ENVIRONMENTAL LAW FOUNDATION
1222 Preservation Park Way, Suite 200, Oakland, California 94612 · (510) 208-4555 · www.envirolaw.org
Nathaniel Kane, Executive Director · nkane@envirolaw.org

June 28, 2024

Via E-mail

John Brodie
Water Resources Program Manager
San Luis & Delta-Mendota Water Authority
PO Box 2157
842 6th Street
Los Banos, CA. 93635
DMSGMA@sldmwa.org

Re: CSPA Comments on Delta-Mendota GSP

Dear Mr. Brodie:

California Sportfishing Protection Alliance (CSPA) appreciates the opportunity to comment on the Draft Groundwater Sustainability Plan (Draft GSP) for the Delta-Mendota Subbasin (Basin). CSPA acknowledges the significant improvements done by the Basin's Groundwater Sustainability Agencies (GSAs) to combine the six component GSPs that currently constitute a single coordinated GSP covering the Basin into a single GSP.

The Draft GSP, however, despite considerable changes since its first iteration as six coordinated GSPs in 2020, still fails to comply with the requirements of the Sustainable Groundwater Management Act (SGMA) and its regulations. (Wat. Code § 10720 et seq.)[1] Specifically, the Draft GSP contains a major calculation error, fails to adequately describe groundwater conditions in the basin, fails to include adequate sustainable management criteria for interconnected surface water, fails to adequately address interconnected surface waters in its projects and management actions and plan implantation provisions, fails to contain other requires GSP components, authorizes unreasonable use of water, and fails to contain a public trust analysis. This letter, and the comments by hydrologist Greg Kamman attached hereto as Exhibit A and fully incorporated herein by reference, explain the deficiencies in the Draft GSP.

---

[1] Further statutory references are to the Water Code unless otherwise indicated.

The GSAs must fix these deficiencies before adopting the Draft GSP.[2]

1. Groundwater Conditions

The GSP does not adequately address groundwater conditions in the Delta-Mendota Subbasin. As a result, the GSP does not provide adequate information relating modeled streamflow depletions to instream conditions that migrating and spawning salmonids require at the times that they require them.

In the Delta-Mendota Subbasin, ESA- and CESA-listed salmonids, including threatened spring-run Chinook salmon and steelhead and species-of-special-concern fall-run and late-fall-run Chinook, are vulnerable to declining flows, increased temperatures, and declining water quality as a result of groundwater overextraction and mismanagement.

The regulations governing GSPs require that a GSP "provide a description of current and historical groundwater conditions in the basin" that includes "[i]dentification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems utilizing data available from the Department, as specified in Section 353.2, or the best available information." (Cal. Code Regs., tit. 23, § 354.16 (hereafter SGMA Regs).)

The Draft GSP states: "Measured groundwater levels and streamflow are fundamental data required to characterize the nature and occurrence of ISW." (Draft GSP at p. 173.) Yet the Draft GSP provides little information on streamflow. While the text and tables in Chapter 8 describe stream "stage," there is no table or figure comparing groundwater levels to flow. (Draft GSP at pp. 174-75, Fig. GWC-55.) And while the Draft GSP provides modeled depletion figures, these are expressed in acre feet per year, without any reference to streamflows. (Draft GSP at pp. 176-77.) In other words, the Draft GSP does not explain whether the depletions attributable to groundwater management in the basin represent a small percentage, half, or all of the flow of the river

[2] CSPA has submitted several comment letters earlier to the GSPs and to DWR. CSPA's comment letters to DWR are available at https://sgma.water.ca.gov/portal/service/gspdocument/download/4036 (accessed June 26, 2024) and https://sgma.water.ca.gov/portal/service/gspdocument/download/9350 (accessed June 26, 2024). CSPA's 2019 letters are attached as Exhibits B and C. These letters are incorporated herein by reference to the extent relevant. CSPA also sent comment letters to, inter alia, the San Joaquin Exchange Contractors Water Authority, the Central Delta-Mendota GSA, the Patterson Irrigation District, the Aliso Water District GSA, the City of Mendota GSA, the City of Newman GSA, County of Stanislaus, Grassland GSA, Turner Island Water District Groundwater Sustainability Agency – 1, Turner Island Water District Groundwater Sustainability Agency – 2, West Stanislaus Irrigation District, Farmers Water District, City of Dos Palos GSA, City of Firebaugh GSA, City of Gustine GSA, Madera County GSA, County of Merced GSA—Delta-Mendota in or about July 2022. These letters are available upon request.

at a given time of the year.

