from groundwater.	Requires continuous stream gaging at appropriate (often multiple) locations. May not provide a full picture of complex groundwater-surface water dynamics.
	Seepage meters[19]	Using a device to directly measure flow between surface water bodies and groundwater. Commonly used to measure water losses from irrigation canals.	Device is low cost and simple to operate.	Numerous sources of error exist. Not well suited for surface water bodies with currents or fast water, rocky sediment, or very soft sediment.
	Monitoring of physical and geochemical properties[20]	Monitoring of properties such as water temperature, isotopes, electrical resistivity, and salinity.	Ability to track movement of groundwater through a connected system. Useful in combination with other methods.	Possibly expensive data collection and analysis.

MAPPING AND MODELING METHODS

TOOL / METHOD	DESCRIPTION	BENEFITS	COSTS AND LIMITATIONS
Mapping groundwater dependent ecosystems (GDEs), streams, and seasonally dry streambeds[21]	Mapping GDEs, interconnected streams, and seasonally dry streambeds to understand groundwater-surface water connections.	Contributes a detailed understanding of the characteristics and spatial distribution of streams and GDEs. Focuses on identifying locations where groundwater is ecologically important. Maps of potential GDEs are available statewide through DWR.	May be labor intensive to map all GDEs, although statewide tools are in development to aid in mapping.[22] Does not provide information about aquifer dynamics.
Water balance[23]	Calculating groundwater contribution to streamflow in the form of baseflow on an annual, seasonal, or monthly basis. Basin-scale groundwater contribution is estimated as a closure term based on estimates of water inputs and outputs within a basin.	Relatively simple and low cost.	Does not provide a full picture of complex groundwater-surface water dynamics. Relies upon accurate water balance data, which may be limited.
Analytical modeling: stream-depletion function[24]	Simple analytical model that calculates stream depletion from well pumping, along with stream recharge, taking into account the distance of pumping/recharge from the stream.	Incorporates basic aquifer characteristics; allows for basic modeling of stream depletion/repletion; simpler and lower cost than a numerical model; provides good working knowledge of trends, overall impacts.	Assumes uniform aquifer conditions, which does not account for complex groundwater dynamics, limiting predictive accuracy. Many wells are not gaged, limiting data availability.
Numerical modeling: integrated groundwater-surface water modeling[25]	Computer model of groundwater system or integrated hydrologic system, which typically includes basin geometry and hydrogeological parameters.	Ability to simulate and predict groundwater flows. Ability to account for three-dimensional complexity of groundwater dynamics.	Accuracy depends upon quality of input data. Building a model that is accurate enough to be useful can be expensive and labor intensive. Used in conjunction with other methods above for calibration.

III. Legal relationships between groundwater and surface water

This section provides a brief review of the principles of groundwater and surface water law in California in order to provide a basis for understanding SGMA's impacts. The section discusses groundwater and surface water rights and regulation before SGMA, and then describes the changes that SGMA introduces.

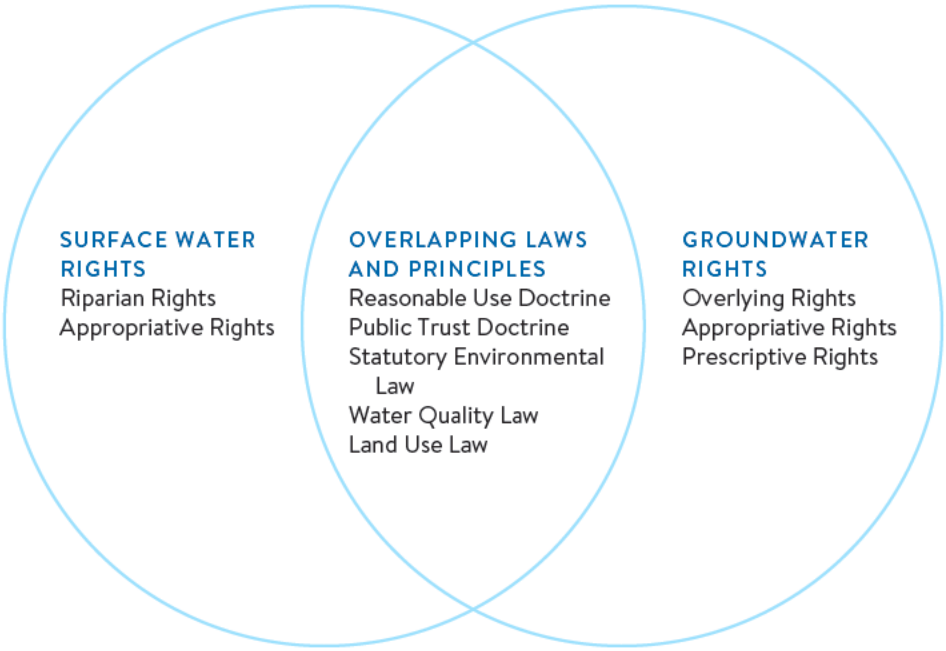
A. GROUNDWATER AND SURFACE WATER RIGHTS AND REGULATION IN CALIFORNIA BEFORE SGMA

There are several main categories of surface water rights in California.[26] Riparian rights entitle riparian landowners to make reasonable use of water on land adjacent to the waterway so long as natural surface flows are present.[27] These rights are correlative so that, in times of shortage, all riparian users share in the shortage.[28] Appropriative rights are not based on land ownership but on temporal priority (i.e., "first in time, first in right,") with the earliest appropriators enjoying the most secure right to use water. Appropriative surface water rights are divided into pre-1914 and post-1914 rights, with post-1914 appropriative rights requiring permitting by, and traditionally being subject to greater regulation from, the SWRCB.[29] The extensive statutory system for regulating post-1914 appropriative rights, which includes a permitting and licensing process administered by the SWRCB,[30] is an important distinction between surface water rights and groundwater rights, which are governed primarily by common law.[31]

Groundwater rights in California are based on several analogous principles.[32] Overlying groundwater rights are largely similar to riparian rights. These rights allow landowners above a groundwater basin to make reasonable use of groundwater on that land, and during times of shortage, overlying users are limited to their correlative share of the safe yield based upon reasonable need.[33] Appropriative rights to use groundwater (for basin export or for non-overlying uses within the basin) may be exercised if there is surplus groundwater beyond what is needed for the reasonable beneficial uses of those with overlying rights.[34] Similar to appropriative rights to use surface water, these appropriative rights have temporal priority. They are considered secondary to overlying users, so in times of shortage appropriative rights, beginning with the most junior uses, are, in theory, the first to be curtailed.[35] Prescriptive rights may be acquired if a water user has continued to use groundwater for a non-overlying use when no surplus was available for five or more years. The water right then can "ripen into" a prescriptive right.[36] As is also the case with surface water, several other, less common types of groundwater rights exist, including pueblo rights and federal reserved rights.[37] Subterranean streams, defined as a body of groundwater flowing through known and definite channels,[38] present a special circumstance for water rights, because withdrawals from these subterranean streams are regulated by California's surface water rights system (see section IV.B of this report for further discussion).

Unlike surface water users, groundwater users have historically faced little regulation or enforcement of legal limits of their rights, and no mandatory statewide system has required permitting and licensing of groundwater use. There were limited efforts to encourage voluntary local management of groundwater before 2014. At the state level, the Groundwater Management Act of 1992 (AB 3030) allowed for voluntary development

Figure 2: Systems of groundwater and surface water rights and regulation



of groundwater management plans in unadjudicated basins. In 2002, SB 1938 modified the Groundwater Management Act by introducing financial incentives for the development of groundwater management plans. SB 1938 also introduced specific minimum requirements for plan elements, but did not require that plans be implemented or that plan objectives be met.[39] In the absence of statewide regulation, some local governments took ambitious steps to manage their groundwater.[40] Many, however, did not.

Despite the lack of integration of surface water rights and groundwater rights,[41] there are several commonalities between the two systems. First, California's constitutional requirement for reasonable use applies to both surface water and groundwater, as do many other laws (Figure 2). Second, there are parallels between riparian surface water rights and overlying groundwater rights, which are both correlative, and between the temporal-priority-based systems of appropriation that exist for both groundwater and surface water. Additionally, resolving conflicts between correlative and appropriative rights in each context has sometimes been difficult.

While the groundwater and surface water rights systems are not integrated, there are historical precedents for reconciling them. In some cases, groundwater and surface water rights have been jointly adjudicated.[42] In other cases, surface water users have used litigation to protect their rights from injury by groundwater pumping,[43] and vice versa.[44] California courts have generally treated all correlative rights as one joint senior priority class, and based the priority of all appropriative rights on their priority dates. Applying these priority rules is complicated by the specifics of hydrologic connectivity in each location, which will affect whether and to what extent actions would actually injure other water users. Where resolving conflicts purely on the basis of water right priority would result in waste or unreasonable use, courts have sought physical solutions designed to reasonably protect more senior rights, consistent with Article X, Section 2, of the California Constitution.[45]

B. GROUNDWATER-SURFACE WATER INTERACTIONS UNDER SGMA

The passage of SGMA in 2014 was a historic step towards sustainably managing the state's groundwater resources.[46] SGMA adopts a state policy of managing groundwater resources "sustainably for long-term reliability and multiple economic, social, and environmental benefits for current and future beneficial uses."[47]

SGMA defines sustainability as the avoidance of six "undesirable results" (Figure 3). Under SGMA, groundwater sustainability agencies (GSAs) must form in groundwater basins designated as medium- or high-priority, which are responsible for developing and implementing groundwater sustainability plans (GSPs) or alternatives.[48] GSPs must demonstrate how GSAs will attain sustainability.

A particularly important—and difficult—aspect of SGMA is that it recognizes the interconnections between groundwater and surface water and requires GSAs to consider them. One of the undesirable results SGMA requires GSAs to avoid is "[d]epletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water."[49] Because beneficial uses include environmental as well as human consumptive uses, this mandate protects groundwater-dependent ecosystems. SGMA defines "interconnected surface water" as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted."[50]

While this obligation may sound far-reaching, SGMA qualifies it by setting a temporal baseline. "The plan may, but is not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015. ... [A] groundwater sustainability agency has discretion as to whether to set measurable objectives and the timeframes for achieving any objectives for undesirable results that occurred before, and have not been corrected by, January 1, 2015."[51] In other words, SGMA limits the scope of GSAs' legal *responsibilities*—at least under SGMA itself—to addressing post-2014 impacts—but does not limit GSA's *authority* to address earlier impacts (see Section IV. C of this report for further discussion of this topic).

SGMA is explicit that it does not modify, alter, or determine any groundwater or surface water right.[52] But by linking groundwater and surface water, SGMA connects the two water rights regimes.

In order to operationalize its substantive mandates, SGMA requires GSPs to include monitoring and management of not only groundwater levels, but also of changes in surface water flow and surface water quality as well as impacts on groundwater dependent ecosystems.[53] SGMA also directs DWR to consider adverse impacts on local habitat and local streamflows in the prioritization of groundwater basins and subbasins.[54]

A crucial upshot of these statutory provisions is that understanding, and in many cases acting to manage, groundwater-surface water interactions is an obligation for GSAs. GSAs must gain sufficient understanding

Figure 3: SGMA sustainability indicators. Six undesirable results to be avoided. Source: DWR

of surface water quantity and quality, groundwater-dependent ecosystems, appropriative and riparian surface water rights, and how groundwater management actions might affect all of these things.[55] GSAs will also need to develop a working knowledge of the basin hydrogeology that mediates these interconnections. SGMA thus creates new needs for data collection and analysis regarding groundwater-surface water interactions.[56]

In addressing surface water depletion and other undesirable results, GSAs play a lead role but do not act alone. DWR regulates and assists in SGMA implementation at the statewide level, and is responsible for providing data, information, and technical support and for reviewing GSPs for adequacy. SWRCB is the enforcing agency, and may intervene and create an interim plan if a GSA fails to develop and implement an adequate GSP. The federal government, tribal interests, other local governments, and other stakeholders may provide input, participate in GSP development and implementation, and provide comments during review periods.[57]

DEFINITIONS FROM SGMA AND DWR GSP REGULATIONS

- **"Sustainable groundwater management"** means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon **without causing undesirable results.** (Cal. Water Code § 10721(u))

- **"Undesirable result"** means one or more of the following effects caused by groundwater conditions occurring throughout the basin… **(6) Depletions of interconnected surface water** that have significant and unreasonable adverse impacts on beneficial uses of the surface water. (Cal. Water Code § 10721(w))

- **"Significant depletions of interconnected surface waters"** means reductions in flow or levels of surface water that is hydrologically connected to the basin such that the reduced surface water flow or levels have a significant and unreasonable adverse impact on beneficial uses of the surface water. (Cal. Water Code § 10735(d))

- **"Groundwater dependent ecosystem"** refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. (23 Cal. Code Regs. § 351(m))

- **"Interconnected surface water"** refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. (23 Cal. Code Regs. § 351(o))

- **"Minimum threshold"** for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. (23 Cal. Code Regs. § 354.28(c)(6))

CONSIDERATIONS FOR DEVELOPING SUSTAINABLE MANAGEMENT CRITERIA RELATED TO DEPLETION OF INTERCONNECTED SURFACE WATER

DWR regulations specify required components of groundwater sustainability plans.[58] GSAs are responsible for establishing minimum thresholds that provide quantitative metrics for each of the six sustainability indicators. The GSP must describe how the minimum threshold was chosen, including how basin conditions at each minimum threshold will avoid undesirable results.[59] Regarding surface water depletion, the regulations specify that the minimum threshold metric for depletion of interconnected surface waters shall be expressed as "a rate or volume of surface water depletion caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results."[60] This rate or volume can be demonstrated using a numerical groundwater and surface water model or another equally effective method, tool, or analytical model. To better account for uncertainty, including climate variability, minimum thresholds should take into account water year type as well as historical trends and projected water use in the basin.[61]

DWR's recent draft best management practice (BMP) document[62] summarizes some considerations for GSPs establishing minimum thresholds for depletions of interconnected surface water caused by groundwater extraction, including:

- What are the historical rates of stream depletion for different water year types?
- What is the uncertainty in streamflow depletion estimates from analytical and numerical tools?
- What is the proximity of pumping to streams?
- Where are groundwater dependent ecosystems in the basin?
- What are the agricultural and municipal surface water needs in the basin?
- What are the applicable state or federally mandated flow requirements?

This list of considerations highlights several of the issues discussed in the rest of this report, including the importance of considering groundwater dependent ecosystems, surface water users, and instream flow requirements, as well as recognition of the uncertainty that characterizes understanding of groundwater-surface water interactions in many basins.

IV. Understanding legal constraints and opportunities associated with groundwater-surface water interactions under SGMA

To ensure that their GSPs and implementation actions are defensible, GSAs will need to understand the interactions between groundwater rights, surface water rights, and other relevant legal principles. But many of these interactions implicate partially unsettled areas of law. This section attempts to clarify, as much as is possible, some key areas of interaction between groundwater and surface water law that are likely to be important under SGMA. Key points from each area of discussion are summarized in Table 1 on page 10.

A. THE CONSTITUTIONAL REQUIREMENT FOR REASONABLE USE

Key Point: *Groundwater use, like all water use in California, is subject to the reasonable use doctrine. But the practical implications of the doctrine are not entirely clear. Reasonable use is, by nature, a flexible and highly context-dependent concept that is based in part on value judgments.*

Article X, Section 2, of the California Constitution requires that all water use be reasonable and beneficial. It states:

> The right to water or to the use or flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water.

Consequently, a basic foundational principle of water rights in California is that there is no right to an unreasonable use of water.[63] Article X, Section 2, states that "the Legislature may also enact laws in the furtherance of the policy." Additionally, California's courts have recognized that the reasonable use doctrine empowers legislators and government regulators to constrain water use, either through generally applicable regulations or through individual enforcement actions.[64]

California's reasonable use doctrine applies to groundwater as well as surface water. For example, in *City of Barstow v. Mojave Water Agency*, the California Supreme Court explicitly applied the reasonable use doctrine to groundwater rights.[65]

While the reasonable use doctrine clearly applies to groundwater use, the practical implications for GSAs are not entirely clear. In practice, the doctrine has not been stringently applied; California courts have rarely invoked the reasonable use doctrine to impose limits on water users, and they (and the courts of other western states) have sometimes concluded that seemingly profligate uses of water are reasonable.[66] However, the doctrine remains potentially powerful. When courts have invoked the doctrine, they have stated that what is reasonable "depends on the circumstances of each case," as well as "statewide considerations of transcendent importance" which may evolve over time in response to

changing conditions and societal needs.[67] And they have repeatedly affirmed that government regulators, not just the legislature and the courts, can shape and apply the doctrine, including through enforcement actions against individual water users.[68] Consequently, the reasonable use doctrine remains underdeveloped, sometimes weak, yet potentially powerful, and its application depends on judicial discretion and on the willingness of regulators to take assertive positions.

The inchoate nature of the doctrine leaves GSAs with a challenge and, potentially, an opportunity. The challenge is that, while they can be sure that the reasonable use doctrine applies to the water uses they regulate, no one has provided them with a formula to figure out exactly what the doctrine allows or prohibits. The opportunity, which we explain in more detail in Part IV, is for GSAs to use their regulatory authority under the reasonable use doctrine to craft legally defensible solutions to the water management challenges they face.

B. SURFACE WATER RIGHTS, GROUNDWATER RIGHTS, AND SGMA

While SGMA is California's first attempt at statewide groundwater regulation, California's groundwater has long been governed by a common-law system of groundwater rights. Similarly, California's system of surface water rights has existed for well over a century. These systems of rights sometimes conflict with each other. The discussion below briefly explains the implications for SGMA implementation of these water rights challenges.

RECONCILING SURFACE WATER AND GROUNDWATER RIGHTS

Key Point: *SGMA explicitly does not alter surface water or groundwater rights. However, the process of bringing a groundwater basin's water budget into sustainable balance may impact both. SGMA does not provide a formula for resolving conflicts between surface water and groundwater rights, but it does provide opportunity and a potential forum for doing so—if GSAs are ambitious.*

SGMA expressly states that it does not alter groundwater or surface water rights.[69] But complying with its requirements will often lead to impacts on the exercise of both groundwater and surface water uses that occur under claims of right. The combination of a disclaimer of any alteration of rights and requirements that will impact the exercise of those rights creates some obvious interpretive challenges, particularly when surface and groundwater rights come into conflict. At first glance, several interpretations may seem possible. On the one hand, one might think that SGMA exempts groundwater regulators from worrying about any impacts on surface water rights, unless those impacts arise after January 1, 2015. On the other hand, one might think that SGMA does not do anything to resolve conflicts between groundwater and surface water rights, and instead leaves the resolution of those conflicts to other laws.

We think the latter interpretation is stronger, and that SGMA does not make surface water rights subordinate to groundwater rights. A basic principle of statutory interpretation is that the interpreter should attempt to harmonize different laws, not create conflict.[70] Yet such conflicts would arise if SGMA were to override any claims that might arise under California's traditional systems of surface water rights. Consequently, the stronger interpretation is that, while SGMA does not establish any *new* obligation for GSPs to correct old impacts to surface water users or rights, it does not *eliminate* any obligations that groundwater users might

have under preexisting law. But the question has not yet been resolved by any court.

More broadly, GSAs and other relevant agencies will need to allocate responsibility for surface water depletions by determining the portion of surface water depletion caused by SGMA-regulated pumping as opposed to the portion attributable to the actions of surface water users themselves, an exercise that may be conceptually straightforward but technically challenging.

SUBTERRANEAN STREAMS

"Subterranean streams" may present a particular challenge for interpretation and operationalization of the connections between groundwater and surface water rights. Under California law, so-called "subterranean streams flowing in known and definite channels"[71] are addressed under the surface water rights system. This suggests a need to identify such subterranean streams, as well as which wells are pumping from them, in order to determine whether wells are subject to SGMA regulation or regulation as surface water . But that will be difficult, both because of uncertainties about hydrology and because the phrase "known and definite streams" is a lawyers' creation, and has little correspondence with concepts used by scientists.

SGMA AND TAKINGS

Key Point: *Water rights in California are property rights, and surface or groundwater users may bring takings claims if they believe regulatory restrictions on use have effectively taken their property. However, inherent in those rights is some susceptibility to reasonable regulation. GSAs can limit the risk of takings liability by managing groundwater in a manner generally consistent with California water rights.*

Both the United States Constitution and the California Constitution protect property rights from being taken by government authorities without just compensation.[72] This prohibition extends to "regulatory takings," in which government regulation accomplishes the functional equivalent of a taking through regulatory controls.[73]

Rights to use surface water and groundwater in California are property rights.[74] Because regulation of groundwater use inevitably limits the exercise of some groundwater rights (while also protecting other rights), and groundwater management decisions may affect rights to use interconnected surface water, GSAs may fear that their efforts to manage groundwater could trigger takings claims. That fear might be heightened by language in SGMA itself, which expressly disclaims making any change to those rights.[75]

Nevertheless, GSAs likely do not face major threats from takings claims. Both California and federal courts have grounded their takings jurisprudence in an understanding that "'government regulation—by definition—involves the adjustment of rights for the public good,' ... [and that] '[g]overnment hardly could go on if to some extent values incident to property could not be diminished without paying for every such change in the general law.'"[76] In the context of water law, California courts have repeatedly affirmed that water rights are subject to government regulation.[77] And in the specific context of groundwater use regulation,

California courts, like the courts of other states, have affirmed that use restrictions do not effect takings unless they fail to meet the United States Supreme Court's *Penn Central* test.[78] That test is generally favorable to government defendants.[79]

That does not mean that the takings doctrine is irrelevant to a GSA's decision making. If a GSA manages groundwater in a way that creates a major redistribution of water away from surface water users and to groundwater users, it may be vulnerable to takings claims by the affected surface water users. Similarly, if a GSA were to effectively redistribute water rights from one class of groundwater users to another, it may be vulnerable to takings claims.[80] But if a GSA makes a good-faith effort to resolve water conflicts in an even-handed way, and takes into account the traditional requirements of surface and groundwater law, then its position is likely to be highly defensible.

C. THE PUBLIC TRUST DOCTRINE

Key Point: *If groundwater pumping within a GSA's jurisdiction draws water from aquifers that are tributary to surface waterways, the public trust doctrine is relevant.*

The public trust doctrine protects the recreational, ecological, navigational, and commercial values of navigable waters. That protection, as the California Supreme Court held in *National Audubon Society v. Superior Court*, is not limited to direct diversions from the navigable waterways themselves.[81] It also extends to diversions from their tributaries.[82] The *National Audubon Society* decision addressed diversions from surface tributaries, not groundwater, and no California appellate court has decided whether diversions of tributary groundwater also implicate the public trust doctrine. But a superior court in Siskiyou County recently held that tributary groundwater is subject to the public trust doctrine.[83] The authors of this report anticipate, based on analogy to the reasoning of *National Audubon Society*, that the appellate court will reach a similar holding. If we are correct, then pumping of tributary groundwater clearly will be subject to the public trust doctrine. However, there is disagreement within the broader legal community on this premise, and while the discussion that follows assumes we are correct on this point, that assumption may not hold. Similarly, a second contested issue in that litigation is whether SGMA completely subsumes the public trust doctrine or whether some independent duties will remain. The discussion that follows considers the scenario in which the latter principle will prevail. In that scenario state and local government decision makers would need to consider the public trust doctrine as they make SGMA-related decisions that will impact public trust waterways.[84]

If the doctrine applies to groundwater, then some obligations clearly exist while other questions remain unresolved. The primary obligation is for the state and its subdivisions to consider the public trust when making decisions that allocate water.[85] GSAs are subdivisions of the state, and for that reason, and also because state agencies must review and approve GSPs and exercise ongoing oversight over their implementation, this obligation will extend to policies set and actions taken by GSAs. Another important principle is also clear: the public trust doctrine can authorize, and even require, changes in use (for example, limits on quantity of water use) even when those uses are authorized by established water rights.[86]

Less clear, in some circumstances, are the implications of the public trust doctrine for the content of GSPs. If the state has established public trust flow requirements for waterways affected by groundwater pumping, then the state probably cannot lawfully determine that a GSP that is inconsistent with those requirements is adequate. But where the state has not set those requirements, the public trust doctrine calls for a balancing of the trust against other uses, with trust uses to be protected "whenever feasible."[87] That language suggests a thumb on the scales in favor of public trust protections, but it does not indicate how hard the thumb should press.

Similarly, even if public trust protections do apply, ambiguity will sometimes exist about the degree to which different water users are obligated to provide for public trust flows. Many waterways that are affected by groundwater pumping are also likely to be affected by surface water diversions, and the public trust doctrine contains no formula for allocating responsibility where multiple users are responsible for excessive cumulative impacts to public trust resources.

Consequently, GSAs seeking to avoid undesirable results due to significant and unreasonable depletions of interconnected surface water caused by groundwater extraction are advised—at a minimum—to minimize risk by considering the public trust impacts of their plans, and to document consideration of those impacts in their GSPs. SWRCB and DWR must also consider the potential public trust impacts of plans they review, and the actual public trust impacts of plan implementation. That consideration is likely to take into account any public trust flow requirements that the SWRCB has set, and it may also be informed by flow requirements established by NOAA Fisheries or FWS in Biological Opinions for species listed under the Endangered Species Act. Finally, although the obligations of GSAs and state oversight agencies are not yet crisply defined, plans will in general be less legally vulnerable if they are more protective.

D. STATUTORY ENVIRONMENTAL CONSIDERATIONS

Many environmental laws have implications—often indirectly—for groundwater uses and groundwater management decisions that affect surface water flows. This section discusses some of the most important laws and their potential implications for GSAs. While the particulars may differ, there are two general themes to this discussion. First, how environmental laws might apply to GSA's management decisions and actions is hard to predict with precision. Second, the legal risks borne by GSAs, and by the groundwater users they regulate, will be lower if environmental impacts on surface water flows and habitats are reduced.

FEDERAL AND STATE ENDANGERED SPECIES ACTS

Key Point: *Endangered species laws apply to groundwater allocation decisions that may impact listed species. GSAs seeking to avoid consequences under the ESA should be aware of these species within the basin and explicitly address their needs when developing GSPs.*

In general, both the state and federal Endangered Species Acts apply to water allocation decisions. Groundwater allocation decisions may impact endangered species and their habitats—including streams and other groundwater-dependent ecosystems such as wetlands. GSAs seeking to avoid consequences under the Endangered Species Acts should consider whether listed species might be affected by groundwater use within their basins. The nature of these laws' applicability is somewhat complicated, however, and does involve some legal ambiguity.

The federal Endangered Species Act (ESA) establishes two primary prohibitions: (a) Section 7 prohibits federal agencies from authorizing, funding, or carrying out actions that are likely to jeopardize the continued existence of listed species, or that are likely to adversely modify their designated critical habitat;[88] and (b) Section 9 prohibits anyone—not just federal agencies—from taking actions that will "take" listed species, unless that person has obtained an incidental take authorization or permit.[89] The former obligations will rarely affect GSAs, which are subdivisions of the state and generally will not need federal authorization for their actions (unless, for example, GSAs are seeking federal funding). The latter obligations, however, could apply, particularly because NOAA Fisheries and the USFWS have defined "take" to include actions, like modifying habitat, that proximately cause harm to members of a listed species.[90] So, for example, groundwater pumping that dewaters a surface stream while coho salmon are present would cause prohibited takes.

The California ESA (CESA) contains a similar restriction. It prohibits "takes" of listed species unless the person or entity[91] committing the take has obtained an incidental take permit.[92] The California Fish and Game Code defines the term "take" somewhat more narrowly than does the federal ESA, and the term "harm"[93] is absent from the state definition.[94] Nevertheless, that narrower definition would not insulate water users from liability if their pumping was demonstrably the cause of deaths of listed species.

While the possibility of takes is clear, the likelihood of GSAs bearing liability in their regulatory roles is less certain. There are two reasons for this uncertainty. First, proving that groundwater pumping proximately caused harm to a protected species might be difficult. Impacts to surface water resources typically arise from a variety of sources, and plaintiffs in Section 9 cases involving water diversions have sometimes struggled to adequately show causation.[95] Second, some legal uncertainty exists about the extent to which regulators face take liability for actions taken by the entities they regulate. Some courts have construed regulatory authorizations as granting permission for actions that otherwise *would not* occur, and thus have concluded that regulators can face take liability.[96] Other courts have construed regulation as a partial prohibition on actions that otherwise *would* occur, and therefore have held that the regulatory decisions only caused a *reduction* in impact, not any of the harms resulting from the regulated action.[97] The former mode of reasoning, if applied to GSAs (or to DWR and the SWRCB), would create potential take liability; the latter would not unless the GSA's regulatory decisions resulted in increased harm to listed species.

GSAs and the entities they regulate can avoid take liability by developing habitat conservation plans (HCPs), which compensate for unavoidable impacts to listed species through other actions to protect or restore habitat.[98] Habitat conservation planning is generally not a quick or cheap process, and if a GSA is concerned about take liability, avoiding impacts may be more efficient than developing an HCP. But if a GSA's planning will be linked to broader and more integrative water resource planning, including an HCP as an element of that planning may make sense.

It is important to note that take liability depends on context. While this discussion focuses primarily on GSAs as regulatory bodies, GSAs may also act as operators who build infrastructure or move water. In that operational capacity, GSAs' potential take liability is clearer.

Of course, the entire regulatory environment will generally be simpler if species are not formally listed as threatened or endangered in the first place. Collaborating with other local entities and working to help species of concern avoid declining to the point where they are formally listed may therefore be a useful strategy for GSAs. This is a common practice, and regulated and governmental entities sometimes formalize these efforts through negotiated deals known as "candidate conservation agreements."[99] To that end, GSAs seeking to avoid liability with regard to endangered species may choose to minimize their risk by a) considering impacts on species that are potentially at risk as they develop their GSPs, and b) strongly considering measures to minimize such impacts.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

Key Point: *The preparation and adoption of GSPs is specifically exempt from CEQA. However, implementation actions taken by a GSA under a GSP would remain subject to CEQA. Compliance with CEQA would include analyzing and mitigating potential negative impacts on interconnected surface waters.*

When California state or local agencies take actions with potentially significant environmental impacts, they normally must comply with the California Environmental Quality Act (CEQA).[100] GSAs are local agencies, and impacts of groundwater management practices on interconnected surface water may be

significant, so the prerequisites for CEQA's applicability exist. SGMA, however, specifically exempts "the preparation and adoption" of GSPs from CEQA.[101] That removes CEQA from GSAs' list of potential concerns as they develop their plans.

However, this exemption does not extend to "a project that would implement actions taken pursuant to a plan adopted pursuant to this chapter."[102] Consequently, GSAs will need to comply with CEQA during the plan implementation stage. Compliance with CEQA would mean, among other things, disclosing environmental impacts upon interconnected surface waters, considering alternative implementation measures that will avoid or reduce those impacts, and adopting, to the extent feasible, mitigation measures for those impacts.

CLEAN WATER ACT AND PORTER-COLOGNE ACT

Key Point: *Although water quality is also addressed separately within SGMA,*[103] *it is relevant to groundwater-surface water interactions, including through effects on streamflow volume and temperature.*

The Federal Clean Water Act and the California Porter-Cologne Water Quality Control Act both protect designated beneficial uses of surface water, and the Porter-Cologne Act also protects groundwater. These beneficial uses include fish and wildlife uses as well as human uses.[104]

Both of these acts focus primarily on protecting water quality from pollution, not on systems of water allocation. However, water quality still is relevant to groundwater-surface water interactions. Broadly speaking, flow is a part of water quality.[105] Additionally, some aspects of water quality are highly related to groundwater-surface water interactions. For example, streams may become excessively warm if groundwater contributions to streamflow are inadequate.[106]

The *legal* connections between GSAs' activities and water quality law are less direct. Because GSAs will regulate the removal of groundwater from aquifers, rather than discharging pollutants into surface water, their activities generally will not trigger the federal Clean Water Act's prohibitions on unpermitted pollutant discharges.[107] Federal Clean Water Act issues instead are most likely to arise under Section 303, which requires states to set water quality standards and also requires them to establish total maximum daily loads (TMDLs)—which essentially are pollution budgets—for impaired waterways.[108] A state may then use its TMDL as a basis for imposing regulatory controls on stressors that are impairing those waterways, and those additional regulatory controls could include measures to limit groundwater pumping.[109] Nevertheless, whether those additional controls exist and under what laws they arise are matters of state discretion; the Clean Water Act itself does not require states to turn TMDLs into actual controls on groundwater users.[110]

Unlike the Clean Water Act, the Porter-Cologne Act contains many provisions that discuss groundwater. But these provisions tend to focus on protecting groundwater *from* contamination, not on protecting surface waterways from groundwater pumping (for this reason, groundwater recharge projects, which GSAs may pursue, will have Porter-Cologne implications, but those implications are outside the scope of this report).

One exception is California Water Code Section 13149, which pertains specifically to cannabis cultivation. That section requires the SWRCB, working with CDFW, to "adopt principles and guidelines for diversion and use of water for cannabis cultivation in areas where cannabis cultivation may have the potential to substantially affect instream flows." Section 13149 then states that "[t]he principles and guidelines may include requirements that apply to groundwater extractions where the board determines those requirements are reasonably necessary for purposes of this section." Section 13149 does not specifically reference SGMA, but these requirements would authorize constraints that GSPs would then need to address—if the GSP regulates groundwater

CASE EXAMPLE: TEMPERATURE TMDL IN THE SCOTT RIVER

Managing the intersection between groundwater, surface water, water quality, and the public trust is complex. Efforts to fully integrate all of these considerations have been rare, but the Scott River provides a promising example of ongoing efforts.

The Scott River, a major tributary to the lower Klamath River, provides important habitat for steelhead trout, Chinook salmon, and coho salmon (the latter listed as threatened under both the federal and California ESAs). These fish require minimum flows at sufficiently low temperatures. Before reaching the Klamath River through a long, steep gorge, the Scott River flows across Scott Valley, a large montane alluvial basin nestled adjacent to the Marble Mountains. Agricultural groundwater pumping in Scott Valley has reduced the amount of cooler groundwater contributing to the Scott River's baseflow. This has reduced late summer and fall streamflow and raised surface water temperatures, which in turn has affected fish habitat.

In 2005, in recognition of the importance of cool temperatures for salmonids in the river, the North Coast Regional Water Quality Control Board established a sediment and temperature TMDL for the Scott River.[111] Because of the relationship between groundwater input and surface water temperatures, groundwater management has become an essential element of meeting the temperature TMDL requirements. In 2008, a Community Groundwater Study Plan was developed to provide a road map toward better understanding of Scott Valley's groundwater resources, their use, and groundwater connectivity to streams. Ensuring that fish habitat is protected in this river—while also protecting other beneficial uses, including agricultural needs—requires developing a solid understanding of groundwater-surface water hydrology, collecting baseline data, developing models, and examining potential approaches to management, as identified in the Study Plan.

Since then, Siskiyou County developed a groundwater management plan under pre-SGMA legislation. An extensive network of private wells has been monitored monthly for water level fluctuations;[112] UC Cooperative Extension has investigated irrigation rates, consumptive water use, and soil moisture dynamics of alfalfa, the major irrigated crop in Scott Valley; and University of California Davis researchers have developed the Scott Valley Integrated Hydrologic Model (SVIHM) in collaboration with the Scott Valley Groundwater Advisory Committee and local stakeholder groups. The SVIHM provides wet, average, and dry year water budgets, detailed information on groundwater-surface water flow dynamics, and a basis for assessing future management activities. Results indicate that groundwater recharge during winter and spring may enhance groundwater accretion into the Scott River as late as September and October, when Chinook salmon migration into Scott Valley begins. With the help of SVIHM data that demonstrate potential beneficial uses to streams, Scott Valley Irrigation District obtained temporary water rights permits to pilot a UC Davis-led study of managed aquifer recharge on agricultural lands during winter months.

In 2017, Siskiyou County Flood Control and Water Conservation District became the governing GSA for Scott Valley. The GSA may collaborate with the North Coast Regional Water Board on the continued implementation of the TMDL,[113] by implementing some of the proposed groundwater management strategies, which would also address the state's groundwater sustainability planning requirements. The latter require that groundwater-dependent ecosystems do not deteriorate beyond baseline conditions prior to 2015.

A recent lower court decision,[114] currently under appeal, established that groundwater pumping in the Scott Valley constitutes a diversion of water from the Scott River that is subject to the public trust doctrine. The court affirmed the county's responsibility in administering the state's public trust doctrine responsibilities. However, the decision explicitly does not elaborate on the specifics of those responsibilities.

In 1980, the Siskiyou County Court adopted the Order of Determination issued by the SWRCB in the Scott River adjudication. The decree allocates water rights to all surface water users on the Scott River, including those with pre-1914 water rights, appropriative rights, and riparian water rights to the Scott River. The decree also establishes a zone of interconnected groundwater along the Scott River, for which groundwater pumpers have been assigned adjudicated water rights. It is the only adjudication in Northern California for which the rights of groundwater pumpers were adjudicated, and remains notable in that it has made linkages between groundwater and surface water explicit. The adjudicated area is explicitly excluded from the 2014 public trust doctrine court decision and from SGMA implementation. Members of the area have been active partners in the existing Groundwater Advisory Committee and in the implementation of the TMDL action plan, and SVIHM scenarios have identified the area as a potentially important area within the Scott Valley for winter and spring groundwater recharge that could benefit summer and fall Scott River flow contributions from the aquifer.

While the Scott River controversy involves a number of unique physical and institutional elements, its progress in generating new options provides some hope that with sufficient will, creativity, and engagement among key stakeholders, it may be possible to find solutions for seemingly intractable conflicts involving groundwater and surface water.

withdrawals for cannabis cultivation. Otherwise, these requirements do not apply to groundwater withdrawals.

INSTREAM FLOW CRITERIA AND OBJECTIVES

Key Point: *To avoid significant and unreasonable adverse impacts on surface water, minimize risk of litigation, and maximize their GSPs' defensibility, GSAs will need to be aware of instream flow requirements set by the SWRCB and consider them when developing and implementing GSPs.*

Together, the Public Trust Doctrine, the Federal and State Endangered Species Acts, and the Federal Clean Water Act and Porter-Cologne Act form much of the legal basis for protecting surface water quality and quantity in California. However, other laws create similar or additional obligations.

For example, CDFW develops instream flow recommendations (criteria) that identify the instream flows necessary to maintain healthy conditions for aquatic and riparian species. The program is based on the streamflow protection standards under California's Public Resources Code,[115] as well as Fish and Game Code § 5937, which requires maintenance "in good condition" of below-dam fisheries.[116] CDFW communicates its recommendations to the SWRCB, which considers these instream flow needs when making decisions related to water allocation.[117] As of October 2017, instream flow criteria were available for twenty-two streams located throughout California.[118]

The SWRCB can build on non-binding flow criteria, developed by CDFW or through contracted instream flow studies, to set and implement requirements for the quantity, quality, and timing of instream flows needed to protect public trust resources. Unlike flow criteria, these requirements, commonly known as instream flow objectives, have regulatory effect.[119]

The effects of instream flow requirements upon GSAs may be largely indirect. GSA's are unlikely to be primarily and directly responsible for ensuring specific instream flow levels. But instream flow objectives might inform the state's willingness to approve a GSP that would result in significant reductions in the baseflow of surface waterways. Consequently, GSAs may decide to factor these streamflows into their decision making, even if the legal connections between streamflow standards and groundwater management are somewhat uncertain and attenuated.

E. SGMA BASELINE DATE AND THE "GRANDFATHER CLAUSE"

Key Point: *SGMA does not require GSAs to address impacts on surface water that occurred before January 1, 2015. However, SGMA probably does not remove the responsibility of GSAs to address requirements stemming from other laws. Further, this grandfather clause likely does not extend to impacts that were caused by pre-2015 pumping but did not emerge until after January 1, 2015.*

As previously mentioned, SGMA does not require GSAs to address impacts on surface water that occurred before January 1, 2015.[120] This raises several questions. First, the text does not address whether GSAs have obligations under other laws to address pre-2015 impacts to surface water or surface water users, and, if so, the extent of GSAs' obligations. Second, some readers might wonder whether impacts of pre-2015 pumping that do not emerge until after January 1, 2015 must be addressed under SGMA.

We think the stronger answer to the first question is that, while SGMA clearly creates no responsibilities to address pre-2015 impacts, it also does not remove any responsibilities that might be created by other laws. This view is based on a classic principle of statutory interpretation. As the California Supreme Court

has stated, "[r]epeals by implication are not favored, and are recognized only when there is no rational basis for harmonizing two potentially conflicting laws."[121] That principle would be violated if SGMA had impliedly repealed laws that otherwise would have obligated a GSA to address pre-2015 impacts.

The second question asks about impacts caused by pre-2015 pumping. Groundwater flow is an often slow process of seepage through small pore spaces. This means that the impacts of groundwater pumping can be delayed.[122] It is our reading that, in focusing on the timing of *impacts* rather than the timing of groundwater extraction itself, SGMA does not extend its grandfather clause to impacts that were caused by pre-2015 pumping but that did not emerge until on or after January 1, 2015. This means that undesirable results emerging after this date that result from pre-2015 pumping still must be addressed. Consequently, GSAs may need to generate sufficient technical understanding to trace the impacts of pumping, such as through the development of stream depletion functions described in Table 2 on page 16, or develop a defensible heuristic to account for temporal lags in impacts.

Additionally, it is important to remember that while SGMA does not require GSAs to address pre-2015 impacts, this does not mean that GSPs must use a January 1, 2015, baseline. A GSA may decide to set minimum thresholds and measurable objectives to address undesirable results that occurred earlier.[123]

V. Institutional roles in addressing groundwater-surface water interactions

In addition to substantive legal questions, SGMA's recognition of the intersection of groundwater and surface water raises questions about decision-making processes and institutional responsibilities. These questions arise partly because acknowledging the physical connections between groundwater and surface water means bringing groundwater law into contact with elements of surface water law that entities other than GSAs have traditionally implemented. These questions also will arise because, just as SGMA does not resolve every question about substantive law, it also leaves unresolved some key questions about procedures and roles. Finally, these questions will arise because many GSAs must confront complex decisions with limited resources, and drawing upon the institutional capacity of other agencies with complementary responsibility and expertise may be a practical necessity.

In this section, we discuss these issues. We attempt to clarify the roles and responsibilities of GSAs, state and federal agencies, and other entities. We also describe potential options for collaborative solutions where ambiguities remain.

A. ROLES AND RESPONSIBILITIES FOR ENGAGEMENT

Some issues around groundwater-surface water interactions will fall partly within and partly outside of GSAs' expertise. Many of those issues also fall outside GSAs' direct regulatory authority or in regulatory arenas where regulatory authority is shared with other agencies. Questions therefore will arise about the roles and responsibilities of GSAs, state and federal agencies, and other basin stakeholders.

Table 3 summarizes some of the main roles and responsibilities of GSAs and other agencies—particularly DWR and SWRCB—for the legal areas outlined in the sections above. It is important to note that while GSAs are generally not responsible for enforcing these state and federal laws, the validity of a GSP is at risk if GSAs do not adequately address them. Additionally, these responsibilities may represent expanded roles for state agencies. DWR, for example, will need to consider some aspects of water law, like water rights and reasonable use doctrine, that have been historically the domain of the SWRCB (though we see nothing in the statute that prevents DWR from asking the SWRCB for help). If, for example, DWR approves a GSP without considering claims that the GSP is inconsistent with reasonable use doctrine, or that it might unlawfully interfere with existing water rights, the fact that another agency has more expertise on these subject areas is not likely to be an acceptable defense to a legal challenge to that approval.

As Table 3 illustrates, GSAs have a particular set of responsibilities, while other entities have authorities and responsibilities in relevant and related areas. In some cases, responsibilities may be relatively clear: for example, the SWRCB has the authority and responsibility to set instream flow requirements for rivers to protect public trust resources, and is under direction from the Governor to do so in the five streams identified in the California Water Action Plan. But, the SWRCB is not mandated to do so in every stream,[124] and public trust obligations still apply to state and local agencies in their decision making. In other cases, it may not be clear: binding decisions may not have been made yet, or it may not be clear how GSAs can or should translate them into the context of SGMA implementation. Additional or different obligations under these laws may also arise if GSAs decide to take on projects themselves—for example, active groundwater recharge projects, or projects that involve importing and distributing water—rather than functioning solely as planners and regulators.

In particular, there may be an unmet need for additional technical assistance and planning assistance for GSAs. While SGMA assigns DWR the general role of technical assistance provider, many of the topics outlined here more closely align with the

Table 3: Roles and responsibilities of GSAs and other agencies related to groundwater-surface water interactions

SOURCE OF RESPONSIBILITY	GSA	DWR	SWRCB	OTHER STAKEHOLDERS
General SGMA	**Planning and implementation.** Develop and implement GSPs (or alternatives) to avoid undesirable results. Set local standards for what constitutes a significant and unreasonable surface water depletion.	**Assistance and oversight.** Identify basin boundaries; prioritize basins. Evaluate and assess the adequacy of GSPs and their implementation. Provide planning and technical assistance to GSAs.	**Enforcement.** Help DWR determine when a GSP or its implementation is inadequate. If so, intervene.	GSAs are required to engage and consider the interests of a wide range of other stakeholders throughout GSP planning and implementation.
Reasonable use	Define and avoid locally undesirable results, including significant and unreasonable surface water depletions. Be cognizant of legal precedents for what is reasonable and unreasonable. Avoid authorizing unreasonable uses.	In evaluating GSPs, consider whether GSPs allocate water (e.g., through groundwater extraction allocations) consistent with reasonable use requirement.	Enforce reasonable use requirement.	Water users bear primary responsibility for avoiding unreasonable uses; a wide variety of stakeholders may bring administrative claims or lawsuits against allegedly unreasonable uses.
Water rights	Develop GSPs with a general understanding of groundwater and surface water rights, and develop actions that are generally consistent with those rights.	In evaluating GSPs, consider their impacts on water rights. Protect DWR's own water rights.	Enforce water rights. Provide compliance assistance as feasible.	Other water right holders and stakeholders: Provide input and feedback on undesirable results and how to avoid them; protect their own water rights.
Public Trust Doctrine	Consider how GSPs will meet public trust-related minimum instream flow requirements, if applicable, and how to provide other feasible protections of public trust resources.	In evaluating GSPs, consider whether they protect public trust resources to the extent feasible.	Set and enforce public trust-based instream flow requirements. Provide compliance assistance as feasible.	CDFW: Develop instream flow recommendations. Federal wildlife agencies: Inform instream flow requirements. All wildlife agencies: Monitor implementation.

SOURCE OF RESPONSIBILITY	GSA	DWR	SWRCB	OTHER STAKEHOLDERS
Endangered Species Act	Develop GSPs in a way that avoids management actions that are likely to result in further take of listed species.	General evaluation and assessment of GSPs.	Set instream flow requirements to protect listed species. Provide compliance assistance as feasible.	USFWS, NOAA Fisheries: Produce biological opinions, review and approve habitat conservation plans, designate critical habitat, issue incidental take authorizations and permits, enforce federal ESA. CDFW: review habitat conservation plans, issue incidental take authorizations and permits, enforce CESA
Clean Water Act	Consider how groundwater management may impact water quality standards meant to protect beneficial uses of interconnected surface water and address / prevent significant and unreasonable impacts.	General evaluation and assessment of GSPs.	Set, implement, and enforce water quality standards, including through instream flow requirements. Provide compliance assistance as feasible.	Regional Water Quality Control Boards: Implement, and enforce water quality standards. US Environmental Protecton Agency: support and oversee state enforcement.

expertise of the SWRCB and other agencies. DWR and the SWRCB may need to work together to ensure that GSAs have access to the expertise they need, and to make sure that roles are sufficiently clear.

B. APPROACHES FOR ENGAGEMENT AROUND GROUNDWATER-SURFACE WATER INTERACTIONS

As the previous section attempts to convey, GSAs do not operate in a vacuum. Their purview for achieving sustainability is closely tied to the mandates of other local, state, and federal entities, as well as consideration of the interests of a broad range of stakeholders who are specifically called out in the legislation. This requires GSAs to make decisions about how to work with other agencies.

Engaging with relevant stakeholders is not just a potentially beneficial idea for GSAs: as outlined in SGMA, GSAs must engage with relevant stakeholders. SGMA requires GSAs to "consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans."[125] The relevant interest groups include, but are not limited to, holders of overlying groundwater rights (including agricultural users and domestic well owners); municipal well operators and public water systems; local land use planning agencies; environmental users of groundwater; surface water users (if groundwater and surface water are hydrologically connected); the federal government; California Native American tribes; disadvantaged communities; and entities monitoring and reporting groundwater elevations. At the same time, other entities also have motivation to engage proactively with GSAs. Doing so may help them ensure that their interests are represented and their issues are addressed.

GSAs will need to weigh the benefits and costs of different potential approaches for engagement with other entities around groundwater-surface water interactions under SGMA. Below, we propose a collaborative approach to groundwater-surface water management, and discuss the potential benefits, as well as risks and costs, associated with this approach. In weighing approaches to collaboration, GSAs may need to make risk- and effort-based management decisions. In Table 4, we outline potential benefits, costs, and risks to help frame deliberation about how GSAs might

CASE EXAMPLE: RECONNECTING THE DISCONNECTED COSUMNES RIVER THROUGH COLLABORATIVE EFFORTS

The Cosumnes River, located in Northern California on the western side of the Sierra Nevada and flowing into the Mokelumne River in the Sacramento-San Joaquin Delta, is one of the last undammed rivers flowing from the Sierra Nevada. The river has ecological and cultural values and supports endangered Chinook salmon. As a result of decades of extensive groundwater pumping for agriculture and urban growth, significant reaches of the Cosumnes River are now hydraulically disconnected from the underlying aquifer.[126] Because these impacts on groundwater-surface water connections largely occurred before SGMA's baseline date of January 1, 2015, SGMA does not *require* the local GSA to address them.

However, the Cosumnes Coalition, a group of local stakeholders, including the American River Conservancy, Cosumnes Culture and WaterWays, the Fishery Foundation of California, Landmark Environmental, and Trout Unlimited, has been working with USFWS, CDFW, US Bureau of Land Management, and UC Davis researchers on plans to recharge groundwater via floodplain restoration in the Cosumnes basin.[127]

Despite the fact that SGMA does not *require* this action, the coalition is utilizing SGMA as a way to promote multi-benefit natural infrastructure projects that could ultimately reconnect the aquifer and the river. In this case, SGMA may provide an *opportunity* for stakeholders to come together for the purpose of furthering environmental goals that center on restoring the river's baseflow. Whether the efforts will ultimately be successful remains to be seen.

approach the issues at stake, and whether and how entities other than the GSA itself might become involved.

As Table 4 illustrates, there are distinct benefits to taking a collaborative approach to addressing conflicts and issues that may arise with regard to groundwater-surface water interactions.

First, conflicts between groundwater and surface water users may be resolved through the process of forging mutually advantageous institutional relationships. For example, an institution that is primarily a surface water user may provide institutional support and funding to ensure better groundwater planning. So, for example, a downstream surface water user that relies at least partly on groundwater recharge for its supplies may have a strong incentive to help upstream GSAs plan (see, for example, the case example describing the Ukiah Valley Groundwater Basin GSA on page 39)—and may also have the financial resources to support such assistance. The resulting collaborative process may involve going beyond baseline legal requirements in order to resolve conflicts between groundwater users, surface water users, and environmental uses of water in a given basin.

Second and relatedly, multi-stakeholder processes can lead to creative and possibly win-win solutions. For example, stakeholders can use strategies associated with conjunctive use, the practice of coordinating use of surface water and groundwater.[128] Such strategies include intentional groundwater recharge; the use of groundwater aquifers for water storage; in-lieu recharge; and agricultural and stormwater recharge programs to directly or indirectly protect or increase baseflow or water levels that support GDEs. Stakeholders also might allocate money to stormwater management projects designed to augment water supplies and alleviate stress on groundwater and surface water. Alternatively, or additionally, groundwater markets may be a potential strategy for allocating the burdens of water use reductions (although water markets come with many considerations).[129]

While these processes are promising, turning them into legally binding arrangements can be tricky. For example, so-called 'physical solutions' can be developed within or outside of an adjudication.[130] Participants in a multi-stakeholder process can use contracts to memorialize their agreements, and if the agreement emerges out of a legal proceeding, the parties can seek judicial approval of a settlement. Both contractual and settlement agreements can be quite creative and need not exactly track California water law, so long as all the affected parties are in agreement. The challenges to these creative deals tend to arise if there are affected holdouts who do not agree to the deal. The parties to a contract cannot negotiate away the legal rights of a third party, and while judges have some equitable discretion to impose a solution even on a reluctant party, that discretion does not allow wholesale abrogation of traditional water rights.[131] A judge also cannot exercise that discretion until judicial proceedings are complete, and that can take years.

While collaborative, multi-stakeholder processes are challenging, SGMA does give GSAs a jump-start toward initiating such projects. The requirements for participation by multiple agencies ensure that several key players will be engaged with the process of GSA approval. The involvement of the SWRCB also means that an agency with regulatory authority over surface water rights will be involved. Consequently, if a GSA wants to link its GSP with a broader set of agreements involving surface water rights and environmental protection, a crucial participant will already be at the table. The fact that SGMA mandates the participation of at least three agencies in groundwater management—the GSA, DWR, and the SWRCB—and as a practical matter may require the participation of many more, will make management of groundwater-surface water interactions institutionally complex. But with the challenges of complexity will come opportunities to turn GSP development and implementation into an inclusive process for addressing a wide variety of water management issues.

Table 4: Proposed approach for collaboration between GSAs and other entities, weighing benefits and costs

	GSA management approach	Potential benefits	Potential costs or risks
Overarching approach	GSA works collaboratively with a range of stakeholders in order to avoid significant and unreasonable adverse impacts to interconnected surface water uses.	Potentially durable decisions, equitable outcomes, and perception of legitimacy. Access to stakeholder data and expertise.	Potentially high direct or upfront costs (including time as well as money)
Approach to monitoring and modeling	GSA robustly monitors and models groundwater-surface water interactions and related impacts in the groundwater basin. GSA collaborates with other experts and stakeholders conducting monitoring and modeling.	Potential for a defensible, durable GSP. Ability to base decisions on data. Potential for avoiding surprises of more stringent restrictions in the future. Access to stakeholder data and expertise.	May run up against technical limitations. May be resource intensive.
Approach to navigating legal context	GSA assumes that a variety of laws, including but not limited to SGMA, have important implications for addressing groundwater- surface water interactions.	Potentially decreased risk of disruptive intervention by state or federal regulators.	Potentially difficult to navigate laws. Legal expertise may be expensive.
Approach to stakeholder engagement	GSA assumes that many different interests depend on groundwater, and that the GSA has the legal responsibility and/or discretion and the societal obligation to advance those interests, as a lead agency (catalyst) or as a partner agency among a multitude of local, regional, state, and federal agencies. GSA assumes that a range of stakeholders have interests in impacts to surface waters, and those stakeholders have a legitimate claim to access the decision-making process.	Potentially decreased risk of costly and divisive lawsuits from other parties. Potential for durable, equitable decisions. Potential for a defensible, durable GSP.	Risk of near term decision failure. Collaboration may increase the chance of paralysis. Risk of catalyzing objections from surface water stakeholders. Potentially resource intensive.
Approach to decision making process	GSA decision-making processes are proactively inclusive, soliciting input (1) from environmental regulators on endangered species, water quality, and public trust flow needs in the basin; (2) from surface water users on their needs and concerns; and (3) from groundwater users. GSA uses professional facilitators to identify goals and arrive at a thoughtful balance between groundwater use and surface water protection in the basin.	Proactive communication is likely to ensure that relevant interests are voiced, understood, and can be addressed satisfactorily.	Potentially high upfront costs. Potential for decision failure.

CASE EXAMPLE: GSA COLLABORATION IN THE UKIAH VALLEY GROUNDWATER BASIN SHOWS THAT AGENCIES ARE READY FOR SUSTAINABLE GROUNDWATER MANAGEMENT

The Ukiah Valley Groundwater Basin is a medium-priority basin located in southeastern Mendocino County, one of several basins adjacent to the Russian River. The Russian River includes domestic, municipal, and agricultural water users as well as multiple ESA-listed salmonid species. Significant groundwater-surface water interactions occur within the Ukiah Valley basin. Thus, local surface water users and managers, as well as the environmental community, have a stake in SGMA implementation.

The Ukiah Valley Basin GSA is a Joint Powers Authority (JPA) that consists of the County of Mendocino, the City of Ukiah, the Russian River Flood Control District, the Upper Russian River Water District, and tribal and agricultural representatives. The GSA is initiating the preparation of a groundwater sustainability plan, whichwill need to evaluate the interaction of groundwater use with in-stream flows and surface water rights.

On the technical side, water balance models for short-term and long-term changes to the aquifer and interconnectivity impacts are being developed through a partnership between local agencies, the State Water Resources Control Board, and the US Geological Survey. A consultant retained by the GSA also is developing a discretized land and water use model. The latter model will identify areas in the surface water system that are vulnerable to potential undesirable results from groundwater pumping. These models will provide a reasonable dataset for analysis and policy making in the GSP in a timely and cost-effective way.

On the social and institutional side, agencies responsible for groundwater and surface water use have collaborated with stakeholders through a transparent public process of monthly meetings. The GSA has conducted a lengthy process of outreach to stakeholders. It also used a professional facilitator, who was funded by a DWR grant, in the GSA formation process. Challenges in the formation process were addressed through a consensus building approach rather than majority rule. Moving forward, if members of the GSA have concerns about a path forward or about a long-term project identified in the GSP, all of the members will work together to develop a solution that all of the agencies can respect and allow.

In the Ukiah Valley Groundwater Basin, groundwater and surface water—and thus the interests of groundwater and surface water users— are closely linked. This means that collaboration between different types of water users is essential. Despite their multiple and sometimes differing interests, the JPA member agencies that are a part of the Ukiah Valley Basin GSA agree that SGMA is the start of a lengthy process of collaboration which, in the long run, hopefully puts agencies on the same page. Future sustainability requires working together and finding ways to address hard questions around the intersections of managing groundwater and surface water.

VI. Conclusion

By acknowledging the connection between groundwater and surface water systems, SGMA took an important step for the future of integrative water management in California. But that step also generates many challenges and questions. Some of the challenges will arise from the need to develop a technical understanding of groundwater-surface water interactions, and others will arise from the many unresolved questions at the intersection of groundwater and surface water rights and other principles of state and federal law.

In this report, we have attempted to identify these questions and, to the extent that is possible to do so, to provide answers. Many of our answers are not definitive, but we hope they will help GSAs, state agencies, and others manage uncertainty as they navigate the challenges of sustainable groundwater management. We also hope our analysis will help GSAs and other stakeholders that choose to use SGMA compliance as an opportunity for collaboratively developing broad responses to a range of surface and groundwater management challenges.

Abbreviations and acronyms used in this report

AB Assembly Bill

BIA Bureau of Indian Affairs

BMP Best Management Practice

CESA California Endangered Species Act

CDFW California Department of Fish and Wildlife

DWR California Department of Water Resources

ESA Federal Endangered Species Act

HCP Habitat Conservation Plan

JPA Joint Powers Authority

GDE Groundwater Dependent Ecosystem

GSA Groundwater Sustainability Agency

GSP Groundwater Sustainability Plan

NOAA Fisheries National Oceanic and Atmospheric Administration Fisheries Service

SB Senate Bill

SGMA Sustainable Groundwater Management Act

SVIHM Scott Valley Integrated Hydrologic Model

SWRCB State Water Resources Control Board

TMDL Total Maximum Daily Load

UC University of California

USBR United States Bureau of Reclamation

USFWS United States Fish and Wildlife Service

USGS United States Geological Survey

Acknowledgments

This report draws on the insights of the experts who participated in the workshop series, augmented by substantial additional research by the author team. Responsibility for the report's content lies with the authors alone.

The following individuals participated in the workshop series:

Tamara Alaniz (Russian River Flood Control District)
Sam Boland-Brien (SWRCB)
Helen Dahlke (UC Davis)
Andrew Fisher (UC Santa Cruz)
Graham Fogg (UC Water)
Tim Godwin (DWR)
Vicki Kretsinger Grabert (Luhdorff & Scalmanini, Consulting Engineers)
Maurice Hall (Environmental Defense Fund)
Jay Jasperse (Sonoma County Water Agency)
Nicole Kuenzi (SWRCB)
Sandi Matsumoto (The Nature Conservancy)
Russ McGlothlin (Brownstein Hyatt Farber Schreck)
Mike Myatt (Water Foundation)
Deborah Ores (Community Water Center)
Richard Roos-Collins (Water and Power Law Group PC)
Stephen Springhorn (DWR)
DerrikWilliams (HydroMetrics)

We are grateful to all participants for sharing their time and expertise, and for their willingness to engage in open discussion of this complex and unsettled topic. We also specifically thank Tamara Alaniz, Jay Jasperse, and Russ McGlothlin for helping to structure workshop content and contributing presentations during the workshops.

The workshops were organized by Alida Cantor, Michael Kiparsky, Nell Green Nylen, Holly Doremus, Dave Owen, and Thomas Harter. Luke Sherman provided valuable organizational assistance. Special thanks to Holly Doremus for formative conceptual input and contributions to the workshops.

This work is supported by the University of California Office of the President (UCOP) through the UC Water Security and Sustainability Research Initiative (UCOP Grant No. 13941).

Review

The authors solicited review of a draft version of this report from workshop participants, as well as others with a range of perspectives and technical expertise. Review comments and the draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Tamara Alaniz
Russian River Flood Control District

Reed Benson
University of New Mexico

Thad Bettner
Glenn-Colusa Irrigation District

Timothy Godwin
California Department of Water Resources

Tyler Hatch
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Nicole Kuenzi
California State Water Resources Control Board

Sandi Matsumoto
The Nature Conservancy

Roderick Walston
Best Best & Krieger, LLP

Derrik Williams
HydroMetrics Water Resources Inc.

All review comments were carefully considered. We are grateful for the efforts of reviewers, whose constructive comments and suggestions have helped us to improve the report. Reviewers were not asked to endorse the report's conclusions or recommendations, and reviewers did not see the final draft of the report before its release. Naturally, responsibility for the final content of this report rests entirely with the authors, and any errors are our own.

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About CLEE

The Wheeler Water Institute develops interdisciplinary solutions to ensure clean water for California. Established in 2012 at the Center for Law, Energy & the Environment (CLEE) at Berkeley Law, the Institute conducts projects at the intersection of law, policy, and science.

The Center for Law, Energy & the Environment (CLEE) at Berkeley Law educates the next generation of environmental leaders and develops policy solutions to pressing environmental and energy issues. CLEE's current initiatives focus on reducing greenhouse gas emissions, advancing the transition to renewable energy, and ensuring clean water for California's future.

The UC Water Security and Sustainability Research Initiative is focused on strategic research to build the knowledge base for better water resources management. UC Water applies innovative science, technology, and implementation strategies to surface water and groundwater management.

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33. *See City of Barstow v. Mojave Water Agency*, 23 Cal. 4th 1224, 1240 (2000); Tehachapi-Cummings Cnty. Water Dist., v. Armstrong, 49 Cal. App. 3d 992, 1001 (1975).

34. *See City of Pasadena v. City of Alhambra*, 33 Cal. 2d. 908, 925–26 (1949).

35. *See City of Santa Maria v. Adam*, 211 Cal. App. 4th 266, 297 (2012).

36. *See City of Los Angeles v. City of San Fernando*, 14 Cal. 3d. 199, 210–11, 251 (1975).

37. *Agua Caliente Band of Cahuilla Indians v. Coachella Valley Water Dist*., 849 F.3d 126217 (9th Cir. 2017).

38. Cal. Water Code § 1200.

39. Existing groundwater management plans developed under this previous legislation are considered in effect until SGMA-approved groundwater sustainability plans (GSPs) are developed; however, as of 2015, new groundwater management plans cannot be adopted in medium- and high- priority basins, although they may still be adopted in very low- or low- priority basins. For more information see DWR, "Developing a Groundwater Management Plan" http://www.water.ca.gov/groundwater/groundwater_management/developingGWMP.cfm.

40. Nelson, R. (2011). Uncommon innovation: Developments in groundwater management planning in California. Woods Institute for the Environment, Stanford University.

41. *See* Sax (2002), endnote 1; *see also* Sax, J.L. (2002). Review of the Laws Establishing the SWRCB's Permitting Authority over Appropriations of Groundwater Classified as Subterranean Streams and the SWRCB's Implementation of Those Laws. California State Water Resources Control Board Report No. 0-076-300-0.

42. In the Matter of Determination of the Rights of the Various Claimants to the Waters of Scott River Stream System, Except Rights to Water of Shackleford Creek, French Creek, and all Streams Tributary to Scott River Downstream from the U.S. Geological Survey Gaging Station, in Siskiyou County, California, Jan. 16, 1980, available at https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/judgments/docs/scottriver_jd.pdf

43. *See Hudson v. Dailey*, 156 Cal. 617 (1909).

44. *See City of Lodi v. E. Bay Mun. Util. Dist.*, 7 Cal. 2d 316, 337–340 (1936); *Peabody v. City of Vallejo*, 2 Cal. 2d 351, 375 (1935); *Miller v. Bay Cities Water Co.*, 157 Cal. 256. 279–80 (1910); *McClintock v. Hudson*, 141 Cal. 275, 281 (1903).

45. *See, e.g.*, *City of Lodi v. E. Bay Mun. Util. Dist*., 7 Cal. 2d 316, 337–340 (1936); *Peabody v. City of Vallejo*, 2 Cal. 2d 351, 375 (1935).

46. Leahy, T.C. (2016). Desperate Times Call for Sensible Measures: The Making of the California Sustainable Groundwater Management Act. *Golden Gate Univ. Envtl. L. J.* 9, 5—40.

47. Cal. Water Code § 113.

48. Cal. Water Code § 10727.2.

49. Cal. Water Code § 10721(x).

50. Cal. Code Regs. tit. 23, § 351(o).

51. Cal. Water Code § 10727.2(b)(4).

52. Cal. Water Code § 10720.5.

53. Cal. Water Code § 10727.2.

54. Cal. Water Code § 10933(b)(8).

55. The Nature Conservancy. (2016). Groundwater and Stream Interaction in California's Central Valley: Insights for Sustainable Groundwater Management. Available at: http://scienceforconservation.org/dl/GroundwaterStreamInteraction_2016.pdf

56. *See* Moran (2016), endnote 25, and generally, Cantor, A, M. Kiparsky, R. Kennedy, S Hubbard, R. Bales, L. Cano Pecharroman, K Guivetchi, C. McCready, and G. Darling. 2018. Data for Water Decision Making: Informing the Implementation of California's Open and Transparent Water Data Act through Research and Engagement. Center for Law, Energy & the Environment, UC Berkeley School of Law, Berkeley, CA. 54 pp. Available at:https://doi.org/10.15779/J28H01 or law.berkeley.edu/datafordecisions

57. California Department of Water Resources, Sustainable Groundwater Management Program. July 2016. Groundwater Sustainability Plan (GSP) Emergency Regulations Guide.

58. Cal. Code Regs. tit. 23, § 350.

59. Cal. Code Regs. tit. 23, § 354.28.

60. Cal. Code Regs. tit. 23, § 354.28(c)(6).

61. Cal. Code Regs. tit. 23, § 354.28.

62. California Department of Water Resources, Sustainable Groundwater Management Program. November 2017. Draft Sustainable Management Criteria BMP.

63. *In re* Waters *of Long Valley Creek Stream System,* 25 Cal. 3d 339, 354 (1979).

64. *See, e.g., Light v. State Water Resources Control Bd.*, 226 Cal. App. 4th 1463, 1482–87 (2014) (affirming the SWRCB's authority to enact reasonable use regulations).

65. *City of Barstow v. Mojave Water Agency*, 23 Cal. 4th 1224, 1241–43 (2000) (citing *Peabody v. City of Vallejo*, 2 Cal.2d 351, 383 (1935); McGlothlin, R. M., & Acos, J. S. (2015). The Golden Rule of Water Management. *Golden Gate U. Envtl. LJ*, *9*, 109—132 (describing SGMA as a reflection of the reasonable use doctrine).

66. Neuman, J. C. (1998). Beneficial use, waste, and forfeiture: The inefficient search for efficiency in western water use. *Environmental Law*, 28, 919–996.

67. *Joslin v. Marin Mun. Water Dist.,* 67 Cal. 2d 132, 140 (1967); *see also Tulare Irr. Dist. v. Lindsay–Strathmore Irr. Dist.,* 3 Cal.2d 489, 567 (1935).

68. *See, e.g., Light*, 226 Cal. App. 4th at 1482–87; *Imperial Irr. Dist. v. State Water Resources Control Bd.*, 225 Cal. App. 3d 548, 573 (1990) ("All things must end, even in the field of water law. It is time to recognize that this law is in flux.").

69. Cal. Water Code § 10720.5.

70. *State Dept. of Public Health v. Sup. Ct.*, 60 Cal. 4th 940, 955 (2015).

71. Cal. Water Code § 1200.

72. U.S. Const., amend. V; Cal. Const. art. I, § 19.

73. *Murr v. United States*, 137 S.Ct. 1933, 1942 (2017).

74. *See City of San Bernardino v. City of Riverside*, 198 P. 784, 792 (Cal. 1921).

75. Cal. Water Code § 10720.5.

76. *Lingle v. Chevron U.S.A. Inc.*, 544 U.S. 528, 538 (2005) (quoting *Andrus v. Allard*, 444 U.S. 51, 65 (1979) and *Pa. Coal Co. v. Mahon*, 260 U.S. 393, 413 (1922)); *Cal. Bldg. Ind. Ass'n v. City of San Jose*, 351 P.3d 974, 995 (2015).

77. *Light v. State Water Resources Control Bd*., 173 Cal. Rptr. 3d 200, 217 (2015); Gray, B. E. (2002). The property right in water. *Hastings W.-Nw J. Envt'l L. & Pol'y*, *9*.

78. *Allegretti & Co. v. Cnty. of Imperial*, 42 Cal. Rptr. 3d 122 (Ct. App. 2006). Owen, D. (2015). Taking Groundwater, *Wash. U. L. Rev.* 91, 253. The *Penn Central* test asks courts to consider the diminution in value caused by the regulatory restriction, the nature of the government action, and the extent of interference with investment-backed expectations.

79. Krier, J. E., & Sterk, S. E. (2016). An Empirical Study of Implicit Takings. *William & Mary Law Review*, *58*(1), 35–95 (documenting the minimal success of *Penn Central* claims).

80. Owen, D. (2013). Taking groundwater. *Wash. UL Rev.*, *91*, 253—307.

81. *Nat'l Audubon Soc'y v. Sup. Ct. of Alpine Cnty*, 33 Cal. 3d 419, 434–438.

82. *Id.*

83. Order after Hearing on Cross-Motions for Judgment on the Pleadings, Envtl. L. Found. v. Ca. State Water Resources Control Bd., Case No.: 34-2010-80000583 (Superior Ct. of Ca., County of Sacramento, July 15, 2014).

84. We make this assumption because courts have already reached similar outcomes for surface water management. In the Mono Lake case, for example, the Court held that the public trust doctrine creates obligations above and beyond those set by statutory law, even though the statutory laws applicable to surface water already were extensive.

85. *Nat'l Audubon Soc'y*, 33 Cal. 3d at 426.

86. *Id.* (stating that the doctrine "bars DWP or any other party from claiming a vested right to divert waters once it becomes clear that such diversions harm the interests protected by the public trust").

87. *Id.* at 446.

88. 16 U.S.C. § 1536.

89. 16 U.S.C. § 1538.

90. *See Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687 (1995) (upholding this definition).

91. While the statute uses the word person, court decisions have assumed and, more recently, held that the prohibition extends to government agencies. *Kern County Water Agency v. Watershed Enforcers*, 185 Cal. App. 4th 969 (2010).

92. Cal. Fish & Game Code §§ 2080, 2080.1.

93. *Babbitt v. Sweet Home*, 515 U.S. 687.

94. Cal. Fish & Game Code § 86. CESA's inclusion of incidental take provisions also suggest that an action can cause a take even if the killing of listed species was just an incidental consequence of the action and not its purpose.

95. *See, e.g., The Aransas Project v. Shaw*, 775 F.3d 641 (5th Cir. 2014) (declining to hold Texas water districts liable for withdrawals that allegedly caused a downstream die-off of whooping cranes).

96. *E.g. Strahan v. Coxe*, 127 F.3d 155, 165 (1st Cir. 1997).

97. *E.g. The Aransas Project*, 775 F.3d at 659–60; *Loggerhead Turtle v. County Council of Volusia County, Florida*, 92 F. Supp. 2d 1296 (M.D. Fla. 2000).

98. *See* 16 U.S.C. § 1539.

99. *See* United States Fish and Wildlife Service, Candidate Conservation/ Candidate Conservation Agreements, https://www.fws.gov/endangered/what-we-do/cca.html.

100. Cal. Public Resources Code §§ 21000–21177; Cal Code Regs. tit. 14, §§ 15000–15387

101. Cal. Water Code § 10728.6.

102. *Id.*

103. Within SGMA, undesirable water quality results are explicitly addressed in two specific provisions: Undesirable Results 3 (Significant and unreasonable seawater intrusion) and 4 (Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies). Cal Water Code § 10721(x)(3), (4).

104. *See, e.g.,* 33 U.S.C. § 1313(c)(2)(A); Cal. Water Code § 12581.

105. *PUD No. 1 of Jefferson Cnty. v. Wash. Dept. of Ecology*, 511 U.S. 700, 719 (1994) (describing a distinction between water quality and water quantity as "artificial").

106. Temperature issues are different in different basins. While groundwater temperature tends to be relatively constant temporally with a relatively small range of fluctuations, groundwater temperatures can vary with relation to streamflow temperatures and streamflow conditions. That is, groundwater may be cooler or warmer than surface water temperatures depending upon the season and the surface water conditions. The issue of groundwater contribution to surface water temperature thus manifests in different ways in different basins at different times of year.

107. *See* 33 U.S.C. § 1311 (prohibiting unpermitted discharges).

108. 33 U.S.C. § 1313.

109. *See, e.g., Pronsolino v. Nastri*, 291 F.3d 1123, 1130 (9th Cir. 2002) (describing allegedly costly restrictions imposed in response to a TMDL).

110. *Id.* at 1140.

111. Scott River TMDL, California Water Boards North Coast R1, https://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/scott_river/ (last updated Nov. 1, 2017).

112. For more information, *see* UC Davis. UC Groundwater Cooperative Extension Program: Research Projects. http://groundwater.ucdavis.edu/Research/ (last visited Feb. 23, 2018).

113. California Regional Water Quality Control Board, North Coast Region. Order No. R1-2017-0031: Scott River TMDL Conditional Waiver of Waste Discharge Requirements. https://www.waterboards.ca.gov/northcoast/board_info/board_meetings/06_2017/5/170601_ScottWaiver_Draft.pdf

114. *Envtl. Law Found. v. State Water Resources Control Bd.*, No. 34-2010-80000583 (Cal. Super. Ct. July 15, 2014)

115. Cal. Public Resources Code § § 10000–10005.

116. Cal. Fish and Game Code § 5937.

117. Cal. Public Resources Code § § 10000–10005.

118. California Department of Fish and Wildlife. CDFW Instream Flow Recommendations Map. https://www.wildlife.ca.gov/Conservation/Watersheds/Instream-Flow/Recommendations (last visited Dec. 13, 2017).

119. SWRCB. Development of Flow Objectives. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/flow_objectives/index.shtml (last updated Aug. 31, 2016).

Delta Stewardship Council (2014). Recommendations for Determining Regional Instream Flow Criteria for Priority Tributaries to the Sacramento-San Joaquin Delta. Available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/flow_objectives/docs/delta_science_rpt_022014.pdf.

120. Cal. Water Code § 10727.2(b)(4).

121. *Fuentes v. Workers Comp. Appeals Bd.*, 547 P.2d 449, 453 (Cal. 1973).

122. *See* Alley, Reilly & Franke (1999), endnote 5.

123. California Department of Water Resources, Sustainable Groundwater Management Program. November 2017. Draft Sustainable Management Criteria BMP. In particular, *see* Figure 8: Example of Depletion of Interconnected Surface Water Minimum Threshold, p. 17.

124. The 2009 Delta Reform Act required the SWRCB to rapidly "develop new flow criteria for the Delta ecosystem necessary to protect public trust resources" and to develop "a prioritized schedule and estimate of costs to complete instream flow studies for the Delta and for high priority rivers and streams in the Delta watershed" by 2012, and for other major rivers and streams by 2018. Cal. Water Code §§ 85056, 85057.

125. Cal. Water Code § 10723.2

126. Fleckenstein, J., Anderson, M., Fogg, G., & Mount, J. (2004). Managing surface water-groundwater to restore fall flows in the Cosumnes River. *Journal of Water Resources Planning and Management*, *130*(4), 301-310.

127. Johnson, M. (2017). Cosumnes River Provides Model for Floodplain Restoration in California. News Deeply. Apr. 19, 2017. https://www.newsdeeply.com/water/articles/2017/04/19/cosumnes-river-provides-model-for-floodplain-restoration-in-california.

128. Thompson Jr, B. H. (2010). Beyond connections: pursuing multidimensional conjunctive management. *Idaho L. Rev.*, *47*, 273–324.

129. *See* Green Nylen et al (2017), endnote 32.

130. Note that, shortly after SGMA was passed, the legislature imposed a set of requirements for future comprehensive groundwater adjudications to ensure that they are consistent with sustainable groundwater management under SGMA. *See* Cal. Water Code §§ 10720.8, 10737.2, 10737.8; *see also* Cal. Civ Proc. Code §§ 830–852 (establishing new rules for comprehensive groundwater adjudications).

131. *See City of Barstow v. Mojave Water Agency*, 5 P.3d 853, 858 (2000) ("We granted review to determine whether a trial court may definitively resolve water right priorities in an overdrafted basin with a "physical solution" that relies on the equitable apportionment doctrine but does not consider the affected owners' legal water rights in the basin. We conclude it may not.").

EXHIBIT C

APPLIED ECOLOGY

Agriculture is a major source of NO_x pollution in California

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Nitrogen oxides (NO_x = NO + NO_2) are a primary component of air pollution—a leading cause of premature death in humans and biodiversity declines worldwide. Although regulatory policies in California have successfully limited transportation sources of NO_x pollution, several of the United States' worst–air quality districts remain in rural regions of the state. Site-based findings suggest that NO_x emissions from California's agricultural soils could contribute to air quality issues; however, a statewide estimate is hitherto lacking. We show that agricultural soils are a dominant source of NO_x pollution in California, with especially high soil NO_x emissions from the state's Central Valley region. We base our conclusion on two independent approaches: (i) a bottom-up spatial model of soil NO_x emissions and (ii) top-down airborne observations of atmospheric NO_x concentrations over the San Joaquin Valley. These approaches point to a large, overlooked NO_x source from cropland soil, which is estimated to increase the NO_x budget by 20 to 51%. These estimates are consistent with previous studies of point-scale measurements of NO_x emissions from the soil. Our results highlight opportunities to limit NO_x emissions from agriculture by investing in management practices that will bring co-benefits to the economy, ecosystems, and human health in rural areas of California.

INTRODUCTION

Nitrogen oxide (NO_x = NO + NO_2) gases are among the most important components of air pollution, which, according to the World Health Organization, is responsible for one in eight premature deaths worldwide (*1*). These nitrogen (N) gases have been linked to upper respiratory disease, asthma, cancer, birth defects, cardiovascular disease, and sudden infant death syndrome (*2*, *3*). Global studies have pointed to similarities in the magnitude of NO_x emissions from fossil fuel combustion and soil, with the largest soil emissions from regions with heavy N fertilizer applications (*4*–*7*). Despite the significance of soil microbial NO_x emissions at the global scale, policies have focused largely on limiting NO_x from mobile and stationary fossil fuel sources (*8*, *9*). Where agriculture is an important source of NO_x, strategies to reduce nonpoint emissions will need to incorporate soil management approaches and policies that are fundamentally different from fossil fuel sources.

California is considered the world's sixth largest economy in terms of gross national product and supports 12.2% of the U.S. food economy (*10*). The state has instituted policies to reduce NO_x pollution from fossil fuel sources, resulting in NO_x declining by 9% per year in Los Angeles, San Francisco, and Sacramento over the period of 2005 to 2008 (*11*). Recent findings have suggested that agriculture is one of the dominant sources of NO_x in the United States, particularly in the midwest region, where fertilizer inputs are substantial (*6*, *12*). In California, local field measurements have similarly ascribed high NO_x emissions to agricultural soil (*13*). Matson *et al.* (*14*) provided some of the first evidence of substantial NO_x production from agricultural soils in California's Central Valley; however, a statewide assessment, which is needed to drive new policies for NO_x pollution, is hitherto lacking. The California Air Resources Board (CARB) estimates that ~3.8% of the state's NO_x budget can be attributed to cropland soils, but these estimates are based on data limited to farms located within 200 km of Sacramento and miss many of the most heavily fertilized areas in the state (*15*). Moreover, CARB does not include these estimated emissions in their official statewide database for air quality modeling (*16*).

Here, we provide the first large scale quantification of soil NO_x emissions for California through two different approaches: integrative "bottom up" spatial modeling and "top down" airborne NO_x measurements. This two pronged approach allows us to independently examine the contribution of biogenic NO_x emissions in California while comparing these estimates to local empirical data. Our overarching hypothesis is that biogenic emissions of NO_x from agricultural areas are much higher than we used to believe and could be a major source of atmospheric NO_x statewide. Alternatively, if agricultural sources are of minor significance, then we would expect to find uniformly low emissions throughout natural and agricultural ecosystems.

RESULTS AND DISCUSSION

Our combined bottom up and top down estimates uniformly point to high NO_x emissions from California's agricultural soil, revealing a significant unrecognized source of N pollution statewide. Our bottom up model reveals that 161,100 metric tons of NO_x N $year^{-1}$ is emitted from California soil with croplands accounting for 79% of total emissions. When combined with data on existing mobile and stationary fossil fuel sources (*16*), our results indicate that fertilized croplands account for 20 to 32% of total NO_x N emissions from all sectors of the state, whereas natural soils account for 5 to 9% (Fig. 1). A meta analysis of soil NO_x emissions from the existing literature demonstrates quantitative coherence between our model based estimates and empirical measurements from different areas of the state (Table 1). Mean NO_x emissions from California cropland soils were 19.8 (±27.3 SD) kg of N ha^{-1} $year^{-1}$ and ranged from 0 to 276 kg of N ha^{-1} $year^{-1}$ (Fig. 2), with $^1/_4$ quartile and $^3/_4$ quartile values of 4.3 and 24.9 kg of N ha^{-1} $year^{-1}$, respectively. NO_x emissions were largest from agricultural soils where N fertilizer applications can reach >600 kg of N ha^{-1} $year^{-1}$ (average N fertilizer

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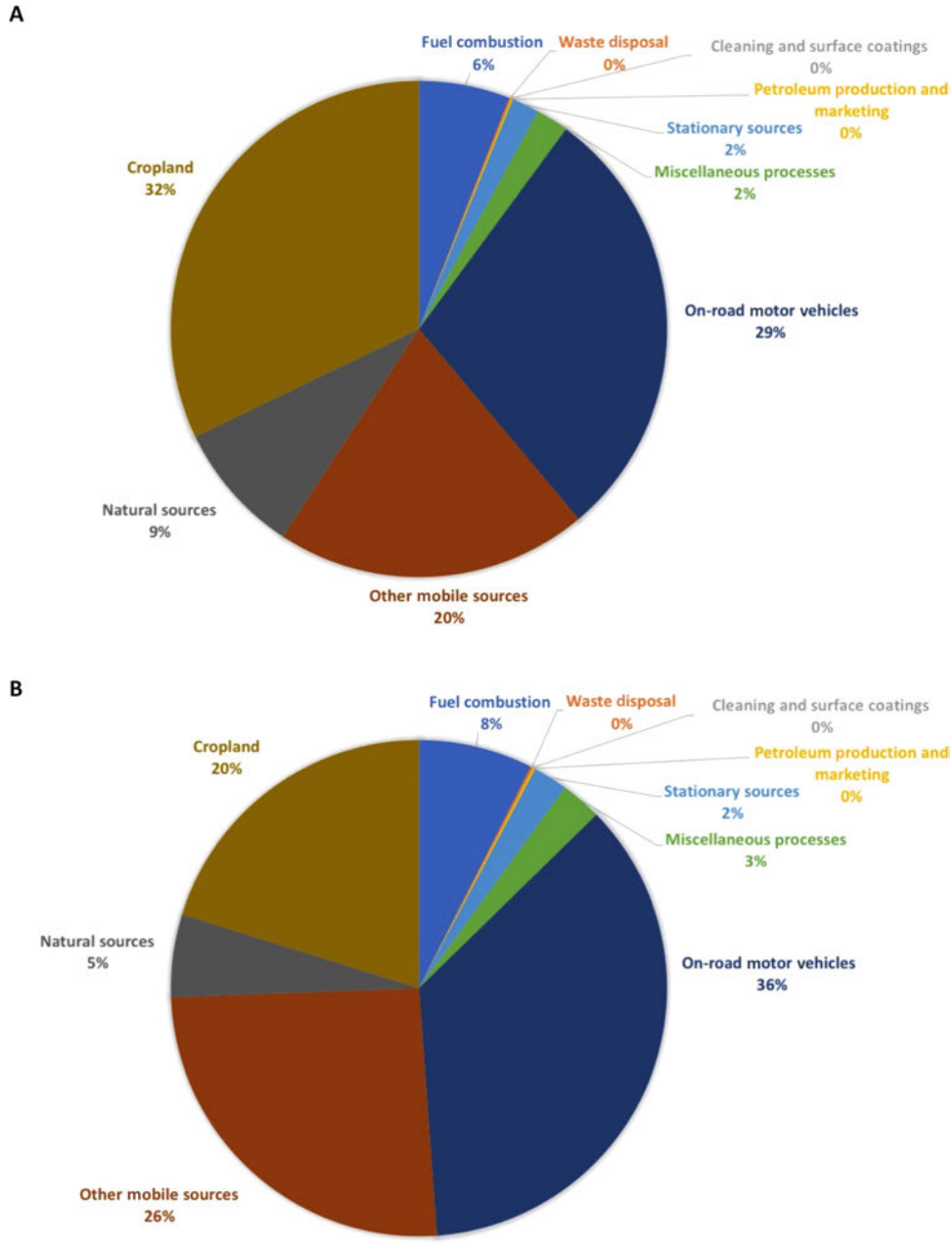

Fig. 1. Contribution of soils to statewide NO_x emissions. Based on CARB emission estimates and IMAGE modeled emission estimates for cropland and natural eco systems (**A**) without vegetation scavenging (gross rates) and (**B**) with 50% of NO_x emissions scavenged by vegetation (net rates).

rates for fertilized soils, 131.8 kg of N ha^{-1} $year^{-1}$; Fig. 3). A spatial max imum hot spot of soil NO_x emissions is identified for southern reaches of the state, where climate is relatively hot and arid (*17*). The model also predicts local maxima in the Sacramento Delta region, the Salinas Valley, and the San Joaquin Valley, with the latter being confirmed by aircraft measurements (see below).

Modeled NO_x emissions track N fertilizer applications

Our findings support the hypothesis that biogenic sources represent a significant fraction of NO_x emissions in California, particularly in areas with high N fertilizer applications. Although we report gross soil emission estimates, NO_x uptake by vegetation can cut atmo spheric NO_x emissions in half (*4*, *18*). We thereby provide a more conservative estimate that attributes 25% of statewide NO_x to the soil (Fig. 1B), which assumes that half of the soil NO_x is lost to dry dep osition within nearby vegetation canopies. Reducing uncertainty re garding the soil contribution of NO_x to the statewide budget will require spatial and temporal assessments that can distinguish between sources.

Our findings for California are consistent with previous global scale estimates given the tremendous agricultural productivity of the state: Yienger and Levy (*4*) used a model to demonstrate that soils ac count for 50% of the total NO_x budget in remote agricultural regions of the Northern Hemisphere, Jaeglé *et al.* (*6*) found that soils were

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Table 1. Modeled values and observed values collected from the literature of NO emissions in California. LAT, latitude; LONG, longitude; SFREC, Sierra Foothill Research and Extension Center.

Site	LAT	LONG	Modeled NO (kg of N ha^{-1} $year^{-1}$)	Observed NO (kg of N ha^{-1} $year^{-1}$)	Observed NO range (kg of N ha^{-1} $year^{-1}$)	Reference
Imperial Valley	32.8476	115.5694	20.6	21.0	0 280	(13)
SFREC	39.2513	121.3137	2.5	3.5	4 31	(27)
Barton Flats	34.2439	116.9114	1.1	1.0	0 2	(28)
Camp Paivika	34.2429	117.2683	3.7	5.0	3 7	(28)
Stanford	37.4241	122.1661	1.9	3.5	0 7	(29)
San Dimas	34.1797	117.7681	0.0	3.0	0 19	(30)
Bonadelle Ranchos	36.9693	119.8873	4.5	7.1	4 12	(14)
Clovis	36.8252	119.7029	1.6	0.9	0 3	(14)
Corcoran	36.098	119.5604	0.2	0.1		(14)
Firebaugh	36.8588	120.456	27.7	6.7	1 18	(14)
Kearny	36.6008	119.5109	17.3	2.8	0 21	(14)
Lindcove	36.3578	119.0636	19.6	1.3	1 2	(14)
Mendota	36.7536	120.3816	23.9	0.7	0 1	(14)
Parlier	36.6116	119.5271	2.9	5.6	0 22	(14)
Plainview	36.144	119.1326	38.1	13.7	0 46	(14)
Riverdale	36.4311	119.8596	28.3	0.1	0 1	(14)
San Joaquin	36.6066	120.189	5.5	7.2	1 57	(14)
Sanger	36.708	119.556	9.1	9.6		(14)
Tranquility	36.6488	120.2527	52.9	2.1	2 3	(14)
Tulare	36.2077	119.3473	20.6	0.1	0 1	(14)
Waukena	36.1382	119.5099	10.4	0.4	0 1	(14)

responsible for 22% of worldwide NO_x emissions, Wang *et al.* (*7*) estimated that agricultural soils were responsible for 20 to 30% of global NO_x sources, and Davidson *et al.* (*5*) estimated that soils were responsible for 10% of emissions in the Southeastern United States, with agriculture contributing to 75% of total soil NO_x emissions. Furthermore, our soil NO_x emission estimates are on par with those from agrarian areas in Europe (24 to 62%) (*19*) and during the crop growing season in the midwestern United States (15 to 40% in June and July) (*12*).

In contrast to high mean efflux from agricultural soils (average, 19.8 kg of N ha^{-1} $year^{-1}$), NO_x emissions from natural ecosystems were much lower (average, 1.0 kg of N ha^{-1} $year^{-1}$). This points to the im portance of N inputs (in fertilizer) in accelerating NO_x emissions from soil microbial communities (*20*). Our model based estimates compared favorably with published literature values for California and beyond, which range from 0 to 25 kg of N ha^{-1} $year^{-1}$ (Table 1). Likewise, in the southern and midwestern regions of the United States, empirically measured NO_x emissions from cultivated soils are on the order of 3 to 14 kg of N ha^{-1} $year^{-1}$ versus 0.1 to 3 kg of N ha^{-1} $year^{-1}$ from nearby unfertilized grasslands (*21 25*). Other studies have also demonstrated that cultivated land produces NO_x emissions an order of magnitude larger than forest soils in the same biome (*26*).

Emission estimate variability

Modeled soil NO_x emissions produced ranges that were similar to those reported in the literature (Table 1). Both modeled and ob served (in situ chamber measurements) emissions were typically less than 5 kg of N ha^{-1} $year^{-1}$, with larger values in the Imperial Valley (located in Southern California between the Salton Sea and Mexico; Fig. 2). Whereas most observed values were similar to those of the model, NO_x emissions showed marked variability, consistent with spatial heterogeneities of soil microbial processes. Biogenic NO_x emissions can also vary temporally, with the largest emissions spik ing when fertilizers are applied (*12*). The timing of fertilization in California varies regionally, considering the variety of crop species grown and the different management practices used. Our model val idation was restricted to a handful of empirical studies (*13*, *14*, *27 30*), which demonstrate the need for more ground measurements through out California to better assess the local impact and spatial distribu tion of soil NO_x emissions.

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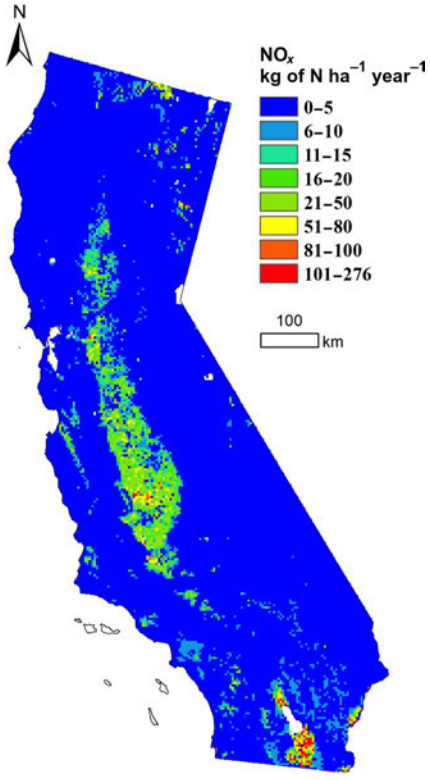

Fig. 2. Estimates of NO_x emissions from California soils (natural and cropland) generated by using stable isotopic modeling and IMAGE model.

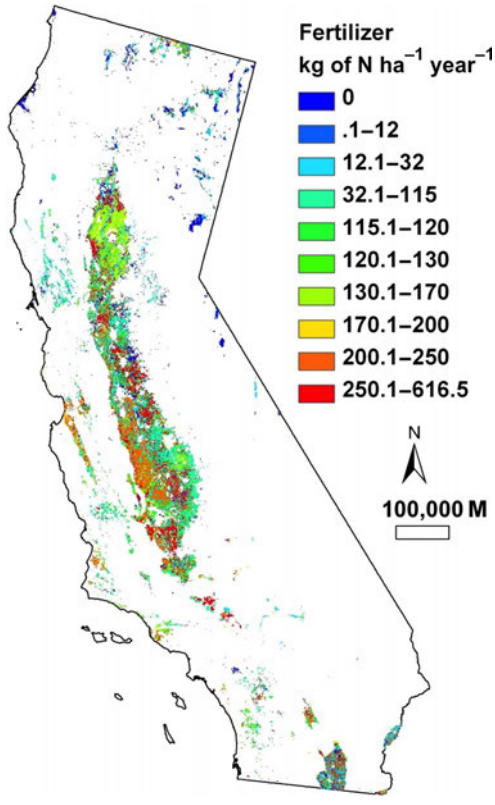

Fig. 3. Nitrogen fertilizer inputs to California soils. Fertilizer application rates are generated based on crop type, using crop specific data provided by the DWR of California and USDA fertilizer consumption database for 1964 to 2006.

Surface emissions estimates from airborne NO_x observations

We used airborne measurements of NO_x concentrations to estimate regional emissions in the San Joaquin Valley. This allows us to further verify our model and determine how NO_x emissions from the soil might affect regional compliance with ambient air quality standards, which are based on 1 hour and annual average concentration thresholds (*31*). Our top–down approach involved repeated airborne measurements of NO_x made between Fresno and Visalia during the summer of 2016 (fig. S3) in conjunction with the California Baseline Ozone Transport Study (CABOTS) coordinated by CARB. Careful accounting of the height of the atmospheric boundary, coupled with direct measurements and some judicious estimates of all the terms in the NO_x concentration budget equation, allowed us to estimate surface emissions (*32*) of NO_x in the region of the flight experiment (see the Supplementary Materials). The average of six flight days (three at the end of July and three at the beginning of August) over a region of ~720,000 ha yielded a NO_x emission estimate of 190 ± 130 metric tons day^{-1}. According to the CARB California Emissions Projection Analysis Model (CEPAM) (*33*), which includes fossil fuel but not natural sources, the sum of average summertime NO_x emissions over all three counties in the surrounding area (Fresno, Tulare, and Kings covering over 3.1 million ha) amounts to 100 metric tons day^{-1}. Although the exact area and diurnal timing of the emissions from the CEPAM inventory cannot be precisely compared to the spatial and temporal footprint of our airborne sampling, the comparison between the CEPAM inventory and airborne sampling shows that soil emissions are likely a very important source of atmospheric NO_x, especially in the agriculturally intensive San Joaquin Valley. In this case, the agricultural soil source would need to account for at least 47% of the total NO_x emissions or a regional flux of 12.4 kg of N ha^{-1} year^{-1} (table S4). We consider this to be a conservative estimate because the county inventories make up a much larger area than the flight domain. Furthermore, the flights did not span either commuter rush hour, when NO_x emissions are at their daily peak. We conclude that soils most likely contribute a majority of all NO_x emissions to the atmosphere in the agriculturally intensive central San Joaquin Valley.

Comparing emissions estimates between methods

We compared surface emissions estimates for the San Joaquin Valley with soil model estimates for the same region (fig. S3 and table S4). Using year round mean emissions for both natural and cropland soils, our model generated an annual flux of 24 kg of N ha^{-1} year^{-1} for the central San Joaquin Valley, between Fresno and Visalia, and as high as 36 kg of N ha^{-1} year^{-1} during the season of the airborne measurements (July to August), which yielded fluxes ranging from 14 to 39 kg of N ha^{-1} year^{-1}. The correspondence between the bottom–up and top–down estimates builds robustness into our estimates for statewide NO_x emissions and confirms our working conclusion for substantial NO_x emissions from fertilized croplands in the Central Valley.

Our soil model estimates are slightly higher than, although comparable with, the few number of empirical measurements of NO_x emissions from the San Joaquin Valley's cropland soils (made between July and September of 1995) (*14*), which ranged from 0.1 to 14 kg of N ha^{-1} year^{-1} (Table 1). That we estimate higher soil NO_x fluxes via the top–down and bottom–up approaches is consistent with more recent empirical measurements (*13*), suggesting that increases in N fertilizer

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use and population growth have likely accelerated soil NO_x emissions since the last time empirical measurements were reported for the region, some 20 years ago (*14*).

Controls on soil NO_x emissions

Previous studies have demonstrated that NO_x emissions are controlled by water filled pore space (influenced by precipitation, irrigation, and soil texture) (*34*), N availability (*20*), and temperature (*13*), all of which were fundamental parameters in our model based estimate of soil NO_x emissions in California (that is, the model relies on functions related to soil organic carbon, soil texture, drainage, temperature, and precipitation). We performed a model sensitivity analysis by evaluating the response of cropland denitrification rates to model input parameters at the ±10% level and examined the effect size of this parameter variation on NO_x emissions. We found that soil NO_x emissions were least sensitive to changes in soil carbon and were much more responsive to changes in soil texture, soil drainage, and climate (fig. S2).

Nitrogen input rates and climate were primary determinants of soil NO_x emissions in our model. The largest chamber based measurements of soil NO_x emissions come from the Imperial Valley in Southern California (Table 1) (*12*), which was accurately predicted by our model, implying that our model is capable of detecting hot spot emissions. High emissions in the Imperial Valley are likely explained by three factors. First, a biogenic source in these soils suggests a kinetic response to high temperatures that occur in this region. Second, arid soils not only produce more NO_x relative to N_2O and N_2 but also allow for the build up of inorganic N via nitrification; N that will then be released in large quantities when soils are irrigated and microbial denitrification is triggered. Third, high fertilizer inputs that increase N availability in the soil may help soils to develop a healthy community of nitrifying bacteria, providing a positive feedback to N availability and subsequent loss.

Implications for California

The CARB emission inventory provides an assessment of air pollution magnitudes and sources in California. Sources are inventoried based on four main categories: mobile, stationary, area wide, and natural. In the current CARB NO_x inventory, mobile emissions are thought to predominate (83%), whereas soil emissions are currently considered negligible (*16*). Here, we show that agricultural soils contribute a substantial amount of NO_x to the atmosphere. We can expect to see the significance of biogenic NO_x emissions increase as N fertilizer inputs increase to keep pace with food demands (*35*) and automotive NO_x controls continue to attenuate mobile fossil fuel sources. Our findings suggest the need to reconsider the role of soil NO_x sources and provide a pathway to constrain these diffuse pathways into CARB inventory analyses. Recent climate changes in California have caused pronounced heat waves and drought, factors which could exacerbate biogenic NO_x emissions, leading to increased air pollution and N deposition rates in natural ecosystems (*8*). Considering the limited number of field based NO_x measurements and the difficulty involved with partitioning soil versus fossil fuel sources through satellite imagery, a more robust field sampling strategy of soil NO_x emissions throughout the state could aid in efforts to understand agricultural impacts on air pollution in the Central Valley.

Several existing approaches could be used to reduce soil NO_x emissions from fertilized croplands. There are many strategies to improve fertilizer efficiencies, which would minimize the unwanted risks of N fertilizer spillovers into the environment and benefit farmers by reducing fertilizer costs. Where mineral fertilizers are used exclusively, for example, applying different forms of fertilizer (for example, slow release fertilizers) (*36*) or lowering N applications and using precision agriculture to target developmental stages (*37*), have been shown to cut N fertilizer losses from cropland soil. Where organic amendments are applied, separating the application timing of mineral N and organic fertilizer has been shown to reduce N emissions (*38*). Precision fertilization, as opposed to broadcasting, can also increase N uptake and minimize losses (*39*). Cover crops that consume residual N, which can subsequently be incorporated into the soil, are another option for reducing N fertilizer application rates (*40*). A complementary institutional strategy would be to incentivize plant production for human versus livestock consumption because livestock manure and the N used to grow livestock feed are major sources of N pollution in the air and water (*3*). Another strategy would be to promote the reduction of NO_x to an environmentally benign gas such as dinitrogen (N_2), which can be achieved by installing riparian zones to collect fertilizer runoff or introducing nitrification inhibitors to stem denitrification rates (*3*, *41*). The ratio in which harmful (NO_x and N_2O) and inert (N_2) gases are emitted from soils depends heavily on N availability, soil moisture, and temperature; thus, irrigation strategies are another important step to reduce N losses from agriculture.

These and many other strategies can help to reduce potentially harmful N losses from agriculture (*3*, *42*, *43*). Losses of N fertilizer are not only costly to farmers but can also create economic costs to the greater United States on the order of $210 billion dollars per year in health and environmental damages (*43*, *44*). Reducing NO_x emissions therefore offers a win win situation for farmers, environmental health, and the economy.

CONCLUSIONS

This study builds on local point scale measurements (*14*) to provide the first spatially explicit evidence of substantial NO_x emissions from agricultural soils in California, a previously unrecognized source that is estimated to contribute 20 to 51% of the state's total NO_x budget. These soil NO_x emissions are sourced to N fertilizer applications in Central Valley croplands. The effect of large soil NO_x emissions on air quality and human health remain unclear, but the magnitude of the flux alone raises concern about its potential impact, particularly in rural California. Where biogenic sources affect air quality and health, the implementation of strategies to reduce these emissions will be imperative. A better understanding of the sources, distribution, and impact of biogenically produced NO_x will improve our ability to mitigate emissions in the future.

MATERIALS AND METHODS

To model the spatial distribution of soil NO_x emissions, we used an N isotope model (*17*, *45*) in natural areas and an Integrated Model for the Assessment of the Global Environment (IMAGE) (*46*) in cropland areas to estimate total N losses from soils based on the surplus of N in the environment [see the study of Wang *et al.* (*7*) for model details]. The N surplus was a function of N inputs (deposition, fixation, fertilizer, and irrigation) minus N outputs besides denitrification and leaching (crop harvest and ammonia volatilization). Manure and grazing were not included as inputs/outputs; instead, we considered them as recycling functions of internal N cycling. Surplus N was then partitioned between leaching and gaseous losses based on temperature, precipitation

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(irrigation), evapotranspiration, soil texture, soil drainage, soil organic carbon content, soil total available water content, and land cover (see the Supplementary Materials). Gaseous losses were partitioned between NO, N_2O, and N_2 based on water filled pore space (fig. S1). The resulting NO flux in California was between 0 and 276 kg of N ha^{-1} $year^{-1}$ with one outlier (525.7 kg of N ha^{-1} $year^{-1}$) being removed.

All data sets were transformed to 4000 m × 4000 m spatial grids before model runs. We used the California Augmented Multisource Land Cover Map published by the Information Center for the Environment, University of California, Davis (UC Davis). Temperature and precipitation data (mean from 1971 to 2000) were from the PRISM (Parameter elevation Regressions on Independent Slopes Model) Climate Group, Oregon State University, created on 4 June 2010 (*47*). Nitrogen deposition data were based on the Community Multiscale Air Quality model by Tonnesen *et al.* (*48*). Nitrogen fertilizer application rates were from the Department of Water Resources (DWR) of California and U.S. Department of Agriculture (USDA) fertilizer consumption database for 1964 to 2006. Nitrogen harvest was calculated by multiplying crop production by percent dry matter by percent N for each crop type at each year. We then used the mean value for each crop type from 1980 to 2007. The data were from the USDA National Agricultural Statistics Service (2012) and the UC Davis Agricultural and Resource Economics. Nitrogen irrigation data were from the DWR irrigation database for 2001, assuming that N content in irrigation water was 1 mg of N $liter^{-1}$ water. We used a fixed N fixation rate for different crops: rice, 2 5 kg of N ha^{-1} $year^{-1}$; beans, 40 kg of N ha^{-1} $year^{-1}$; alfalfa, 400 kg of N ha^{-1} $year^{-1}$; clover, 15 kg of N ha^{-1} $year^{-1}$; and natural vegetation, 5 kg of N ha^{-1} $year^{-1}$ (*10*). The ammonia volatilization rate was estimated to be 3.6% of N fertilizer, as reported in the California Department of Food and Agriculture Fertilizer Research and Education Program, and to be 15 kg of N ha^{-1} $year^{-1}$ in manure applied areas and 1.6 kg of N ha^{-1} $year^{-1}$ in urban areas (*49*). Soil properties data, including soil texture, soil drainage, SOC (soil organic carbon) content, and total available water content, were from the USDA Soil Survey. We collected data from the literature, which we then compared to our model generated fluxes. Data were collected using Google Scholar and some combination of the following search terms: "NO_x," "nitrogen oxides," "nitric oxide," "emissions," "trace gas," "California," and "site name." References were then followed from papers that were found to be useful.

The airborne NO measurements were made with an Eco Physics (model CLD 88) chemiluminescence instrument with a stabilized photomultiplier tube and reaction chamber temperatures and other operating parameters to ensure a steady calibration point and high reproducibility. A blue light light emitting diode photolytic converter (Model 42i BLC2 395 manufactured by Air Quality Design Inc.) was used to selectively convert NO_2 to NO for alternating measurements of NO_x (= NO + NO_2). Further, a Teflon prereaction chamber was installed to run the chemiluminescence reaction to completion before the detection cell to keep track of any interferences or changes in the background signal, thereby increasing the confidence in the measurements and lowering the detection limit generally to less than 0.05 parts per billion by volume. The instrument was cycled through the three states of NO and NO_x, and background measurements were done every 20 s. Calibrations were performed by O_3 titration with a National Institute of Standards and Technology traceable NO standard (Scott Marrin Inc.) certified to within 5%. Full calibrations were performed before and after the entire flight series, with zero and span checks run routinely before and after each flight. The aircraft used to conduct the experiment is operated by Scientific Aviation Inc. (http://scientificaviation.com/overview/).

Emission estimates were made using a simple boundary layer budget equation for NO_x (see the Supplementary Materials). This technique was outlined in the study of Lenschow *et al.* (*50*), can be generalized to any scalar (*51 54*), and was recently used to estimate regional methane emissions in the San Joaquin Valley (*32*). The technique involves thoroughly probing the atmospheric boundary layer (ABL) over a particular region via aircraft, horizontally and vertically, to determine the time rate of change, horizontal advection, and vertical mixing for various scalars, as well as the boundary layer height and its growth. This technique permits the calculation of residual terms within the scalar budgets for the region of interest (*32*). See the Supplementary Materials and Trousdell *et al.* (*32*) for greater details of the budget method, error estimates, and the other aircraft measurements.

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at http://advances.sciencemag.org/cgi/content/full/4/1/eaao3477/DC1

Supplementary Methods

table S1. Crop classification and fertilizer rate data (mean for 1964 to 2006) collected from the DWR of California and USDA fertilizer consumption database.

table S2. ABL heights, z_i, and budget terms for the six flights.

table S3. NO_x budget table and the consequent total regional emissions for each flight.

table S4. Flight estimates of total NO_x and soil NO_x and model estimates of soil NO_x for the flight area in fig. S3 [Coordinates box: (36°51′52.09″N, 120°43′19.65″W), (37°0′6.85″ N, 119°50′53.87″W), (35°57′49.03″N, 120°1′37.93″W), and (36°5′27.03″N, 118°58′2.91″W) compared with CARB inventory of total NO_x].

fig. S1. Model of how nitrogen oxide (NO), nitrous oxide (N_2O), and dinitrogen (N_2) partitioning varies with water filled pore space.

fig. S2. Sensitivity of NO emission from croplands to different input parameters: soil organic carbon (fsoc), soil texture (ftxt), soil drainage (fdrain), and climate (fclim).

fig. S3. Airborne NO_x observation sampling area.

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Acknowledgments: We would like to thank T. O'Green and D. Liptzin for assistance with data acquisition and S. Chen for sharing her Weather Research and Forecasting (WRF) modeling runs. **Funding:** This work was supported by the NSF Postdoctoral Research Fellowship in Biology (1611895), the Major State Basic Research Development Program of China (2014CB954400), the NSF CAREER Grant (1411368), and the Dave and Lucile Packard Foundation. I.F. was supported in part by the California Agricultural Experiment Station, Hatch

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project CA D LAW 2229 H. The airborne NO_x measurements were supported by a grant sponsored by the U.S. Environmental Protection Agency through the Bay Area Air Quality Management District (grant #2016 129) for the CARB's CABOTS project. **Author contributions:** M.A., E.B., and B.Z.H. conceived the research and designed the study. M.A. collected literature data on NO_x observations recorded in California. E.B. and B.Z.H developed the model. E.B and C.W. generated model estimates of soil NO_x emissions. I.F., J.T., and S.C. performed airborne measurements of NO_x and generated estimates of soil NO_x emissions for the Central Valley in California. M.A. led the manuscript preparation with input from all co authors. **Competing interests:** The authors declare that they have no competing interests and have filed no patents related to this work. **Data and materials availability:** All data needed to evaluate the conclusions in the paper are present in the paper and/or the Supplementary Materials. Additional data related to this paper may be requested from the authors. Please contact the corresponding author for additional data not reported in the manuscript or Supplementary Materials.

Submitted 10 July 2017
Accepted 5 January 2018
Published 31 January 2018
10.1126/sciadv.aao3477

Citation: M. Almaraz, E. Bai, C. Wang, J. Trousdell, S. Conley, I. Faloona, B. Z. Houlton, Agriculture is a major source of NO_x pollution in California. *Sci. Adv.* **4**, eaao3477 (2018).

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Agriculture is a major source of NO_x pollution in California

Maya A maraz, Ed th Ba , Chao Wang, Just n Trousde , Stephen Con ey, Ian Fa oona and Benjam n Z. Hou ton

Sci Adv **4** (1), eaao3477.
DOI: 10.1126/sc adv.aao3477

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EXHIBIT D

Social Disparities in Nitrate-Contaminated Drinking Water in California's San Joaquin Valley

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Background: Research on drinking water in the United States has rarely examined disproportionate exposures to contaminants faced by low-income and minority communities. This study analyzes the relationship between nitrate concentrations in community water systems (CWSs) and the racial/ethnic and socioeconomic characteristics of customers.

Objectives: We hypothesized that CWSs in California's San Joaquin Valley that serve a higher proportion of minority or residents of lower socioeconomic status have higher nitrate levels and that these disparities are greater among smaller drinking water systems.

Methods: We used water quality monitoring data sets (1999–2001) to estimate nitrate levels in CWSs, and source location and census block group data to estimate customer demographics. Our linear regression model included 327 CWSs and reported robust standard errors clustered at the CWS level. Our adjusted model controlled for demographics and water system characteristics and stratified by CWS size.

Results: Percent Latino was associated with a 0.04-mg nitrate-ion (NO_3)/L increase in a CWS's estimated NO_3 concentration [95% confidence interval (CI), –0.08 to 0.16], and rate of home ownership was associated with a 0.16-mg NO_3/L decrease (95% CI, –0.32 to 0.002). Among smaller systems, the percentage of Latinos and of homeownership was associated with an estimated increase of 0.44 mg NO_3/L (95% CI, 0.03–0.84) and a decrease of 0.15 mg NO_3/L (95% CI, –0.64 to 0.33), respectively.

Conclusions: Our findings suggest that in smaller water systems, CWSs serving larger percentages of Latinos and renters receive drinking water with higher nitrate levels. This suggests an environmental inequity in drinking water quality.

Key words: California, drinking water, environmental justice, nitrate, public health, Safe Drinking Water Act, social disparities, water systems. *Environ Health Perspect* 119:1272–1278 (2011). http://dx.doi.org/10.1289/ehp.1002878 [Online 3 June 2011]

An array of drinking water–related problems still exists in the United States, despite a history of investment in sophisticated water infrastructure and the existence of federal laws such as the Clean Water Act of 1972 and Safe Drinking Water Act of 1974 (SDWA) that regulate source contamination and protect the public's health. These problems include increasing source contamination (Dubrovsky et al. 2010), exposure to chemical and microbial contaminants, poor implementation of water laws (Burke 2009; Duhigg 2009), and degrading infrastructure (Levin et al. 2002). Rural areas often face the largest burden, as aquifers are contaminated by intensive agriculture and livestock production (Dubrovsky et al. 1998). Some rural unincorporated areas, such as some communities along the U.S.–Mexico border, lack access to adequate infrastructure, service provision, and clean water (Olmstead 2004; Pilley et al. 2009).

Despite these problems, there is a paucity of studies that examine social disparities in exposure to unsafe water. A literature review in the 1990s (Calderon et al. 1993) recommended that more quantitative analyses examine whether vulnerable populations, including people of color and the poor, are disproportionately affected by drinking water contamination. Since then, a handful of studies have addressed different aspects of this issue. In San Joaquin County, California, one study found a weak but significant relationship between areas with higher poverty and greater proportions of minorities and poor drinking water quality (Byrne 2003). Research in the Navajo Nation found bacteriological and chemical contamination in unregulated drinking water sources (Murphy et al. 2009). In Arizona, researchers examined whether public water systems serving higher fractions of minority or low-socioeconomic-status (SES) residents were more likely to exceed the arsenic maximum contaminant level (MCL) than were those serving higher fractions of whites or high-SES residents. They found a positive association between the percentage of Latino residents and the likelihood of exceeding the MCL of arsenic. However, they concluded that environmental justice concerns were unwarranted for Latinos, because there was no difference between the percentages of Latinos who were served by water systems with and without violations. (Cory and Rahman 2009). In New Mexico, preliminary research documented high arsenic levels in drinking water sources that provided water to predominantly Latino border communities known as "colonias" (Pilley et al. 2009).

Our research addresses several methodological limitations of previous studies, particularly regarding appropriate unit of analysis, characterization of exposure, and scale. For example, Byrne (2003) estimated average trichloroethylene levels and MCL exceedances in drinking water systems and characterized exposure as a continuous measure across San Joaquin County; the community level, however, is more appropriate when considering community-level exposure. Cory and Rahman (2009) characterized the association between percent minority and a binary outcome of arsenic, rather than a continuous measure of arsenic levels, and they did not explore this association among smaller systems where they noted that most arsenic violations occurred.

Our study used the community as the unit of analysis to examine the relationship between nitrate concentration in community water systems (CWSs) and social factors. CWSs are public water systems that serve water year-round to at least 25 people or have > 15 service connections [U.S. Environmental Protection Agency (EPA) 2010b]. We characterized potential exposure to nitrate because it is one of the most common contaminants found in groundwater (Harter 2009; Spalding and Exner 1993) yet has received little attention regarding social disparities in exposure.

Nitrate in drinking water is associated with methemoglobinemia (i.e., "blue baby syndrome") in infants (Fan and Steinberg 1996; U.S. EPA 2010a), although other risk factors include enteric infections (Charamandari et al. 2001; Hanukoglu and Danon 1996) and foods

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Supplemental Material is available online (http://dx.doi.org/ 10.1289/ehp.1002878).

We thank L. Firestone, S. de Anda, and M. Herrera; R. Haberman [former San Joaquin Valley Regional Engineer for California Department of Public Health (CDPH) Drinking Water Program], D. Spath (former Chief of the Division of Drinking Water and Environmental Management, CDPH), and C. Peterman for support and feedback on analysis; CDPH and Tulare County Environmental Health Services for data; and B. Nerness for research assistance.

This research was supported by a National Science Foundation graduate research fellowship, the California Endowment through a collaborative research grant between Community Water Center and University of California–Berkeley, and the Switzer Environmental Fellowship.

The authors declare they have no actual or potential competing financial interests.

Received 19 August 2010; accepted 3 June 2011.

high in nitrates (Sanchez-Echaniz et al. 2001). Epidemiologic data also suggest an association between nitrate levels in drinking water and reproductive toxicity, developmental effects, and various cancers (Fan and Steinberg 1996; Ward et al. 2005, 2010), although the consistency of these associations varies. To protect against methemoglobinemia, the SDWA has established an MCL of 45 mg/L as nitrate ion (NO_3) or 10 mg/L as nitrate-nitrogen in drinking water (U.S. EPA 2010a).

California's San Joaquin Valley is an important site for examining potential disparities in exposure to nitrate. With its intensive irrigated agriculture, the valley has two of the most contaminated aquifers in the nation and some of the highest nitrate levels in the country (Dubrovsky et al. 1998, 2010). Because nearly 95% of the valley's population relies on groundwater for drinking [Permits, Inspections, Compliance, Monitoring and Evaluation (PICME) [California Department of Public Health (CDPH) 2008a], groundwater contamination is a particular health risk. This risk is compounded by the fact that with high costs of mitigation, few systems actually treat for nitrate. The San Joaquin Valley also has some of the highest rates of poverty and minority populations—particularly Latinos—in the state (U.S. Census Bureau 2007). These communities are economically and socially disadvantaged, making it harder for them to afford mitigation or to address related health consequences of nitrate contamination. The continued use of nitrogen-based fertilizers (Dubrovsky et al. 2010; Ruddy et al. 2006) and the increasing demand for groundwater (Glover 2010) further highlight the importance of this contaminant, because exposure may become increasingly widespread.

Given this context, we used water quality monitoring data from the CDPH to analyze the association between racial/ethnic and SES characteristics of people served by CWSs and nitrate levels of these systems in the San Joaquin Valley. With few exceptions (Byrne 2003), there has been limited use of CDPH monitoring data to examine whether certain groups are disproportionately affected by exposure to drinking water contaminants. Similarly, despite an acknowledgment of the burden faced by small systems (Committee on Small Water Systems 1997), few studies have explored associated social disparities.

We hypothesized that CWSs serving a higher percentage of minority or lower-SES residents have higher nitrate levels and that these disparities are likely to be greater among smaller drinking water systems. Disparities in nitrate exposures, if they exist, could signal a potential environmental injustice. This analysis expands the emerging literature on drinking water quality and social disparities in the United States and informs national- and state-level policy on the needs of underresourced water systems.

Materials and Methods

Our units of observation were CWSs in California's San Joaquin Valley. We used three measures to test our study's hypotheses: *a*) estimated average nitrate concentrations for each CWS to describe average water quality served to customers; *b*) population potentially exposed (PEP) to three nitrate levels to estimate the population affected by nitrate contamination; and *c*) nitrate concentrations at points of entry into each CWS's distribution system to assess the relationship between demographic characteristics of customers and CWS nitrate levels. The first two measures were used in a series of descriptive statistical analyses. The third measure was used as the outcome variable in linear regression models that estimated the relationships between race/ethnicity and SES and a system's nitrate concentration.

Sample selection and time period. We included CWSs that were active in the San Joaquin Valley between 1999 and 2001, had at least one point-of-entry source with a nitrate sample reported for this period, and had any source (i.e., point of entry or not) with geographic coordinate data available to estimate CWS demographics. Point-of-entry sources can be defined as sources of supply (e.g., well with no treatment or effluent from a well/surface water plant) that directly enter into the distribution system (Figure 1). We used nitrate-sampling data from 1999 to 2001 and demographic data from the 2000 Census. The sampling period represents one full compliance period under the SDWA [California Code of Regulations (CCR) 2008, §64400.25]. Of the 873 CWSs that were active during 1999–2001, 711 had sources with geographic coordinates. Of these, 327 (37%) had nitrate water quality sampling data and were included in our final sample.

Average nitrate concentration for CWSs. To estimate nitrate concentration for each CWS, we selected two types of point-of-entry sources for inclusion (Figure 1): *a*) sources, such as well fields or surface water plants, that were in active use and had no treatment or that were treated for contaminants other than nitrate, and *b*) treatment plants in active use that potentially treated for nitrate. In both cases, we included only sources that were last in line to enter the distribution system (i.e., did not flow to another source before entering), to avoid double counting of nitrate levels. We used the CDPH's Permits, Inspections, Compliance, Monitoring and Enforcement database (CDPH 2008a) to identify source types, their location in relation to the distribution system, and their possible treatment techniques. If a plant had a treatment technique commonly used for nitrate (e.g., reverse osmosis), we assumed that it treated for nitrate.

We then used nitrate-sampling data for these sources from the CDPH (2008b) Water Quality Monitoring database to determine nitrate concentration at points of entry. This served as a proxy for water quality in each CWS's distribution system and for tap water quality. Nitrate levels are unlikely to change from these entry points to the tap (unless systems chloraminate, which those in the valley do not) (Haberman R, personal communication). CWSs using groundwater are required to sample each source for nitrate annually (unless a single sample or average of two samples exceeds the MCL, in which case the system must sample quarterly); CWSs using surface water must sample quarterly (CCR 2008, §64432.1). In practice, however, systems often fail to sample regularly (Haberman R, personal communication). If a nitrate sample was below the detection limit

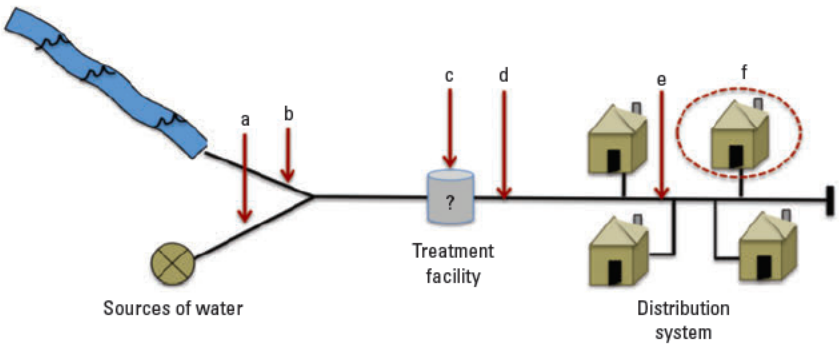

Figure 1. Schematic of a community water system (CWS) indicating the location of point-of-entry sources and the use of average nitrate concentration in the distribution system as a proxy for tap water quality. Water entering the distribution system may flow from a groundwater well (point a) or from a surface water source (i.e., stream; point b). Water may then be treated (point c; different treatment techniques may be used, depending on the contaminant of interest and original source). Water then enters the distribution system at points of entry (point d). In this example, nitrate samples would be used from point d, because points a and b flow into the same point of entry. Average nitrate level at point d is used to represent average water quality in the distribution system (point e). Nitrate levels in the distribution system are a proxy for tap water quality (point f). If points a and b are separate points of entry (i.e., do not flow into a shared point d), nitrate sample points would be used from each source separately. Constant and equal flows are assumed.

of 2 mg NO_3/L (CCR 2008, §64432), we took the square root of the value as a proxy for that sample's nitrate level (Lubin et al. 2004). We did not have flow measurements for the individual sources that contributed water to each CWS's distribution system. Therefore, we could not determine a flow-weighted measure of distribution water quality for each CWS based on the nitrate level measured in samples from each contributing source. Instead, we assumed that each point-of-entry source contributed independently and equally to a CWS's distribution system, and that each source contributed a constant amount to the system, regardless of season.

Finally, we determined the average nitrate level for each point-of-entry source and averaged the resulting values across all sources to estimate an average systemwide nitrate level. The systemwide average was then used to categorize each CWS's average nitrate concentration as *a*) low, defined as < MCL/2 (< 22.5 mg NO_3/L); *b*) medium (22.5–44.9 mg NO_3/L); and *c*) high (≥ 45 mg NO_3/L, the MCL for nitrate). These categories correspond to those used to assess source-level nitrate concentrations for regulatory purposes (CCR 2008, §64432.1). Besides the high category, the medium category is important to consider because research suggests that exposure to nitrate in drinking water at half the MCL can cause adverse health effects among susceptible subpopulations (DeRoos et al. 2003). In addition to calculating average nitrate levels, we used nitrate MCL violation data from PICME to verify whether CWSs with high nitrates did in fact receive violations, and to run a sensitivity analysis on PEP data.

Potentially exposed population. Using a method by Storm (1994), we computed the potentially exposed population (PEP) by apportioning the total population served by each CWS into three exposure categories based on the proportion of sources for that CWS with average nitrate levels that were low, medium, or high, as defined above. The population in each category was then summed across all CWS to estimate the total population potentially exposed to the three nitrate levels. The approach to calculate the PEP for the high-nitrate category is summarized by the following equation:

$$PEP_h = \sum_{i=1}^{327} (X_i \times s_{ih}/S_{it}), \qquad [1]$$

where X_i is the total population served in CWS i; s_{ih} is the number of sources for CWS i with average nitrate concentrations classified as high (h); and S_{it} is the total number of point-of-entry sources for CWS i. To calculate the PEP for the low (l) or medium (m) nitrate categories, we replaced s_{ih} with s_{il} or s_{im}, respectively. We used PICME 2008 data on the number of people served by each CWS to calculate the population size in each exposure category during 1999 to 2001. If the number of customers served by a CWS was not available from the PICME data, we used information from the CDPH Water Quality Monitoring database. To estimate population counts of potentially exposed individuals according to demographic characteristics (e.g., race/ethnicity) we multiplied the potentially exposed population in each nitrate category for each CWS by the estimated proportion of customers in each demographic subgroup for the CWS, and then summed these values across all CWS for each nitrate category. Because home ownership is based on housing units rather than population count, we did not derive a count of housing units.

Statistical analysis of nitrate levels and CWS characteristics. We used a linear regression model to analyze the relationship between CWS demographics and nitrate levels. We fitted a model selected *a priori* that controlled for known or hypothesized system-level confounders. We originally used a mixed model approach to account for clustering (Laird and Ware 1982). However, diagnostics of the mixed model indicated a very non-normal distribution of residuals. Therefore, we used an approach that provided inference that was robust under laxer modeling assumptions. To derive the inference (i.e., standard errors), we clustered outcomes at the water system level (i.e., point-of-entry nitrate concentrations measured on a given day for a given source). Thus, our final model reported sandwich-type robust standard errors (Huber 1967) that allow for arbitrary correlation, including correlation within or across sources in a CWS.

Our outcome variable, Y_{ijk}, is nitrate concentration for the ith water system, the jth source in system i, on day k (since 1 January 1999). Although nitrate samples from individual sources are our outcome measurements, the CWS is the primary unit of analysis, consistent with average nitrate level calculations discussed above. Our final model did not reweight CWSs with more samples (as the mixed model might have, depending on the implied estimated correlation structure), because we wanted CWS to contribute measurements based on a proxy of the number of people served. Thus, systems with more measurements contributed more to the estimates. We addressed this assumption by stratifying by system size, to see if smaller CWSs (with fewer samples) had a different effect than did larger CWSs. Because differences between the estimates of the mixed model and the linear model were small, this comparison provided evidence that the nonweighted approach of our final model was reasonable.

Key independent variables were the percentage of Latino and non-Latino people of color served by CWSs (referent category was non-Latino whites) and percent home ownership in the area served by a CWS. Latinos were analyzed separately because they are the largest ethnic group in the valley (40%; U.S. Census Bureau 2007). SES was represented by home ownership rate, which is a proxy for wealth and political representation (Krieger et al. 1997; Morello-Frosch et al. 2001; Oliver and Shapiro 1997). Because of our focus on CWS-level exposures, these variables were measured at the CWS level. We assumed these remained constant for all 3 years.

Race/ethnicity and home ownership data were derived from the 2000 U.S. Census (U.S. Census Bureau 2000). Because CWS service areas do not follow census boundaries, we used two spatial approaches in geographic information systems to estimate demographic variables for each CWS. We first compared an aerially weighted approach using digitized CWS boundaries in two pilot counties (Tulare and Fresno) with a second approach joining spatial coordinates from CDPH data for all sources (well fields, surface water intakes, and treatment plants) to census block groups. Based on spatial and goodness-of-fit comparisons, we concluded that it was reasonable to use the latter approach [for details on the aerially weighted approach and the comparison between the two methods, see Supplemental Material (http://dx.doi.org/10.1289/ehp.1002878)]. In brief, for each CWS, we estimated a population-based average of each variable across all block groups that included sources for the CWS. For example, if a CWS had two sources in two census block groups, we determined the population-weighted average of the variable across both census block groups and used that value to derive a percent estimate of demographic groups (e.g., 50% Latino) served by each CWS.

We controlled for other water system characteristics that could be potential confounders: source of water (groundwater or groundwater plus surface water vs. surface water alone), whether the system served a city (i.e., incorporated) or an unincorporated area, ownership structure of the system [publicly vs. privately owned and not regulated by the Public Utility Commission (PUC), with privately owned PUC-regulated systems as the referent category], system location (agricultural valley floor or not), season (summer/fall or winter/spring), year of sampling (2000 or 2001, with 1999 as referent category), and number of service connections (< 200 or ≥ 200 connections). CWSs with < 200 connections are generally considered "small" (CCR 2008, §64432.1). We determined ownership structure by combining data in PICME with data from the PUC's list

of regulated systems. We obtained all other characteristics from PICME. With the exception of year and season, which were measured at the source level, all covariates were measured at the water system level.

In addition to models including all CWSs, we stratified by system size to assess whether demographic effects on water quality might be stronger among smaller systems and to test the hypothesis that scale alone explains water quality. We also used our final model to estimate the amount of nitrate contamination attributable to the proportion of the population that is Latino. We did so by using the final model to predict expected values for each observation if percent Latino equaled zero, as described in Greenland and Drescher (1993). All statistical analyses were conducted using Stata (version 10; StataCorp LP, College Station, TX). We used Stata's cluster command (clustering at the CWS level) to derive robust SEs.

Results

Descriptive statistics. The 327 systems in our sample served approximately 2.95 million people, or 96% of the San Joaquin Valley population served by CWSs (Table 1). The distribution of average system-level nitrate concentrations is right-skewed and ranges from 0 to 150 mg NO_3/L. This distribution and range are similar for average source-level nitrate concentrations and for individual sampling points (data not shown). The mean proportion of Latinos served across these CWSs was 32%, with an interquartile range (IQR) of 10–50%. The mean proportion of homeownership was 70%, with an IQR of 60–82%. Compared with all the CWSs in the valley active from 1999 to 2001, our study sample underrepresented small CWSs that have < 200 connections (49% vs. 73%; Table 1). The number of samples per source in systems with < 200 connections ranged from 1 to 110 (mean, 3.2), compared with a range of 1–133 (mean, 4.5) for systems with ≥ 200 connections. Six percent of samples had concentrations below the detection limit.

Overall, 3% (n = 10) of all CWSs in our sample had high average nitrate concentrations (above the MCL of 45 mg NO_3/L) for at least some part of the study period, 10% (n = 33) had medium average concentrations (MCL/2 to MCL), and 87% (n = 284) had low average concentrations (< MCL/2; Figure 2). Of the 10 CWSs with an average nitrate concentration > MCL, 9 had < 200 connections and 8 had only one or two sources. All but 1 of these 10 CWSs received at least one MCL violation during the study period, and 14 CWSs in our sample (serving ~ 92,268 people) received at least one MCL violation [PICME (CDPH 2008a); see also Supplemental Material, Table 1 (http://dx.doi.org/ 10.1289/ehp.1002878)].

CWSs that served higher fractions of Latinos and lower fractions of homeowners (i.e., more renters) had higher average nitrate levels. Figure 3 shows that in the two highest Latino quartiles, proportionately more systems had average nitrate concentrations > MCL (i.e., 5% and 7% in the two higher quartiles compared with 0% in both of the lower quartiles). These two quartiles also had the largest fractions of CWSs in the medium nitrate category. The two quartiles with the lowest rates of home ownership had the

Table 1. CWSs included in study sample compared with all active CWSs, San Joaquin Valley, California, 1999–2001.

Variable of interest	Active CWSs with source location (n = 327)	CWSs in study (n = 327)	CWSs with < 200 connections (n = 160)	CWSs with ≥ 200 connections (n = 167)
Total population	3,047,822[a]	2,948,346	27,165	2,921,181
Latino population (%)	34	39	29	40
White population (%)	58	47	64	47
Population above poverty level[b] (%)	57	57	59	57
Population served (mean/median)	4,206/150	9,016/565	170/100	17,492/430
Incorporated[c] (%)	9	18	2	34
< 200 connections (n)	73	49	100	0
Only groundwater[d] (%)	89	90	97	84
Groundwater and surface water[d] (%)	5	8	3	13

[a]Approximately 71,418 people were served by CWSs whose sources did not have geographic coordinates, and 80 CWSs had no population estimates available; including these sources, the estimate of "true" population served by active CWSs was at least 3,119,240. [b]Above 200% of the poverty level. [c]A CWS that serves a city that is a legally recognized municipal corporation with a charter from the state and governing officials that is incorporated, as opposed to a water system that serves an unincorporated area. [d]Reference group, surface water only.

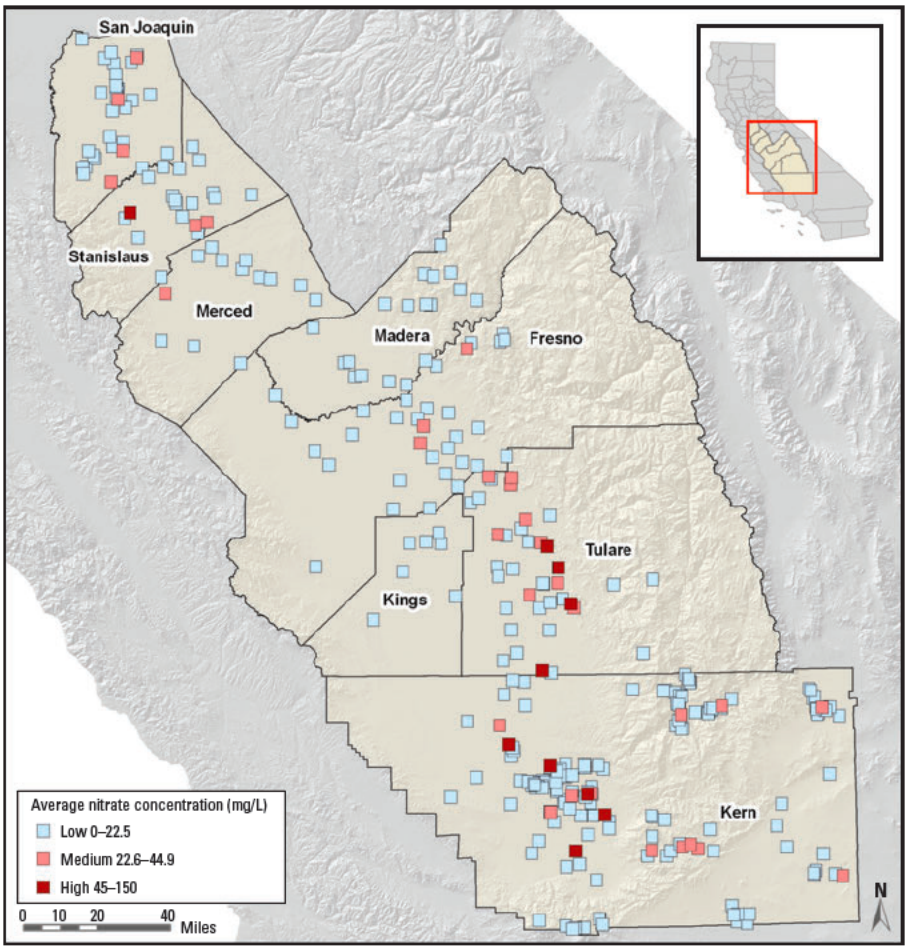

Figure 2. Average nitrate concentration of CWSs in California's San Joaquin Valley, 1999–2001 (n = 327). Estimates are based on an average of each point-of-entry source's average concentration. Data are from CDPH (2008) Water Quality Monitoring and PICME databases (CDPH 2008a, 2008b). Approximate locations of CWSs are depicted, but not true boundaries. Because of close proximity of some CWSs, some CWSs not fully visible.

largest proportions of systems in the medium and high nitrate categories (15% and 22%, respectively), compared with the two quartiles with the highest rates of home ownership (which had 7% and 8%, respectively).

Of the population served in our sample, approximately 84.6% (~ 2,494,442 people) were potentially exposed to low nitrate levels, 15.2% (~ 448,729 people) to medium nitrate levels, and 0.2% (~ 5,176 people) to high nitrate levels (Table 2). Of the 5,176 people served water with nitrates above the MCL, 56% were people of color (50% Latinos and 6% non-Latino), compared with 52% in the low and medium nitrate categories (Table 2).The percentage of Latinos served by high-nitrate CWSs was higher than the percentage of Latinos served by CWSs in the other two nitrate categories (39% and 40% for low and medium nitrate, respectively). This percentage was also greater than the percentage of Latinos in our entire study sample (39%; Table 1). This percentage was also higher than the percentage of Latinos served by CWSs in the other two nitrate categories (39% and 40% for low and medium nitrate, respectively).

Model results. Table 3 shows the multivariate modeling results. Unadjusted models indicate that percent Latino was positively and significantly [β = 0.14; 95% confidence interval (CI), 0.04–0.24] correlated with the average nitrate concentration in the distribution system. Conversely, home ownership was negatively correlated with average nitrate concentration but only marginally significant (β = –0.15; 95% CI, –0.30 to 0.003).

Our adjusted model suggests that, on average, a 1% increase in Latinos served by a CWS was associated with an increase of 0.04 mg NO_3/L (95% CI, –0.08 to 0.16). For home ownership, each percent increase was associated with a decrease of 0.16 mg NO_3/L (95% CI, –0.33 to 0.002). For systems with < 200 connections, the associations between percent Latino and home ownership and nitrate concentration were consistent with both the unadjusted model and adjusted model for all CWSs, but the strength of the association for percent Latino increased. Specifically, on average, each percent increase in Latino was associated with a 0.44 mg NO_3/L increase (95% CI, 0.03–0.84) in the smaller systems. A 1% increase in home ownership was associated with a 0.15 mg NO_3/L decrease (95% CI, –0.64 to 0.33), although the association was not statistically significant. In systems with ≥ 200 connections, neither race/ethnicity nor home ownership was associated with nitrate concentrations. Using the final model to predict expected values, we estimated that among small systems, nitrate levels for CWSs with 0% Latinos would be, on average, 6 mg NO_3/L lower compared with CWSs at the mean.

Discussion

To our knowledge, this is the first study to examine the relationship between nitrate levels in CWSs and social disparities in the United States. After stratifying by system size, we found that among systems with < 200 connections, those serving higher percentages of Latinos had higher nitrate levels. We found an inverse but not statistically significant association between home ownership and nitrate levels for smaller systems. For large systems, we did not find significant associations between race/ethnicity or home ownership and nitrate levels. Our findings corroborate previous drinking water studies (e.g., Byrne 2003) that showed a positive relationship between percent minority and poor water quality but are specific to nitrate contamination at the community level. That water quality varied by percent Latino or home ownership matters not only because of environmental equity but also because elevated nitrate levels could pose a greater hazard to subpopulations that may have less access to health care.

The association of race/ethnicity and SES with nitrate levels could be due to several factors. Race/ethnicity could have been related to proximity to agriculture, as well as the ability of residents to participate in the governance of their CWSs. For example, in systems with higher fractions of Latinos, language abilities, citizenship status, or lack of political clout could inhibit residents from speaking out and demanding improvements in water quality (for a discussion in relation to electoral politics, see Michelson 2000). Home ownership could have been negatively associated with nitrate levels because renter-based communities may have had a lower capacity to pay for improvements in water infrastructure or to hold a CWS accountable, assuming they received notices of violation as required (CCR 2008, §64463). Or, it might indicate that a lack of economic resources may influence whether CWSs can hire capable water managers or comply with regulations.

That > 5,000 people in our study sample were potentially exposed to drinking water with nitrate concentrations above the MCL raises health concerns. As noted, acute and chronic health effects have been found for vulnerable populations (e.g., infants and pregnant women) exposed to nitrate exceeding the MCL (Ward et al. 2005). Furthermore, that many of the water systems in this category had only one or two sources can lead to increased chances of high exposure for residents if these are high-nitrate sources, because there is no immediate alternative water source to draw from or blend with. These small systems often go years with high nitrate levels, until a new water source can be developed (Spath D, personal communication). PICME (CDPH 2008a) data corroborates this observation: of the 10 systems whose average nitrate concentration exceeded the MCL, 6 had recurring MCL violations over an 8-year time frame. In these systems, customers may be continually exposed (although exposure would be lower if people frequently use alternative sources). Additionally, because customers in the

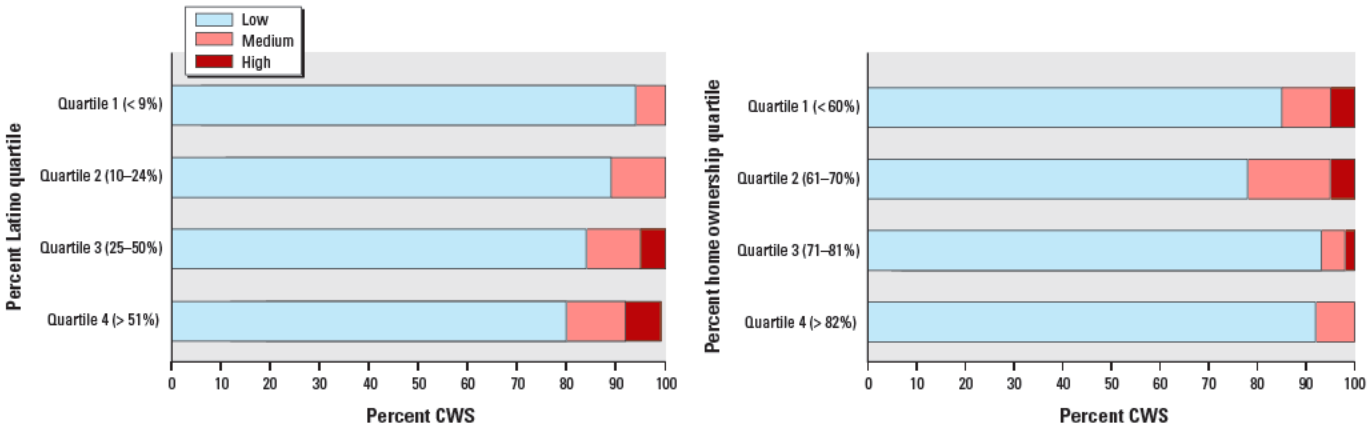

Figure 3. Percentage of CWSs with low, medium, and high average nitrate concentrations, by quartiles of percent Latino and home ownership. Average system-level nitrate concentration is derived from the average of each source's average nitrate concentration at point of entry. Low is < one half the MCL of 45 mg NO_3/L. Medium is one half the MCL up to the MCL (22.5 mg/L to 44.9 mg/L NO_3). High is ≥ to the MCL.

San Joaquin Valley often cope by purchasing bottled water, they pay two water bills—one for tap water and the other for bottled water (Moore et al. 2011).

Our results also highlight a less frequently discussed issue—approximately 448,700 residents, served by 33 CWSs, in our sample received water with medium nitrate levels (< MCL but > MCL/2). Nitrate levels in these systems could be approaching the MCL in some cases. In our study, one-third of CWSs in this category had average concentrations > 30 mg NO_3/L. Residents in these systems could be at risk of adverse health outcomes and/or could experience additional economic costs. For example, in one study, the risk of colon cancer increased for certain susceptible subgroups (e.g., those with low vitamin C intake or high meat intake) whose water had nitrate levels > MCL/2 for at least 10 years (DeRoos et al. 2003). More generally, although several authors have suggested that the current nitrate MCL could be increased to a less stringent level of regulation (L'hirondel and L'hirondel 2002), others have argued that the standard should not be changed (Ward et al. 2005) because of uncertainties in the exposure assessment data and health effect estimates of the epidemiologic study upon which the current MCL is based (Walton 1951). Some authors also argue that the MCL includes no safety factor, and documented cases of infant methemoglobinemia have occurred at levels below the MCL (Fan and Steinberg 1996). Thus, exposure to nitrates in the middle category is important to consider.

Monitoring of water quality by these CWSs is also an important consideration. CWSs with any source whose nitrate levels exceed MCL/2 (> 22.5 mg NO_3/L) are required to increase their monitoring frequency from annual to quarterly sampling (CCR 2008, §64432.1). At best, the cost of increased monitoring must be passed along to consumers. At worst, the funding and staffing constraints can limit the capacity of small CWSs to monitor; these CWSs may have nitrate levels approaching the MCL but neither the system operators nor customer base would know (Haberman R, personal communication). Such a scenario would undermine the aim of the SDWA, which is supposed to protect the public from harmful exposures and requires systems to notify their customers so that precautionary measures can be taken to reduce exposures (CCR 2008, §64480; Fan and Steinberg 1996).

This study used an appropriate unit of analysis (i.e., CWS) for estimating system-level nitrate exposure. The methods we used could be applied to other contaminants and to other regions of the United States. However, sources of error exist in our demographic estimate because *a*) surface intakes/well fields could fall in census block groups not served by the CWS, *b*) not all census block groups served by a CWS have an intake/field located within them, and *c*) Latinos in census data could be undercounted because of legal status. Despite these potential errors, for most CWSs, sources fell within the same census block groups that overlapped with service area boundaries of CWSs. And, for 9 of the 10 systems in the high-nitrate category, all sources were in the same census block groups as those included in each CWS service area [see Supplemental Material (http://dx.doi.org/10.1289/ehp.1002878)]. Additional sources of error include possible misclassification of points of entry to the distribution system because of errors in PICME. Furthermore, because the relative flow of different sources contributing to each CWS was not known, our method may have over- or underestimated average nitrate levels. However, at least among CWSs with average concentrations over the MCL, the estimated concentrations were similar to the measured concentrations for which that CWS received one or more MCL violations. Our measure of exposure was limited by data availability, so for systems with fewer samples tested for nitrates, our estimate may be less accurate. Although the number of persons potentially exposed to nitrate over the MCL is small, it is likely to be an underestimate of the actual population affected in the San Joaquin Valley. This is partly because our study underrepresented smaller CWSs, and partly because we used average rather than maximum nitrate levels or other measures of nitrate (e.g., MCL violations). Thus, our estimate is likely to be a conservative measure of potential exposure. The estimate of the PEP may also contain some error, because there may be some differences among utilities in how population estimates are calculated. Finally, although our results are based on data that are 10 years old, we believe that, at a minimum, they capture current trends in the San Joaquin Valley because nitrate concentrations generally

Table 2. Demographic profile of total PEP[a] in study sample by average level of nitrate concentration.

Variable of interest	Nitrate level		
	Low	Medium	High
Percent total population (n = 2,948,346)	84.6	15.2	0.2
Percent Latino (n = 1,164,714)	39	40	50
Percent non-Latino people of color (n = 389,336)	13	12	6
Percent white (n = 1,394,296)	47	48	44

Low is less than one-half the MCL of 45 mg NO_3/L; medium is one-half the MCL up to the MCL (22.5 mg/L to 44.9 mg/L NO_3); high is equal to or greater than the MCL.
[a]Per water system, PEP is the population count of the demographic variable of interest x (number of point-of-entry sources in one of three nitrate levels ÷ by the total number of point-of-entry sources). PEP displayed in table is equal to the sum across all water systems. This value can also be interpreted as the estimated number of people served water at this level.

Table 3. Regression for factors associated with nitrate concentration (mg NO_3/L) in CWSs, with beta coefficients, 95% CIs, and levels of significance.

Variable	Model A[a]	Model B[a]	Model C[b]	Model D (< 200 con.)	Model E (≥ 200 con.)
Constant	14.2 (9.1 to 19.4)#	27.1 (16.3 to 38.0)*	6.3 (–11.4 to 24.0)	10.8 (–32.3 to 53.9)	3.2 (–15.5 to 21.9)
Percent Latino	0.14 (0.04 to 0.24)#		0.04 (–0.08 to 0.16)	0.44 (0.03 to 0.84)**	–0.01 (–0.12 to 0.10)
Percent non-Latino people of color	–0.18 (–0.62 to 0.25)		–0.15 (–0.47 to 0.18)	–0.44 (–1.1 to 0.27)	–0.13 (–0.45 to 0.18)
Percent home ownership		–0.15 (–0.30 to 0.003)*	–0.16 (–0.33 to 0.002)*	–0.15 (–0.64 to 0.33)	–0.10 (–0.27 to 0.07)
Incorporated			–4.4 (–9.3 to 0.56)	–2.9 (–31.8 to 25.9)	–4.1 (–9.3 to 1.1)
Groundwater or combined[c]			9.7 (4.3 to 15.2)#	NA	11.7 (7.9 to 15.4)#
Private non-PUC regulated[d]			2.7 (–5.4 to 10.9)	5.5 (–2.7 to 13.7)	–0.23 (–4.5 to 4.1)
Public[d]			7.2 (2.8 to 11.5)#	10.3 (–17.4 to 38.0)	7.3 (3.6 to 11.1)
< 200 service connections			9.1 (–2.5 to 20.7)	NA	NA
Valley floor			7.9 (1.6 to 14.2)**	1.7 (–12.0 to 15.4)	7.4 (1.0 to 13.9)
2000[e]			1.3 (–0.44 to 3.1)	5.0 (1.2 to 8.8)#	0.71 (–1.1 to 2.6)
2001[e]			1.4 (–0.26 to 3.1)*	5.5 (1.9 to 9.1)#	0.67 (–0.98 to 2.3)
Summer/fall			1.3 (–0.30 to 2.9)	3.2 (0.31 to 6.3)**	1.1 (–0.72 to 3.0)

NA, not applicable, because no CWS in this model run contains this factor, or all CWSs have this factor. Data are regression statistics with robust SEs, clustered by CWSs. Coefficients represent the estimated difference in mean concentration at the system level associated with a unit change in the covariate (95% CI). Empty cells indicate that the unadjusted model included only the key variables of interest.
[a]Unadjusted models, all CWSs included. [b]Adjusted model, all CWSs included. [c]Surface water is referent category. [d]Privately owned PUC-regulated CWSs are referent category. [e]1999 is referent year. *$p < 0.10$. **$p < 0.05$. #$p < 0.01$.

change slowly in deeper public supply wells and have been increasing in most locations because of increasing fertilizer use (Dubrovsky et al. 2010).

Conclusion

Our study is one of the first to analyze the relationships between drinking water contamination, race/ethnicity, and SES in the United States and the first that focuses on social disparities in nitrate contamination. Our results indicate that Latinos in the San Joaquin Valley may be disproportionately exposed to higher levels of nitrates and that this exposure is particularly prevalent in smaller water systems. With the increasing use of nitrogen-based fertilizers and growing demand for groundwater, these trends are likely to worsen in future years. Regulatory and policy strategies to address scale-related vulnerabilities in drinking water quality have generally ignored the environmental justice implications for CWSs. Given the U.S. EPA's renewed focus on environmental justice (U.S. EPA 2009) and the paucity of environmental justice studies on drinking water, this study highlights the importance of targeting funding for mitigation and source water protection efforts for underserved communities and those with nitrate levels over the MCL. Furthermore, there is a need for resources to better monitor water quality and develop precautionary mitigation for communities with nitrate levels > MCL/2.

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ERRATUM

NOTE: In the article by Balazs et al. [Environ Health Perspect 119:1272–1278 (2011)], Equation 1 was incorrect.

EHP apologizes for the error.

This error has been corrected in the PDF version of this article.

EXHIBIT E

February 21, 2017

Glenn Meeks
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670

RE: Draft Salt and Nutrient Management Plan – EJ Stakeholders' Comments

Dear Mr. Meeks,

The above listed organizations (the "EJ Stakeholders") write in response to the release of the final draft of the Salt and Nutrient Management Plan ("SNMP" or "draft SNMP") both on their own behalves and on behalf of the communities impacted by nitrates and vulnerable to nitrate related impacts throughout the San Joaquin Valley including but not limited communities represented by the AGUA coalition, Tombstone territory, and Tooleville.

The EJ Stakeholders have participated in the Central Valley Salinity Coalition's (the "Coalition") process for developing this Draft SNMP for most of its 10 years, serving as the lone environmental justice participants. Our goal in participating is and has always been to ensure that the impact of nitrates on communities is reduced and that nitrate contamination does not spread to more communities. While we support the three central management goals of the CV-SALTS process for nitrates: (1) addressing short & long-term drinking water needs for communities impacted by nitrates; (2) achieving nitrate loading balance within groundwater basins; and (3) restoring the basin, the policies espoused in these documents fail to achieve these goals with any certainty or within any meaningful timeframe.

In fact, the studies and analyses that support the draft SNMP show that degradation of the basins will continue for decades, if not centuries, to come if the SNMP is adopted and implemented. We have expressed our concerns about the inadequacy of the SNMP repeatedly to the Coalition, in the form of comment letters,[1] redlines of the policy documents, and verbal comments at monthly Coalition meetings. Despite our long-standing participation and efforts to work with the Coalition members to ensure that the final SNMP, and any related basin plan amendment, will be protective of groundwater quality, the majority of our comments and

[1] The most recent comment letter, as well as red-lines of the policy documents are attached to this comment letter. They remain relevant given that little substantive change has been made from prior drafts of the SNMP and supporting documents.

edits to the documents have been included as nominal alternatives and relegated to an appendix to the Final Draft SNMP. Neither the environmental nor economic analyses consider the alternatives put forward by our organizations.

The result is an SNMP that includes few, if any, enforceable timelines, targets, or standards — apparently demonstrating a lack of commitment to any difficult or costly policies that would minimize nitrate related degradation to groundwater, or require remediation and restoration. Moreover, the Substitute Environmental Document ("SED"), Antidegradation Analysis, and Economic Analysis submitted in support of the SNMP are wholly inadequate, inconsistent, and incomplete. (*See* Technical Comment Letter concurrently submitted by the EJ Participants.) Below is a brief summary of some of the major issues with the draft SNMP and supporting documents.

I. THE SNMP ALLOWS CONTINUED DEGRADATION AND EVENTUAL DE-DESIGNATION OF AFFECTED GROUNDWATER BASINS.

1. Reliance on assimilative capacity will exacerbate groundwater degradation and pollution and increase vulnerability of residents and communities to nitrate contamination.

a. Assimilative capacity must not be based on the maximum contaminant level ("MCL").

The SNMP recommends that assimilative capacity be allocated up to the MCL of 10 mg/L, with some additional information and data required if discharges exceed 7.5 mg/L. While we appreciate that the SNMP requires an Alternative Compliance Plan (ACP) for discharges over 7.5 mg/L, it is unclear how protective these ACPs will be when management goals 2 and 3 (nitrate balancing and restoration) are only required where "reasonable and feasible". There needs to be more protective measures put in place, rather than allow discharges up to the MCL. This allows no room for error, accidental discharges, discharges of parties not included in the cumulative analysis, or mistaken calculations or assumptions as to how much assimilative capacity exists. Any plan or regulatory framework designed to prevent groundwater from exceeding the MCL must include a buffer. A water system is deemed out of compliance after just one exceedance, even if with the next testing the system is back under the standard. Yet, despite the additional treatment and testing costs that will be borne by public water systems, and consequently individual water users, the SNMP does not address these rising costs and actually contributes to ongoing contamination of water supplies. Additionally, many communities within the Central Valley rely upon state small water systems or private wells, which have no testing requirements. These communities are the most vulnerable to MCL exceedances, and any regulatory program which proposes to regulate an acute contaminate like nitrates must be hyper-aware of the potential impact an error might have.

We have proposed that assimilative capacity should be capped at 7.5 mg/L and any additional discharges must obtain an exception. A 7.5 mg/L standard is consistent with the Drinking Water regulatory program's existing policy.

b. Determination of assimilative capacity across a management zone is not appropriate.

The SNMP proposes to allow dischargers participating in a management zone to determine assimilative capacity averaged across the entire management zone. To put into perspective, a management zone may be as large as an entire basin. This will obscure areas of contamination - or hot spots - within a management zone. In fact, as acknowledged in the SNMP and related SED, averaging across a broad stretch of land that is not close to the discharge is likely to result in localized impacts. As the EKI report states, studies have shown that there is relatively little mixing of groundwater, even when in close geographic proximity.

Assimilative capacity must not be granted across a management zone. Assimilative capacity should be determined in a much more narrow geographical scope. Potential alternatives could include, but should not be limited to: determining assimilative capacity by looking at a mile and a half radius from impacted wells (consistent with the UCD Nitrate Report), or granting assimilative capacity only in an area of the discharge with established hydrologic connections that indicate mixing will occur within the period of the permit or 10 years, whichever is shorter. These alternatives, and any others, would of course need to be analyzed within the requisite CEQA documents to ensure they would not result in degradation of groundwater.

c. The production zone is never an acceptable means of vertical measurement of assimilative capacity.

While the EJ stakeholders appreciate the move away from determining assimilative capacity across the production zone for nitrate discharges to the use of “shallow groundwater”, we are still concerned that this is an insufficient change. Further, we are concerned with the use of the “upper zone” for dischargers participating in a management zone. For dischargers complying with WDRs individually, the standard proposed by the SNMP is to determine assimilative capacity in “shallow groundwater” which is defined as the upper 10% of the upper zone. However, dischargers participating in a management zone are allowed to determine assimilative capacity across the entire upper zone. It is not clear from the SNMP how the actual depth of the upper zone is determined, and the EJ stakeholders are concerned that in practice the upper zone will look more like the production zone (upper and lower zones) than shallow groundwater. The production zone is never an acceptable means of vertical measurement of assimilative capacity. Averaging across the production zone leans towards the deeper aquifer, beyond the depth of many domestic private wells. This leaves communities dependent upon shallow wells vulnerable to exceedances of drinking water standards.

d. **Offsets threaten to create and exacerbate hot spots and facilitate greater degradation of the aquifer.**

As defined and used within the SNMP, “offsets” have the potential to result in degradation and contamination hot spots. Offsets should not be used as a mitigation for contamination but rather as a mechanism to, literally, offset a discharge in a given area. In circumstances where a discharge will exceed water quality objectives without a corresponding offset to eliminate or adequately reduce the discharge, the exception policy applies.

Accordingly, the offsets policy needs to be limited only to use as a means of compliance with water quality objectives such that the discharger can demonstrate no degradation and no localized impacts as a result of the discharge in combination with the "offset".

e. **Exceptions granted for indefinite periods of time are inconsistent with the management goals of the SNMP.**

The SNMP recommends that exceptions should be granted for 10 years, though longer exceptions may be granted. However, exceptions granted for longer periods of time are not consistent with the management goals. Indefinite exceptions will prevent the achievement of nitrate balancing and long-term restoration of the basin. Exceptions should thus not be granted for more than 10 years at a time, though the Board may grant an extension so long as additional requirements are met, including meeting measurable objectives and targets. New data and technology are frequently discovered and thus may make the need for an exemption null as the discharger may be able to effectively reduce their nitrate loading.

2. Failure to require a plan for long-term restoration will result in continued degradation of the basins.

The draft SNMP does not contain a timeline for restoring the basin, or even a timeline for drafting a plan for restoration. In fact, even the basic first step towards restoration, achieving a salt and nutrient balance, is not a firm requirement. This is at odds with the goals of the SNMP and must not be permitted. The SNMP must contain a timeline for 1) achieving a salt and nutrient balance and 2) creating a plan including measurable objectives and targets toward restoration. The Plan must also be reviewed on a regular basis, at least every 10 years, to ensure targets are being met and to incorporate new data or technology.

3. Allowing dischargers to determine whether nitrate balancing or long-term restoration is "reasonable and feasible" will result in de-facto de-designation of the basins.

Despite the fact that balancing nitrate loading and long-term restoration of the basin are stated goals of the SNMP, they are only "required" when it is "reasonable and feasible" to do so. This is unacceptable. Furthermore, the SNMP provides no guidelines on what the phrase "reasonable and feasible" means. Allowing dischargers to side-step the process by determining a recommended action is not "reasonable and feasible" will result in de facto de-designation of basins.

Section 2.2 of the Management Zone Policy is titled "Minimum Requirements for Management Zone Implementation Plan." However, the section still qualifies that a plan for balanced nitrate loading and long-term restoration are only necessary where "reasonable and feasible." This is not a "requirement" but a suggestion. Without clarification of what "reasonable and feasible" means, it is an easy suggestion for management zone participants to ignore.

II. THE SED, ANTIDEGRADATION ANALYSIS, AND ECONOMIC ANALYSIS ARE INADEQUATE.

As noted above, the EJ Stakeholders have concurrently submitted a letter describing in detail the flaws in these three (3) technical documents (the "Technical Comment Letter"). Attached to that letter is a report prepared by Erler & Kalinowski, Inc (EKI Report). which supports the conclusions and opinions of the EJ Stakeholders. For the convenience of the Regional Board, the comments detailed in the comment letter on the technical documents are summarized in part here.

1. The Supplemental Environmental Document in Inadequate.

As an initial matter, the SED analyzes only two (2) alternatives, the "Proposed Project" and a "No Project" alternative. An SED that analyzes only two alternatives is facially invalid under CEQA because it does not discuss a "reasonable range" of alternatives. Though the SNMP in Attachment D lists several proposed project alternatives, including many of the EJ Stakeholders' proposed alternatives, the SED does not analyze these options. Furthermore, the analysis of the "No Project" alternative is insufficient in its own right, as the discussion is speculative and lacks factual bases regarding the projected nitrate degradation under presently operative regulations.

The SED also does not contain any analysis of enforceable feasible mitigation to address the significant impacts that the policies in the draft SNMP will cause. While the SED does briefly mention in connection with the "exceptions" policy that exceptions will not be authorized unless "dischargers assure an adequate supply" of drinking water adversely affected by the non-compliant discharge, this is not an adequate mitigation measure. The requirement does not apply to the other discrete policy proposals or cumulative impacts, and does not address environmental impacts to the basin itself. Further, there are no proposed enforcement measures or monitoring programs to ensure that replacement drinking water is actually provided.

Additionally, the impact findings in the SED are not supported by substantial evidence, and the SED thus fails as an informational document. In the Technical Comment Letter, the inadequacies of the findings are discussed with respect to each impact category. Those inadequacies are exemplified by the inconsistency between the proposition that long term impacts will be "less than significant" though the policies contained in the SNMP will cause, at a minimum, localized impacts some of which will not be restorable in "reasonable and feasible" manner. (*See* SED p. 137 ["the Proposed Project would allow localized areas of groundwater basins/subbasins that are near or over the applicable water quality objective to be further degraded in the future, and because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions, … the Proposed Project would contribute considerably to adverse cumulative conditions of nitrate in some localized areas of basins/subbasins within the Central Valley."].)

Moreover, even if the SED were consistent with substantive CEQA requirements, the Regional Board still could not rely on the SED in adopting the SNMP because the Board cannot delegate its duty to exercise "independent judgment" in an "adequate" and "objective" manner to the central Valley Salinity Coalition. (*See* Cal. Code Regs., tit. 14, § 15084(e).)

For these reasons, the SED does not comply with applicable CEQA requirements.

2. The Economic Analysis Is Inaccurate.

The Economic Analysis contains a number of unbacked assumptions which impact the adequacy of the SED and Antidegradation Analysis, including but not limited to:

a. The Economic Analysis excludes communities larger than 5,000 residents, citing an assumption these communities have water systems and thus would not "be candidates for user protection under the Central Valley SNMP." (Economic Analysis p. 98). There is no evidence all communities over 5,000 have water systems nor is there any evidence that communities larger than 5,000 residents are not or will not be impacted by nitrate exceedances. Further, the Economic Analysis does not provide evidence that water systems for communities over 5,000, and which may be impacted by nitrates, are able to provide affordable water to their customers.
b. The Economic Analysis utilizes 2010 census numbers rather than more accurate population projections. Similarly, it does not consider the dynamic costs associated with providing bottled water as more residents are impacted by increased nitrate levels, while at the same time, more residents receive clean drinking water through permanent solutions.
c. The economic analysis assumes that drinking water needs are only 2.25 gallons per day per household. 2.25 gallons represents the bare minimum necessary for drinking water and does not include other consumptive uses such as brushing teeth, washing produce, or cooking. A per household estimate is closer to 10-20 gallons per day. (EKI Report, p. 9). Furthermore, the 2.25 gallon number assumes a temperate climate, not the 90+ degree Central Valley summers. Thus the economic analysis significantly underestimates the cost of replacement water. Couple this with the lack of analysis on future impacted populations due to the slow move of nitrate to the basins, and there is a serious need for further analysis.

3. The Antidegradation Analysis Is Inconsistent And Inadequate.

First, the Antidegradation Analysis states the wrong legal standard, relying on an unsigned proposed order for the proposition that *Asociacion de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Bd.* (2012) 210 Cal.App.4th 1255, 1256 in inapplicable. Under the proper legal standard, the discussion contained in the Analysis does not comply with the State or Federal Antidegradation Policy.

Second, the Antidegradation Analysis relies on two (2) proposed "qualitative" categories that it assumes without support comply with the Antidegradation Policy: (a) "A policy element will allow short-term change in high quality waters while actions are taken that improve beneficial use protection and provide long-term water quality improvement or other benefits"; and (b) "A policy element will allow a short term (sic) change of in (sic) high quality waters in a localized area while creating water quality improvements or other benefits in a larger area." (Antidegradation Analysis p. 81-82.) As for the first category, permitting degradation – even short-term degradation – may not be consistent with the maximum benefit to the people of the State, especially given that "short-term" is defined to mean years or decades. The second "category" is similarly inconsistent with the State

Antidegradation Policy, which looks to site-specific impacts on people. Depending on the location of the "localized area" of degradation, it may have significant impact on people outweighing any benefit to those living in a larger area.

Third, the Analysis uses an improper baseline for comparing water quality, utilizing "current water quality conditions" rather than "the best water quality that has existed since 1968." (*See* Antidegradation Analysis p. 81.)

Fourth, though the Antidegradation Analysis discusses degradation caused by the discrete SNMP policies, it does not consider the significant cumulative impacts acknowledged in the SED.

Additionally, though the Antidegradation Analysis tacitly acknowledges that some "short-term" degradation will result from the SNMP policies, it is inconsistent with the SED which acknowledges "years" or "decades" of substantial impairment to groundwater due to nitrate contamination, some of which will persist permanently. (*See* SED p. 137.) As the Antidegradation Analysis thus impermissibly minimizes the degradation likely to result from implementation and adoption of the draft SNMP, it does not comply with the State or Federal Antidegradation Policy.

Finally, when applying the proper "two-step process" required by the State Antidegradation Policy, the Analysis does not affirmatively "demonstrate" that the degradation permitted by the SNMP is "consistent with the maximum benefit to the people of the State" or that adoption of the SNMP will result in "best practicable treatment or control of the discharge necessary to avoid pollution or nuisance and to maintain the highest water quality consistent with the maximum benefit to the people of the State." (*See* Technical Comment Letter pp. 26-32.) "Short-term" degradation of groundwater spanning "years" or "decades," some of which will never be restored is not consistent with the maximum benefit to the people of the State, especially given that this groundwater is used by 95% of San Joaquin Valley residents for drinking water. (Carolina Balazs et al., Social Disparities in Nitrate-Contaminated Drinking Water in California's San Joaquin Valley (Environmental Health Perspective 2011), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3230390/.)

Sincerely,

Debi Ores
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Community Water Center

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February 21, 2017

[SENT VIA EMAIL: GLENN.MEEKS@WATERBOARDS.CA.GOV]

Glenn Meeks
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670

RE: Comments On Technical Documents Offered In Support Of Draft Central Valley-Wide Salt And Nitrate Management Plan

Dear Mr. Meeks:

On behalf of the undersigned Environmental Justice Stakeholders (the "EJ Stakeholders"), as well as the communities impacted by nitrates and vulnerable to nitrate related impacts throughout the San Joaquin Valley including but not limited communities represented by the AGUA coalition, Tombstone territory, and Tooleville, we urge the Central Valley Regional Water Quality Control Board (the "Regional Board") not to accept the draft Central Valley-Wide Salt and Nutrient Management Plan (the "draft SNMP") prepared as part of the Central Valley Salinity Alternatives for Long-term Sustainability ("CV-SALTS") process. In addition to the fact that the draft SNMP contains policies that would degrade water quality in the San Joaquin Valley, the SNMP should not be adopted because it is supported by an inconsistent and inadequate Substitute Environmental Document ("SED"), Economic Analysis and Antidegradation Analysis.

In support of these comments, the EJ Stakeholders offer a report dated February 17, 2017 prepared by Andrew N. Safford, P.E. of Erler & Kalinowski, Inc., attached hereto as Exhibit "A" and incorporated herein by reference (the "EKI Report"). The Environmental Justice Stakeholders also offer a copy of Mr. Safford's curriculum vitae, attached hereto as Exhibit "B".

I. Substitute Environmental Document[1]

A. Legal Standard

The California Supreme Court has held that "[t]he foremost principle under CEQA is that the Legislature intended the act 'to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language.'" (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 390 (*hereinafter "Laurel Heights*") quoting *Friends of Mammoth v. Board of Supervisors* (1972) 8

[1] Incorporated herein by reference are the arguments offered by EJ Stakeholders in comments on the SNMP, policy documents, Economic Analysis, and Antidegradation Analysis.

Cal.3d 247, 259 disapproved on other grounds by *Kowis v. Howard* (1992) 3 Cal.4th 888; *Mountain Lion Foundation v. Fish & Game Com.* (1997) 16 Cal.4th 105, 112.)

The purpose of an environmental impact report ("EIR") is to "provide public agencies and the public in general with detailed information about the effect which a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project.'" (*Laurel Heights*, 47 Cal.3d at 390 citing Pub. Resources Code § 21061; CEQA Guidelines, § 15003, subds. (b)-(e).)

The phrase "significant effect on the environment" means "a substantial, or potentially substantial, adverse change in the environment." (Pub. Resources Code § 21068; *Laurel Heights*, 47 Cal.3d at 390.)

The same principles apply to an SED. Basin Planning is a "certified regulatory program," and therefore requires development of an SED pursuant to CEQA. (*California Sportfishing Protection Alliance v. State Water Resources Control Bd.* (2008) 160 Cal.App.4th 1625, 1631.) In the SED, the Central Valley Regional Quality Control Board the ("Regional Board") must comply with CEQA's mandate to disclose the environmental effects of a proposed change to a basin plan and must "identify the environmental effects of projects, and then to mitigate those adverse effects through the imposition of feasible mitigation measures through the selection of feasible alternatives." (*Sierra Club v. State Bd. of Forestry* (1994) 7 Cal.4th 1215, 1233.)

Pursuant to Public Resources Code § 21159(a),[2] an SED must "at a minimum" include all of the following:

> (1) An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
> (2) An analysis of reasonably foreseeable feasible mitigation measures.
> (3) An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation.
>
> …

Section 21159(d) further explains that an SED must "take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites."

Though § 21159 does not require the preparing agency to engage in "speculation or conjecture," an SED must consider the environmental effects of future actions that might result from a project if: "(1) it is a reasonably foreseeable consequence of the initial project; and (2) the future expansion or action will be significant in that it will likely change the scope or nature of the initial project or its environmental effects." (*Laurel Heights*, 47 Cal.3d at 396; *Center for Biological Diversity v. County of San Bernardino* (2016) 247 Cal.App.4th 326, 349; *Paulek v. Department of Water Resources* (2014) 231 Cal.App.4th 35, 46.)

[2] Cited by the subject SED as applicable authority. (SED p. 2.)

B. The Regional Board Cannot Delegate To CV SALTS Its Responsibility To Prepare An SED In Support Of An SNMP Or Basin Amendment.

The SED was prepared by Robertson-Bryan, Inc. in association with CDM Smith. Neither of these companies were retained, managed or directed by the Central Valley Regional Water Quality Control Board (the "Regional Board"). Instead, they were retained by CV-SALTS stakeholders, which itself was formed by "a broad group of agriculture, cities, industry, and regulatory agencies…" (SNMP, p. ES-2.) Specifically, CV-SALTS and its experts are funded by a non-profit organization called Central Valley Salinity Coalition ("CVSC"), which has members including certain regulated local and county governments, agencies, and agricultural associations.[3] The Regional Board is not a member of CVSC.

Reliance on the draft SED produced by CVSC consultants is improper because the Regional Board has not exercised its "own review and analysis," and the SED does not "reflect the independent judgment of the" Regional Board. (*See* Cal. Code Regs., tit. 14, § 15084(e).) Moreover, the Regional Board has not met its responsibility to ensure that the SED is "adequate" and "objective," especially given that those who conducted the relevant studies and environmental analysis were assuredly not "objective" as they themselves would be regulated under the draft SNMP and any resulting basin amendments. (*Id.*; *see also* California Clean Energy Committee v. City of Woodland (2014) 225 Cal.App.4th 173, 194 ["Under CEQA, a public agency cannot charge a developer with the responsibility to study the impact of a proposed project."]; *Sundstrom v. County of Mendocino* (1988) 202 Cal.App.3d 296, 307 ["It is also clear that the conditions improperly delegate the County's legal responsibility to assess environmental impact by directing the applicant himself to conduct the hydrological studies subject to the approval of the planning commission staff."].)

C. The SED Does Not Properly Analyze A Reasonable Range Of Alternatives.

In order to comply with the "analysis of alternate means of compliance" requirement of § 21159, an SED must include "[a]lternatives to the activity and mitigation measures to avoid or reduce any significant or potentially significant effects that the project might have on the environment." (Cal.Code Regs., tit. 14, § 15252(a); *see also Conway v. State Water Resources Control Bd.* (2015) 235 Cal.App.4th 671, 680 [holding in the context of a basin plan amendment that "[t]he document used as a substitute for an EIR must include a description of the proposed activity with alternatives to the activity and mitigation measures as well as written responses to significant environmental points raised during the evaluation process."].)

The "alternatives" discussion must include "a reasonable range of alternatives to the project, or to the location of the project, which could feasibly attain the basic objectives of the project and evaluate the comparative merits of the alternatives." (*Laurel Heights*, 47 Cal.3d at 400; Guidelines, § 15126(d).) Moreover, "[t]hese alternatives must be discussed, 'even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly.'" (*Id.*)

The SED here does not comply with these requirements. By its own terms, the SED analyzes only two (2) alternatives: "[t]wo alternatives are provided for this assessment, the Proposed Project and

[3] http://www.cvsalinity.org/index.php/about-us/what-is-the-central-valley-salinity-coalition.html

a No Project Alternative…" (SED, pp. 3-4.) This is not a "reasonable range of alternatives to the project" as is required.[4] Taking no action, while clearly an alternative, does not encompass all "reasonably foreseeable" alternatives.

The California Supreme Court's opinion in *Laurel Heights* is instructive. (47 Cal.3d at 376.) In *Laurel Heights*, a draft EIR analyzed only three (3) alternatives for the site for research facilities at the University of California, San Francisco: "no project anywhere, alternative sites on the UCSF Parnassus campus, and alternative sites off-campus." (*Id.* at 403.) In analyzing the alternatives, the EIR made the conclusion that the no project alternative would have no environmental effects, and then stated merely that "no alternative sites on [the Parnassus] campus were evaluated…" (*Id.*) The court concluded that "[t]his is not a sufficient discussion of on-campus alternatives; it is merely an admission that such alternatives were not considered." (*Id.*) With respect to consideration of other off-campus sites, *Laurel Heights* held that the discussion in the EIR was "equally deficient" because the discussion simply entailed a statement that none of the off-campus properties owned by UCSF "had space available of sufficient size to accommodate the School of Pharmacy units that are to be moved." (*Id.*) The court thus held that "[i]t defies common sense for the Regents to characterize this as a discussion of any kind; it is barely an identification of alternatives, if even that. (*Id.*)

The discussion of alternatives in the instant SED falls short of even the Regents' "discussion" in *Laurel Heights*. While the Regents' at least identified, albeit in a cursory manner, alternatives in addition to a "no project" alternative, the SED here *only* discusses a "No Project" alternative. This is facially insufficient, and does not satisfy one of the primary purpose of CEQA, i.e., to "demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implications of its action." (*Bay Area Citizens v. Association of Bay Area Governments* (2016) 248 Cal.App.4th 966, 996.)

The range of alternatives that the SED should have considered and discussed in various combinations (many of which were brought to the attention of CV-SALTS participants by the EJ Stakeholders and are included in Attachment D-3) include, but are not limited to: (a) strengthening or otherwise modifying standards for waste discharge requirements and exceptions (*See* Attachment D-3 p. 3-4); (b) no use of management zones for compliance with nitrate requirements of the SNMP or determination of assimilative capacity (Attachment D3 pp. 1-2); (c) use of only three categories of discharges rather than the proposed five in order to prevent degradation of water quality and provide a buffer between a proposed discharge and the water quality objectives (Attachment D-3 p. 3); and (d) limiting the use of offsets as a means of compliance with water quality objectives such that the discharger can demonstrate no degradation and no localized impacts as a result of the discharge in combination with the "offset" (Attachment D-3 p. 5).

Moreover, even if the "No Project Alternative" by itself constituted a "reasonable range of alternatives" – though it clearly does not – the SED would still be deficient because it does not discuss the implications of the No Project Alternative in a sufficiently careful and factual manner.

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[4] Though the SED briefly mentions certain "options" describing potential variations to the Proposed Project, those options are not subjected to environmental analysis and thus do not constitute an "analysis" of alternatives.

As noted in the SED and above, the Regional Board should not engage in "speculation or conjecture." Along the same lines, "[c]onclusory comments in support of environmental conclusions are generally inappropriate." (*Laurel Heights*, 47 Cal.3d at 404 citing *People v. County of Kern* (1974) 39 Cal.App.3d 830, 840; *see also Bay Area Citizens*, 248 Cal.App.4th at 997 ["As a general matter the EIR must present facts and analysis, not simply the bare conclusions or opinions of the agency."].)

In contrast to these requirements, the SED engages in significant speculation and conjecture with respect to the negative impacts of the "No Project Alternative" in an apparent attempt to lessen by comparison the significant impacts associated with the Proposed Project. (*See*, e.g., p. 140 ["it should be noted that it is ***uncertain*** whether implementation of additional [best management practices] by agriculture could achieve compliance with existing regulations for salts and nitrate."] [emphasis added]; ["Degradation of groundwater salt and nitrate levels that is occurring under existing conditions would continue to occur in *some areas* of the Central Valley Region for a *period of time* before necessary actions to stop degradation could be implemented."]; p. 141 ["further degradation of such groundwater areas also would occur over a multi-year period into the future before corrective actions would be implemented under the No Project Alternative"]; ["implementation of the No Project Alternative would not result in the ultimate improvements in groundwater quality that are anticipated to occur with full implementation of the SNMP."].) No factual evidence is given for these conclusions, and as such the discussion of the impacts of the No Project Alternative is mere speculation.

The EKI Report also concludes that the "No Project Alternative" is not adequately evaluated in the SED. Specifically, the Report concludes that:

> The strategies assessed by CV-SALTS do attribute some nitrogen reductions to the dairy and irrigated lands WDRs, but do not evaluate nitrogen reductions that are being attained or are possible with best management practices ("BMPs"). LWA [Larry Walker Associates, Luhdorff and scalmanini Consulting Engineers, PlanTierra, and Formation Environmental] states it applied a "relatively arbitrary 20% estimate of potential future reductions in N application rates" to the irrigated lands WDRs. Thus, simulation results for the No Project (i.e., Scenario 3) scenario presented in the Economic Analysis are not based on actual or anticipated nitrogen reductions and may not reflect how groundwater nitrate concentrations will really change in response to BMPs.

(p. 4.)

Consequently, the Regional Board should not adopt the SNMP. The supporting SED does not comply with the requirements of CEQA or Public Resources Code § 21159. Further, even if a reasonable range of alternatives had been discussed, the Regional Board should not approve the Project as proposed because there are feasible alternatives and feasible mitigation measures available which would substantially lessen the significant environmental effects of the project. (*See* (Pub. Resources Code, § 21002 ["public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects…"].)

D. **The SED Does Not Adequately Discuss Enforceable And Feasible Mitigation Measures.**

CEQA requires identification of "feasible mitigation measures." (*Laurel Heights*, 47 Cal.3d at 402.) "Mitigation" may include "(a) Avoiding the impact altogether by not taking a certain action or parts of an action; (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment; (d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; [and] (e) Compensating for the impact by replacing or providing substitute resources or environments." (Cal. Code Regs., tit. 14, § 15370.) The term "feasible" means "'Feasible' means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." (Cal. Code Regs., tit. 14, § 15364.)

Additionally, "[f]ormulation of mitigation measures should not be deferred until some future time." (*Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 92 quoting CEQA Guidelines, § 15126.4(a)(1)(B).) An EIR is inadequate if "[t]he success or failure of mitigation efforts may largely depend upon management plans that have not yet been formulated, and have not been subject to analysis and review within the EIR." (*Communities for a Better Environment*, 184 Cal.App.4th at 92)

Here, the SED fails to discuss feasible mitigation measures. For example, the SED concludes that the Nitrate Permitting Strategy, Exceptions Policy, and Offsets Policy will have "potentially significant impacts" to degradation of water quality. (pp. 101-111.) However, no feasible mitigation measures are identified or discussed with respect to these significant impacts, though such measures are available as demonstrated by CV-SALTS technical memoranda. (*See*, e.g., Alta Irrigation District Management Zone: Aggressive Restoration Alternative Modeling Scenario Results, p. 13 ["Localized efforts in areas that are of high priority (based on proximity to communities and existing ambient conditions) may be potentially ideal for restoration activities that may include on farm recharge, other artificial recharge efforts, and pump/treat/reinject efforts."]; EKI Report p. 7 [same].) The failure to discuss feasible mitigation measures, and deferral of specific discussions to future plans, renders the SED non-compliant with CEQA.

The SED does briefly mention in connection with the "exceptions" policy that "[a]s a condition for authorizing an exception for nitrate, [the policy] add[s] a new provision requiring dischargers to assure an adequate supply of safe, reliable and affordable drinking water in those areas of the groundwater basin or subbasin adversely affected by the non-compliant discharge (or discharges)." (p. 66.) Though this discussion is not characterized in the SED as a mitigation measure, it is conceivable that the proponents of the draft SNMP may contend that it is intended to be mitigation. One problem with this argument is that it is only offered as "mitigation" to the "exceptions" policy and not to the other discrete policy proposals or cumulative impact assessment. Another problem is that the "mitigation" measure does nothing to address the environmental impacts of the draft SNMP.

Further, the replacement water proposal, to the extent it can be characterized as a specific proposal, is insufficient because there are no enforcement measures or monitoring programs. "When a project will result in an adverse change to the physical environment, CEQA instructs that 'the agency 'shall provide that measures to mitigate or avoid significant effects on the environment

are fully enforceable through permit conditions, agreements, or other measures' ([Pub. Resources Code] § 21081.6, subd. (b)) and must adopt a monitoring program to ensure that the mitigation measures are implemented (§ 21081.6, subd. (a))." (*California Clean Energy Committee v. City of Woodland* (2014) 225 Cal.App.4th 173, 189.) The "purpose of these requirements is to ensure that feasible mitigation measures will actually be implemented as a condition of development, and not merely adopted and then neglected or disregarded." (*Id.*)

Thus, even to the limited extent that the SED discusses mitigation, it is insufficient because there are no discussed measures to ensure that mitigation measures are fully enforceable or monitoring programs to ensure that mitigation measures are implemented.

E. **The Conclusions In The SED Are Not Supported By Substantial Evidence, And The SED Is Not Sufficient As An Informational Document.**

The conclusions contained in an SED are subject to judicial review to determine "whether they are supported by substantial evidence and whether the EIR is sufficient as an informational document." (*Laurel Heights*, 47 Cal.3d at 407.) "Argument, speculation, unsubstantiated opinion or narrative, [or] evidence which is clearly erroneous or inaccurate…does not constitute substantial evidence." (Cal. Code Regs., tit. 14, § 15384(a).) Moreover, a conclusion is not supported by substantial evidence, and an SED is not sufficient as an information document, if its conclusions and discussions are internally inconsistent or contradictory. (*See Communities for a Better Environment*, 184 Cal.App.4th at 89 ["For the foregoing reasons, we agree with the trial court that the EIR fails as an informational document because the EIR's project description is inconsistent and obscure as to whether the Project enables the Refinery to process heavier crude. … Due to these errors, the EIR failed its informational purpose under CEQA."].)

1. The "No Impact" Finding Related To Violation Of Water Quality Standards Or Waste Discharge Requirements Is Unsupported By Substantial Evidence.

The SED acknowledges that the SNMP "policies would allow temporary, modified application of water quality standards for individual dischargers so that discharges can be permitted that would otherwise be determined out of compliance with WDRs or would need to be prohibited." (p. 99.) Similarly, the SED states that:

> During the period in which the management zone is formed and the required proposals and plans are prepared and submitted, and the plans are implemented, there could be degradation of nitrate relative to existing conditions. If this degradation occurs in areas where groundwater nitrate is near or already above the 10 mg/L-N objective, this degradation would have the potential to adversely affect the MUN beneficial use. The duration of the degraded nitrate conditions would depend on the sources and amount of nitrate loading to the affected aquifer, and type of short and long-term project(s) implemented to reduce groundwater nitrate concentrations, but is estimated to be multiple years, if not decades in some areas of substantial impairment.

(pp. 104-105.)

Similarly, the SNMP states as follows:

> Overall, the SNMP recommends that the Central Valley Water Board be predisposed to allocate assimilative capacity, and allow lower water quality, where doing so assures a significantly better outcome for the people of California than would requiring strict compliance with default WDRs/Conditional Waivers.

(pp. 4-45.)

These conclusions in the SED and SNMP regarding impact on groundwater are consistent with the EKI Report. The Report concludes that "[i]n essence, both CV-SALTS and the California Nitrate Project find that it is not 'reasonable and feasible' to restore an aquifer to its beneficial uses once groundwater nitrate concentrations are greater than the drinking water standard. The Proposed Project allows for continued lowering of groundwater quality even though aquifer restoration is not possible." (EKI Report, pp. 3-4.) The Report further concludes that "[g]roundwater quality in a basin or subbasin will likely decline [under the Proposed Project] because the default position of the SNMP is to allocate assimilative capacity based on nitrate concentrations in the basin/subbasin. The prospect for improving groundwater quality after the Regional Board has allocated assimilative capacity is limited given basin/subbasin restoration is not practicable." (EKI Report p. 6.)

Despite these clear statements of impact in the SNMP, SED and the concurrently filed Report, the SED paradoxically also concludes "the Proposed Project itself would not cause violation of water quality standards or waste discharge requirements." (p. 99.) The unstated premise appears to be that modified application of water quality standards and waste discharge requirements will have no impact on violation of water quality standards because either: (a) water quality standards have been modified such that the discharger, even if it causes an exceedance of the nitrate maximum contaminant level, is in compliance; or (b) the discharger was bound to violate the water quality standards or waste discharge requirements under present regulations, such that a modification of those regulations has no effect. (*Id.*) The other possible interpretation is that a "regulatory action" cannot impact on the violation of water quality standards or waste discharge requirements. (*Id.*)

None of these possible interpretations meets the requirements of CEQA. The "no impact" finding for violation of water quality standards and waste discharge requirements is thus unsupported by substantial evidence, and the SED fails as an informational document.

2. The "Less Than Significant Impact" Finding Related To Groundwater Supplies Is Not Supported By Substantial Evidence.

The SED concludes that there will be a less than significant impact on groundwater supplies because the proposed project does not call for construction of "facilities that would rely on extraction of groundwater supplies" and does not effect groundwater recharge. (p. 99.) However, the SED does not consider or discuss the fact that reduction in groundwater quality has a substantial

effect on groundwater supplies for relevant beneficial uses, and that the Proposed Project will have a significant impact on groundwater quality. As such, the "less than significant" impact finding is not supported by substantial evidence and the SED fails as an informational document.

3. The "Less Than Significant" Finding Related To The Nitrate Permitting Strategy As Applied To Individual Dischargers Is Unsupported By Substantial Evidence.

The SED concludes that "the Nitrate Permitting Strategy could result in **potentially significant impacts** to water quality degradation in regard to nitrate in the coming years and potentially decades, but would be expected to ultimately improve nitrate concentrations within the Central Valley Region, relative to existing conditions, upon the full implementation of the strategy such that the impact with regard to water quality degradation would be **less than significant**." (p. 105 [emphasis in the original].)

The duration and severity of these water quality degradation impacts are acknowledged to be "depend on the sources and amount of nitrate loading to the affected aquifer, and type of short and long-term project(s) implemented to reduce groundwater nitrate concentrations, but is estimated to be multiple years, if not decades in some areas of substantial impairment." (*Id.*) Similarly, the SED acknowledges that the proposed project would cause water quality degradation for a period of time that could be "years or decades." (*Id.*)

The conclusion that, "upon full implementation" degradation would be "less than significant" is made based on pure conjecture. There is no analysis to support the conclusion, and the timeframe is speculative. As the EKI Report concludes, "[i]n essence, both CV-SALTS and the California Nitrate Project find that it is not "reasonable and feasible" to restore an aquifer to its beneficial uses once groundwater nitrate concentrations are greater than the drinking water standard. The Proposed Project allows for continued lowering of groundwater quality even though aquifer restoration is not possible." (p. 4.) Further, the SED itself concludes that restoration of degraded waters will only be done, alternatively, "where feasible and practicable" (pp. 104, 119, 140) or when "reasonable and feasible" (*See* pp. 1, 2, 56, 62). The SNMP does not specify relevant factors or protocols for determining when restoration would be "reasonable and feasible," nor does it include any timeline for restoration. (*See* EKI Report p. 8.)

As such, the conclusory statement that upon "full implementation" the SNMP will have a "less than significant" impact on groundwater quality is unsupported by substantial evidence, and the SED fails as an informational document.

4. The "Less Than Significant Impact" Finding Related To The Nitrate Permitting Strategy As Applied To Management Zones

As noted in Section D.3., *supra*, the conclusion in the SED that the nitrate permitting strategy will have a less than significant impact on water quality degradation "upon full implementation" is erroneous and unsupported by substantial evidence. As applied to management zones, the "less than significant" impact finding fails for the same reasons.

Additionally, the option to apply the nitrate permitting strategy as applied to management zones will have an even more significant impact - even after "full implementation." The SED states that,

the SNMP would permit allocation of "assimilative capacity for nitrate in groundwater…management zones." (p. 103.) The SED then admits that, "[d]uring the period in which the management zone is formed and the required proposals and plans are prepared and submitted, and the plans are implemented, there could be degradation of nitrate relative to existing conditions" and that the duration of degraded conditions "is estimated to be multiple years if not decades…" (p. 105.)

What the SED fails to note is that, even after "full implementation" the allocation of "assimilative capacity" across a management zone – which is not defined to have any hydrological basis for its boundaries – there will inevitably be continued degradation in localized areas. The implicit assumption underlying the "assimilative capacity" concept is that groundwater in a basin or subbasin undergoes rapid mixing such that when a contaminant is introduced it diffuses into the basin or subbasin as a whole. This assumption is incorrect.

As explained in the EKI report:

> Assimilative capacity is generally regarded to exist when receiving waters are able to absorb increased pollutant loads without exceeding applicable Basin Plan objectives. In other words, the nitrate assimilative capacity of an aquifer can be defined as the cumulative effect of all biologic and hydraulic processes that keep nitrate mass flux or concentration below a limit set for a given water body.
>
> However, "the flow of groundwater does not promote mixing and any mixing that does occur is over very long periods of time." Lack of rapid mixing leaves open the possibility that groundwater nitrate plumes will form and persist despite the availability of assimilative capacity on a basin/subbasin scale. The SNMP does not indicate the permissible size of such nitrate plumes and is ambiguous as to the portion of an aquifer that may be affected.

(EKI Report, p. 8.)

As the SED does not acknowledge or discuss the likelihood of creation of nitrate plumes and other localized impacts, its "less than significant" impact finding related to the nitrate permitting strategy are unsupported by substantial evidence and the SED fails as an informational document.

5. The Impact Determinations Related To The Offsets Policy Are Unsupported By Substantial Evidence.

The SED properly acknowledges that adoption of the "offsets policy" has the "potential for long-term degradation of water quality, relative to existing conditions, on a localized basis within groundwater basins, subbasins, and management zones, on a long-term average basis, that could adversely affect the direct use of the degraded water for MUN or AGR uses within the local area" such that "it is concluded that the Offsets Policy could result in localized potentially significant impacts with regard to water quality degradation." (p. 110.) However, the impact is not "unavoidable" as the SED concludes in that reasonable alternatives and feasible mitigation measures exist. (*See* Sections I.C. and I.D., *supra*.)

Moreover, the SED incorrectly concludes that the use of "offsets" will have "no impact" under "Option 2" which permits offsetting "only in the area of the discharge impact that [would] result in water quality objectives being attained." (*Id.*) However, the SNMP does not define the phrase "in the area of the discharge impact" in a way that is sufficient to protect groundwater. For the same reasons discussed above with respect to the nitrate permitting strategy as applied to management zones (Section E.4., *supra*), localized impacts will occur even where the offset project is relatively near to the discharge. This is because groundwater mixing occurs slowly and nitrate plumes are thus likely to occur. (EKI Report, p. 8.)

Finally, the SNMP includes as an example of an "offsets" payment by dischargers into a "nitrate mitigation fund" to be used for drinking water supply projects. (*See* SNMP A7-7.) While the EJ Stakeholders support creation of such a fund, it is not an "offset" that would have any impact on groundwater quality. As such, the "offsets" policy may result in substantial impacts on groundwater quality even if applied only under Option 2. Because this issue is not discussed in the SED, it fails as an informational document.

6. The Impact Determinations Related To Cumulative Groundwater Quality Conditions Are Unsupported By Substantial Evidence.

The SED concludes that there are "potentially significant" but "unavoidable" cumulative impacts on nitrate in groundwater because "the Proposed Project would allow localized areas of groundwater basins/subbasins that are near or over the applicable water quality objective to be further degraded in the future, and because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions," and that as a result, "the Proposed Project would contribute considerably to adverse cumulative conditions of nitrate in some localized areas of basins/subbasins within the Central Valley." (p. 137.)

While the SED is correct to conclude that the draft SNMP will cause considerable adverse cumulative impacts, it is incorrect that the impacts are "unavoidable." The conclusion once again highlights the SED's failure to consider a reasonably foreseeable alternatives and feasible mitigation measures. (*See* Sections I.C. and I.D., *supra*.)

Further, its discussion of the benefits of the Proposed Project relative to the No Project Alternative fails for the same reason as discussed in Section I.C., *supra*. Though the SED concludes that the Proposed Project "is expected to have a beneficial impact on the future cumulative nitrate conditions at the basin and subbasin level," that conclusion is based wholly on speculation both with respect to the impact of the Proposed Project and on the evaluation of the No Project Alternative.

The cumulative impact evaluation in the SED is also inconsistent with respect to management zones in its analysis of cumulative groundwater impacts. Specifically, the SED discusses cumulative impacts on a "basin/subbasin volume-weighted average basis, which is the proposed management structure for controlling and restoring nitrate." (SED, p. 138.) This conclusion is inconsistent with the management zone discussion, in that a management zone can exceed the size of any relevant basin in Region 5. Because the findings related to cumulative impacts do not take into consideration that management zones are not restricted to only one basin or subbasin, the conclusion that "implementation of the Proposed Project is not expected to have a considerable

contribution to any adverse cumulative conditions with respect to nitrate conditions at the basin or subbasin level" is incorrect. If a management zone is larger than a basin or subbasin, cumulative impacts at the basin or subbasin level are likely, given averaging across the management zone.

The cumulative impact evaluation is thus not supported by substantial evidence, and fails as an informational document.

7. The "Less Than Significant Impact" Finding Related To Greenhouse Gas Emissions Is Not Supported By Substantial Evidence.

The SED acknowledges that "[n]itrate in soil can be converted to nitrous oxide, a greenhouse gas" and that "[n]itrogen fertilization practices contribute significantly to nitrous oxide production; nitrous oxide emissions increase dramatically when fertilization exceeds crop usage…" (p. 93.) However, the SED concludes that the Proposed Project will have a "less than significant" impact on greenhouse gas emissions because "fertilizer application rates in the future would be expected to be no greater than under existing conditions." (Id.)

This impact finding is incorrect and not supported by substantial evidence because the SED is answering the wrong question. The Proposed Project alters existing regulations related to nitrate loading, waste discharge requirements, and exceptions. The correct question, then, is not whether fertilizer application rates in the future are expected to be greater than current fertilizer application rates, but whether rates will be greater in the future under the Proposed Project or the No Project Alternative.

Further, as the SED acknowledges that the Proposed Project will result in "water quality degradation in regard to nitrate in the coming years and potentially decades" (p. 105) due to allegedly temporary "degradation of nitrate relative to existing conditions" (p. 104), it stands to reason that there will also be temporary significant impacts related to greenhouse gas emissions. As the SED does not discuss of acknowledge these impacts, it is unsupported by substantial evidence and fails as an informational document.

II. <u>Economic Analysis</u>

The Economic Analysis contains many untenable assumptions that were made without proper consideration and that affect not only the analysis itself, but also the SED and Antidegradation analysis. Those assumptions include, but are not necessarily limited to, the following.

First, the Economic Analysis excludes from consideration cities and towns with populations greater than 5,000 "because, for this analysis, it is assumed that these cities[5] have existing community water systems and would not be candidates for user protection under the Central Valley SNMP." (p. 98.) This is circularity and assumption masquerading as reasoning. No analysis is performed to support the assumption that "these cities have existing community water systems" and no criteria is given for why they "would not be candidates for user protection under the Central Valley SNMP." There is no evidence examined in the economic analysis regarding how many cities with greater than 5,000 residents have community water systems. Further, even if small cities do generally have community water systems, that fact alone does not support the conclusion

[5] Later in the Economic Analysis, this statement is broadened to include "towns" as well. (p. 98.)

that the water systems are in compliance with the nitrate MCL, or that the residents of those cities are able to afford treatment facilities for contaminated groundwater. Many communities with greater than 5,000 residents likely cannot afford nitrate treatment costs.

The Economic Analysis uses this unsupported and unwarranted assumption to exclude communities with more than 5,000 residents from its calculations regarding the likely cost of emergency drinking water and permanent solutions. The conclusions of the Analysis should thus be rejected.

Second, the Analysis assumes 2010 population numbers for cost estimates regarding drinking water programs. (See p. 98 n.35 ["Enumeration of households based on census block data taken from 2010 U.S. Census data."].) The Analysis should instead rely on population projections that will more accurately reflect the cost of implementing the underlying program and projects. Many portions of the study area are projected to increase substantially in the coming years, and that population growth will have an impact on the accuracy of the Economic Analysis.

Third, the Economic Analysis should, but does not, consider the dynamic costs associated with providing bottled water as more residents are impacted by increased nitrate levels, while at the same time, more residents receive clean drinking water through permanent solutions.

Fourth, the Economic Analysis estimates that the average household uses 2.25 gallons of water per day, both in calculating the costs of bottled water and the costs of point of use treatment. (See p. 101 ["The following assumptions were used to calculate the annual cost to provide bottled water to individuals and households: Drinking water consumption per household is 2.25 gallons per day (gpd)."]; Appendix E [showing under "Assumptions" for point of use treatment systems, "2.25 gallons per day per household."].)

It appears that the 2.25 gallons per day per household assumption comes from the California Nitrate Project. (EKI Report, p. 8.) Unfortunately, it is not an accurate assumption of household water needs in the study area. As described in more detail in the EKI Report (pp. 8-9), this assumption corresponds to the average Adequate Intake of drinking water and beverages necessary to maintain sufficient hydration in young men and women between the ages of 19 to 30 years in temperate climates. Adequate Intake refers to the amount of water a person needs to "stay sufficiently hydrated." (EKI Report, p. 8.)

This number is thus significantly low. The study area is not a temperate climate, where summer temperatures "routinely reach 90°F or higher." (EKI Report, p. 9.) Moreover, 2.25 gallons does not include water used for "washing foodstuffs, cooking, and oral hygiene." (Id.) In order to take these necessary activities into consideration, "a more appropriate water usage rate for estimating bottled water costs is 10 to 20 gal/day per household, not 2.25 gal/day per household." (Id.)

This change would significantly alter the conclusions in the Economic Analysis, which already estimates bottled water costs at a minimum of $80 million annually and point of use costs at a minimum of $19 million annually. (Economic Analysis, pp. 101, 105.) The bottom line is that the Economic Analysis significantly underestimates the costs associated with providing replacement drinking water, and thus the SNMP undervalues the benefits associated with preventing further groundwater degradation.

Cumulatively, the unsupported assumptions described above render the conclusions in the Economic Analysis unsupported by substantial evidence. Thus, to the extent that those conclusions are used and relied upon in the SNMP, Antidegradation Analysis and SED, those documents are tainted by the same incorrect reasoning contained in the Economic Analysis.

III. Antidegradation

A. The Antidegradation Analysis States The Wrong Legal Standard For The State Antidegradation Policy.

As properly acknowledged in the Antidegradation Analysis, the California State Antidegradation Policy derives from Resolution 68-16 issued by the State Water Resources Control Board ("SWRCB"), which states in part that high quality waters shall "be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies." Resolution 68-16 further states that "[a]ny acitivity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with the maximum benefit to the people of the State will be maintained."

However, the Antidegradation Analysis here misstates applicable law interpreting the Antidegradation Policy. Specifically, it cites to an unsigned and inoperable proposed order submitted to the SWRCB: "However, as explained within State Board Order WQ-2016-XXXX,[6] the State Water Board found that it is inappropriate to apply a discrete point source discharge approach in the context of a general order regulating both surface water and groundwater discharges from irrigated agriculture operations across a large landscape." (*See* p. 7.) The unsigned proposed order states that "[t]he diffuse, landscape level groundwater discharges regulated under the Eastern San Joaquin Agricultural General WDRs are unlike the concentrated discharges from dairy retention ponds and corral areas that were the subject of Asociacion de Gente Unida por el Agua v. Central Valley Water Board…" (*Id.* at n.8.)

As the unsigned proposed order has not been adopted by the SWRCB, it is not authority for the proposition that *Asociacion de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Bd.* (2012) 210 Cal.App.4th 1255, 1256 (hereinafter "*AGUA*") is inapplicable in the context of discharges from irrigated agriculture. Further, there is nothing in *AGUA* that would suggest that it should be limited to point source discharges. The case relies on an interpretation of Resolution 68-16 and the Porter-Cologne Water Quality Control Act, neither of which are limited in applicability to point source discharges.

The opinion of the Court of Appeal for the Third Appellate District in *AGUA* thus applies. In AGUA, the court considered whether a general waste discharge order issued by the Central Valley

[6] The "XXXX" appears to be a place holder for the order number inserted by the author in anticipation that the proposed order may be adopted before the final Antidegradation Analysis was submitted to the Regional Board.

Regional Water Control Board in 2007, which purported to prohibit further degradation of groundwater from existing dairy farms, was consistent with the antidegradation policy. (*Id.* at 1258-59.) In concluding that it was not, the court noted that a conclusory prohibition on further degradation was not sufficient to comply with the antidegradation policy. (*Id.* at 1259.) Instead, the *AGUA* court held that the Regional Board, in order to comply with the Antidegradation Policy, must affirmatively "demonstrate" compliance with the Policy. (*Id.* at 1278.)

This affirmative requirement is accomplished through a "two-step process" for "determining whether a discharge into high quality waters is permitted." (*Id.* at 1278, 1282.) The first step of the process is for the Regional Water Board to make three (3) "specified findings," that the "change in water quality (1) will be consistent with maximum benefit to the people of the State, (2) will not unreasonably affect present and anticipated beneficial use of such water, and (3) will not result in water quality less than that prescribed in state policies…" (*Id.* at 1278.)

The finding that a change in water quality will be "consistent with the maximum benefit to the people of the State" must be made on a "case-by-case basis…based on considerations of reasonableness under the circumstances at the site." (*Id.* at 1279.) In making this "case-by-case" finding, the Board must consider the following factors "(1) past, present, and probable beneficial uses of the water (specified in Water Quality Control Plans); (2) economic and social costs, tangible and intangible, of the proposed discharge compared to the benefits, (3) environmental aspects of the proposed discharge; and (4) the implementation of feasible alternative treatment or control methods." (*Id.*)

The second step of the AGUA process is a finding "that any activities that result in discharges to such high quality waters are required to use the best practicable treatment or control of the discharge necessary to avoid a pollution or nuisance and to maintain the highest water quality consistent with the maximum benefit to the people of the State." (*Id.*)

B. <u>The Degradation Of High Quality Waters Permitted By The Draft SNMP Is Not Consistent With The State Or Federal Antidegradation Policy.</u>

1. The "Qualitative Assessment" Categories Do Not Comply With State Antidegradation Policy.

The draft SNMP Antidegradation Analysis states that:

> In the absence of information to support a quantitative analysis,[7] the findings presented herein are presented as qualitative assessments.
> …
>
> These qualitative assessments described below fall into several common categories, all of which would be consistent with antidegradation policies, which are described below:

[7] The EJ Stakeholders question this statement, as CV-SALTS produced economic analysis, environmental studies and modeling that were submitted to the Regional Board concurrently with this Antidegradation Analysis. Though the EJ Stakeholders have challenged the accuracy of this data, the failure to cite to and discuss data where available should not be sanctioned by the Regional Board.

…

- A policy element will allow short-term change in high quality waters while actions are taken that improve beneficial use protection and provide long-term water quality improvement or other benefits.
- A policy element will allow a short term (sic) change of in (sic) high quality waters in a localized area while creating water quality improvements or other benefits in a larger area.

(p. 81-82.)

No analysis is offered as to why these two (2) "categories" are "consistent with antidegradation policies." As for the first category, permitting degradation – even short-term degradation – may not be consistent with the maximum benefit to the people of the State, especially given that "short-term" is defined to mean years or decades. The second "category" is similarly inconsistent with the State Antidegradation Policy, which looks to site-specific impacts on people. Depending on the location of the "localized area" of degradation, it may have significant impact on people outweighing any benefit to those living in a larger area. As a simple example demonstrating the principle, if a policy reduces concentrations of nitrate on a basin-wide basis from 5 mg/L to 4.9 mg/L, while also creating "hotspots" where nitrate concentrations increase from 7.5 mg/L to 15 mg/L thereby effecting beneficial uses, the policy likely would not be consistent with the maximum benefit to the people of the State.

As the instant Antidegradation Analysis relies on these two (2) categories, and incorrectly concludes categorically that any policy falling within them complies with the State Antidegradation Policy, the Analysis itself does not comply with the State or Federal Antidegradation Policy.

2. The Antidegradation Analysis Does Not Make The Proper Baseline Comparison.

"When undertaking an antidegradation analysis, the Regional Board must compare the baseline water quality (the best quality that has existed since 1968) to the water quality objectives." (*AGUA*, 210 Cal.App.4th at 1270.) Then, "[i]f the baseline water quality is equal to or less than the objectives, the objectives set forth the water quality that must be maintained or achieved" and "the antidegradation policy is not triggered." (*Id.*) On the other hand, "if the baseline water quality is better than the water quality objectives, the baseline water quality must be maintained in the absence of findings required by the antidegradation policy." (*Id.*)

The instant Antidegradation Analysis acknowledges that the proper baseline is the best water quality that has existed since 1968. (*See* p. 81 ["It should be noted that the consideration of water quality conditions existing in 1968 should be used in project specific evaluations performed in the implementation of the SNMP and associated policies where ambient data is available to enable such an assessment."].) However, the Analysis does not actually make any comparison of baseline water quality to water quality objectives. Instead, the Analysis uses "current water quality conditions in the Central Valley" to "provide a frame of reference for the evaluation of consistency with antidegradation policies." (*Id.*)

The argument appears to be that a proper antidegradation analysis – which makes the correct baseline comparison – does not need to be performed until "project specific" evaluations are conducted. There is no authority for this proposition cited in the antidegradation analysis.

Without a baseline analysis, the Antidegradation Analysis here is inadequate.

3. The Antidegradation Analysis Does Not Account For Cumulative Impacts.

As an initial matter, the Antidegradation Analysis undertaken here addresses only the discrete aspects of the Proposed Project separately, and does not evaluate the degradation permitted by the Project as a whole. (*See* pp. 80-144.) This approach is impermissible under the State Antidegradation Policy, as it avoids discussion of cumulative impacts. For example, it is possible, if not likely, that degradation permitted by each discrete policy (i.e., nitrate permitting strategy, offsets, etc.), even if separately consistent with the maximum benefit to the people of the State, would have cumulative impacts not consistent with the maximum benefit to the people of the State.

This oversight is particularly problematic here because the SED offered in support of the draft SNMP concludes that it will create "potentially significant" but "unavoidable" cumulative impacts on nitrate in groundwater because "the Proposed Project would allow localized areas of groundwater basins/subbasins that are near or over the applicable water quality objective to be further degraded in the future, and because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions," and that as a result, "the Proposed Project would contribute considerably to adverse cumulative conditions of nitrate in some localized areas of basins/subbasins within the Central Valley." (SED, p. 137.)

4. The Factual Findings In The Antidegradation Analysis Are Inconsistent With Those In The Draft SNMP And Related SED.

The Antidegradation Analysis tacitly acknowledges that many of the discrete policy proposals will degrade high quality waters of the State. (*See* Antidegradation Analysis, pp. 96 ["any short-term degradation will inhere to the maximum benefit to the people of the state…"]; 128 ["under the proposed Offsets Policy, the Board could authorize the allocation of assimilative capacity that would result in localized and limited water quality degradation while dischargers participating in the Offset Project implement projects that result in better water quality in the receiving water than if the non-compliant discharge was prohibited altogether"].)

Both the SED and draft SNMP go much further, acknowledging the potential of "decades" of "substantial impairment." (*See* SED pp. 104-105 ["During the period in which the management zone is formed and the required proposals and plans are prepared and submitted, and the plans are implemented, there could be degradation of nitrate relative to existing conditions. … The duration of the degraded nitrate conditions would depend on the sources and amount of nitrate loading to the affected aquifer, and type of short and long-term project(s) implemented to reduce groundwater nitrate concentrations, but is estimated to be multiple years, if not decades in some areas of substantial impairment.]; 105 ["the Nitrate Permitting Strategy could result in potentially significant impacts to water quality degradation in regard to nitrate in the coming years and potentially decades…"]; 110 [the "offsets policy" has the "potential for long-term degradation of water quality, relative to existing conditions, on a localized basis within groundwater basins,

subbasins, and management zones, on a long-term average basis, that could adversely affect the direct use of the degraded water for MUN or AGR uses within the local area" such that "it is concluded that the Offsets Policy could result in localized potentially significant impacts with regard to water quality degradation."]; 137 ["the Proposed Project would allow localized areas of groundwater basins/subbasins that are near or over the applicable water quality objective to be further degraded in the future, and because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions, … the Proposed Project would contribute considerably to adverse cumulative conditions of nitrate in some localized areas of basins/subbasins within the Central Valley."]; SNMP pp. 4-45 ["Overall, the SNMP recommends that the Central Valley Water Board be predisposed to allocate assimilative capacity, and allow lower water quality, where doing so assures a significantly better outcome for the people of California than would requiring strict compliance with default WDRs/Conditional Waivers."].)

As the Antidegradation Analysis inaccurately minimizes the potential nitrate degradation impacts associated with the draft SNMP, it should be rejected by the Regional Board.

Further, as it is clear that adoption of the draft SNMP will likely cause "substantial" degradation of high quality waters of the State for "multiple years, if not decades," an antidegradation analysis consistent with *AGUA* is required. Applying the proper legal standard, the policies contained in the draft SNMP do not comply with the State or Federal Antidegradation Policy.

5. The Degradation Permitted By The Draft SNMP Is Not Consistent With The Maximum Benefit To The People Of The State.

As noted above, the finding that a change in water quality will be "consistent with the maximum benefit to the people of the State" must be "affirmatively demonstrated" and made on a "case-by-case basis…based on considerations of reasonableness under the circumstances at the site." (*AGUA*, 210 Cal.App.4th at 1279.)

In making this "case-by-case" finding, the Board must consider the following factors "(1) past, present, and probable beneficial uses of the water (specified in Water Quality Control Plans); (2) economic and social costs, tangible and intangible, of the proposed discharge compared to the benefits, (3) environmental aspects of the proposed discharge; and (4) the implementation of feasible alternative treatment or control methods." (*Id.*) As the Antidegradation Analysis here does not consider those factors, and because those factors weigh against a maximum benefit finding, the draft SNMP does not comply with the State or Federal Antidegradation Policy.

a) Past, Present, And Probable Beneficial Uses Of The Water (Specified In Water Quality Control Plans)

The past, present and probable beneficial uses of water in the project area are varied and diverse. The Municipal and Domestic Supply Beneficial Use in particular has the potential for being severely impacted by degradation of groundwater due to nitrate discharges, even if that degradation is "short-term" or "localized." This is especially true given that "95% of the [San Joaquin] valley's population relies on groundwater for drinking." (CAROLINA BALAZS ET AL., SOCIAL DISPARITIES IN NITRATE-CONTAMINATED DRINKING WATER IN CALIFORNIA'S SAN

JOAQUIN VALLEY (Environmental Health Perspective 2011), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3230390/.)

As significant degradation is acknowledged to potentially result from the draft SNMP for "years" or "decades," and as the vast majority of residents of the San Joaquin valley rely on groundwater for drinking water, this factor weighs against a maximum benefit finding.

b) Economic And Social Costs

In considering "economic" costs, the Regional Board must consider "both costs to the discharger and the affected public," and in doing so, "[c]ost savings to the discharger, standing alone, absent a demonstration of how these savings are necessary to accommodate 'important social and economic development' are not adequate justification" for permitting degradation. (*Id.*) In considering "social" costs, consideration must be given to whether a lower water quality can be abated through reasonable means. In other words, the lower water quality should not result from inappropriate treatment facilities or less-than-optimal operation of treatment facilities." (*Id.*)

Discussing the "economic" costs first, the policies in the draft SNMP would permit "short-term" degradation for years or decades, followed by undefined remediation measures at some point in the future. Further, certain localized impacts will persist beyond that undefined point in time, given the conclusion that remediation of localized degradation will not always be feasible. (SED p. 137 ["the Proposed Project would allow localized areas of groundwater basins/subbasins that are near or over the applicable water quality objective to be further degraded in the future, and because it will not be feasible to remediate all such localized areas of groundwater back to existing conditions or conditions better than existing conditions…"].) That short-term and permanent degradation of groundwater will have a significant economic impact on the public at large, who will be forced to pay for replacement drinking water and/or permanent solutions given that dischargers are not required to provide replacement water by any provision in the draft SNMP in any consistent or enforceable manner. (*See* Section I.D., *supra*.) Moreover, even if the dischargers were required to provide replacement "drinking water," that phrase appears to be defined so narrowly as to include only the amount of water required for hydration at temperate climates, and does not include water used for cooking or washing. (*See* Section II., *supra*.)

Further, to the extent that replacement water is not provided by the discharger or end user, people will suffer health effects from drinking contaminated drinking water. Additionally, the increased degradation permitted by the draft SNMP will increase the eventual remediation costs associated with restoration of groundwater basins and subbasins. The Antidegradation Analysis here does not acknowledge or discuss these economic costs.

Weighed against these costs to the public are the cost savings to the discharger under the draft SNMP. (*See*, e.g., p. 88 ["Authorizing such degradation would grant dischargers the latitude to develop long-term implementation plans that are both ***cost-effective*** and that can prioritize compliance alternatives that will have a greater net effect on nitrate reduction."] [emphasis added].) These proposed solutions are "cost-effective" because restoration is only required when "reasonable and feasible." (*See* SED pp. 1, 2, 56, 62.) However, as there is no reasoning or facts supporting the proposition that cost savings to the dischargers "are necessary to accommodate 'important social and economic development," the costs savings standing alone do not support an "economic" benefit finding. Any statements to the contrary in the Antidegradation Analysis are

based on pure speculation[8] and underemphasize the interest in protective the broader economic interests of the people of the State of California relative the interests of the regulated community.

Turning to "social" costs, the question is whether the additional significant degradation can be abated by alternate means. The answer to that question is in the affirmative. The Regional Board could decline to adopt the SNMP and initiate basin plan amendments, and instead continue to enforce and strengthen waste discharge requirements and exceptions under the present regulatory framework.

Based on the above discussion, the "economic" and "social" costs factor weighs against a maximum benefit finding.

c) Environmental Aspects Of The Proposed Discharge

The environmental aspects of the proposed discharge have been detailed at length above, and will not be repeated at length here. It suffices to point out again that the draft SNMP would permit significant short-term degradation for years or decades, and that restoration of some localized areas will not be reasonable or feasible at any time in the future according to the SNMP. Further, the EKI Report, as explained in more detail in Section I.C, *supra*, concludes that even on a long-term basis, the SNMP will have a negative impact on nitrate contamination in the project area.

This factor thus weighs against a maximum benefit finding.

d) The Implementation Of Feasible Alternative Treatment Or Control Methods

As discussed in Section 4.b., *supra*, alternative control methods are available, and are already in effect. Specifically, the currently operative regulatory framework provides more protection to groundwater. As such, this factor also weighs against a maximum benefit finding.

As all four (4) factors weigh against a finding that adoption of the draft SNMP is consistent with the maximum benefit to the people of the State, permitting the degradation associated with the draft SNMP is not consistent with State or Federal Antidegradation Policy.

6. The SNMP Will Unreasonably Affect Present And Anticipated Beneficial Use Of High Quality Waters Of The State.

Even if the discharges permitted by the draft SNMP were consistent with the maximum benefit to the people of the State – though they are not – the SNMP still would not satisfy the "first step" of an Antidegradation Analysis because the SNMP will unreasonably affect present and anticipated beneficial use of high quality waters of the State. As discussed in Section B.4., *supra*, the SNMP will permit "short-term" degradation for "years" or "decades," and restoration of those impacted areas will not always be reasonable or feasible. Though no locations or time periods are specified in the SNMP, it is likely that this degradation will in some areas restrict present beneficial uses of groundwater for "years," "decades" or indefinitely. (*See*, e.g., SED p. 110 [the "offsets policy"

[8] (*See* p. 143 ["Consequences to dischargers are outlined in Section 5.2, ***raising a question*** of whether dischargers would be able to comply with issued permits and WDRs, or if the cost of continued operation would force dischargers to cease operations."] [emphasis added].)

has the "potential for long-term degradation of water quality, relative to existing conditions, on a localized basis within groundwater basins, subbasins, and management zones, on a long-term average basis, that could adversely affect the direct use of the degraded water for MUN or AGR uses within the local area"].) This impact is unreasonable, especially given that alternative regulatory structures exist and are presently in effect that better protect groundwater, and the only negative economic impacts on dischargers are speculative. (*See* Section 4.b., *supra*.)

7. The SNMP Will Result In Water Quality Less Than That Prescribed In State Policies

The SED acknowledges that the SNMP will result in degradation that will have the potential to degrade water to the point that MUN and AGR beneficial uses are effected. (*See* SED p. 110.) It also acknowledges that there will be degradation of groundwater due to nitrate discharges for "years" and "decades," and that it will not be reasonable or feasible to restore some localized areas of degradation. (*See* Section 4., *supra*.) As such, the SNMP will result in water quality that is less than that prescribed in State policies.

8. The SNMP Will Not Result In Best Practicable Treatment Or Control Of The Discharge Necessary To Avoid A Pollution Or Nuisance And To Maintain The Highest Water Quality Consistent With The Maximum Benefit To The People Of The State

Based on the foregoing discussion, under the proper standards to the first step of the antidegradation analysis, the discharges permitted by the draft SNMP are inconsistent with the Antidegradation Policy. As such, the discharges should not be permitted and the SNMP should not be adopted. The Regional Board should not proceed to the second step of the "two step" Antidegradation process.

However, assuming for sake of argument that the Regional Board could demonstrate that the nitrate discharges permitted by the SNMP were consistent with the maximum benefit to the people of the State, it should still refuse to adopt the SNMP because it would not result in best practicable treatment or control of the discharge necessary to avoid pollution or nuisance. The SNMP makes no attempt to control discharges or nitrate contamination in the short-term, stating:

> Overall, the SNMP recommends that the Central Valley Water Board be predisposed to allocate assimilative capacity, and allow lower water quality, where doing so assures a significantly better outcome for the people of California than would requiring strict compliance with default WDRs/Conditional Waivers.

(pp. 4-45.) As a result of this predisposition to allocation of assimilative capacity on a subbasin, basin or potentially larger geographic area, as well as the other discrete policies such as offsets, the SNMP would create localized impacts on both a short and long-term basis, and would specifically impact the MUN beneficial use. (*See* SED p. 110.) As "pollution" in this context is defined in part to mean "an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects…[t]he waters for beneficial uses," an impairment that impacts the MUN beneficial use is pollution.

As a result, best practicable treatment or control in this context must address restoration of groundwater so as not to interfere with beneficial uses. However, after degradation is permitted, the SNMP requires only that dischargers engage in restoration of degraded groundwater where "reasonable and feasible." (*See* SNMP Goal 3 ["Implement managed aquifer restoration program, where reasonable and feasible."].) This is an exception that ultimately swallows the rule, given that the SNMP, SED and Economic Analysis all come to the conclusion that restoration of groundwater, once degraded, is not "reasonable and feasible." (*See* EKI Report pp. 2-4.)

As the draft SNMP does not have any enforceable requirements for groundwater restoration, it does not result in best practicable treatment or control of the discharges it permits. As the Court in *AGUA* eloquently stated, "[t]he wish is not the father to the action." (*AGUA*, 210 Cal.App.4th at 1279.)

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For the foregoing reasons, the Regional Board should not accept the draft SNMP.

Respectfully submitted,

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