Tables GWC 10 and 11 also fail to adequately characterize the timing of stream depletions, as required by SGMA Regs. section 354.16(f). Depletions are presented by season. But the definition of "season" is not presented, leaving ambiguity as to how the GSP defines each season. And a seasonal figure is insufficient for characterizing impacts to salmonids. For instance, Central Valley Steelhead have migration windows that last as little as 4-6 weeks; a seasonal figure is insufficient to inform relevant management strategies.[3]

This failure to account for timing is notable in light of the Draft GSP's statement that "Depletions of ISW are minimal during low flow conditions because of low surface-water flow and stage. The most significant depletions of ISW happen during high flow conditions, specifically during periods of runoff following the dry Summer and Fall when groundwater levels are lowest." (Draft GSP at p. 176.) This statement ignores that instream beneficial uses may be at their most sensitive during low-flow conditions. A reduction of flow by only a few cubic feet per second could be the difference between fish passage around an obstacle being feasible or not, or could lead temperatures to exceed fish lethality thresholds. As discussed further in the Sustainable Management Criteria Section below, the GSP must discuss not only the magnitude of depletions in acre feet per year, but the effects of those depletions on instream beneficial uses.

Tables GWC 10 and 11 also fail to provide adequate information on the location of depletions, as required by SGMA Regulations section 354.16, subdivision (f). The tables only provide depletions for the entire basin (after excluding several streams and reaches of the San Joaquin River). The total depletions over a 100-mile stretch of the San Joaquin River provide insufficient information to manage groundwater to avoid harms to fish. This is especially true as some runs of salmonids require access to the Stanislaus, Tuolumne, and Merced Rivers, while others spawn in the upper reaches of the San Joaquin.[4] Below the Merced confluence, the River is subject to the San Joaquin River Restoration Program (SJRRP), which may require different management strategies to ensure adequate flows reach the Merced confluence.[5] A 2022 comment letter from the SJRRP Restoration Administrator to DWR regarding the Delta-Mendota Coordinated

---

[3] National Marine Fisheries Service, Recovery Plan for Central Valley Chinook Salmon and Steelhead (2014) at pp. 48, 53, available at https://www.fisheries.noaa.gov/resource/document/recovery-plan-evolutionarily-significant-units-sacramento-river-winter-run (accessed June 24, 2024).

[4] *Id.* at 32, 48; San Joaquin River Restoration Project, Annual Report 2019-2020, at p. 3-1, available at https://www.restoresjr.net/?wpfb_dl=2677 (accessed June 26, 2024).

[5] See Notice of Lodgment of Stipulation Settlement, *NRDC v. Rodgers* (E.D.Cal. Sept. 13, 2006, No. CIV S-88-1658 LKK/GGH), at pp. 4-5, 14-15, available at https://www.restoresjr.net/?wpfb_dl=9 (accessed June 24, 2024); San Joaquin River Restoration Program, Overview Map, available at https://www.restoresjr.net/about/overview-map/ (accessed June 24, 2024).

GSP stated that "During most times of the year other than the wettest periods, losses of 50% to 65% of the flows released to the river at Friant Dam prior to arrival at the Merced confluence are typical."[6] These depletions, and their effects on instream beneficial uses, must be detailed and addressed.

The exclusion of certain streams, water bodies, reaches from the definition of ISW also raises concerns, as described by Mr. Kamman. In addition, the GSP excludes reaches of the San Joaquin River south of milepost 106. (Draft GSP at p. 175.) This exclusion is based upon a correlation between stream stage and groundwater levels in the upper aquifer. Yet previous iterations of the GSP include those reaches as ISW.[7] The GSP fails to explain why the methodology for describing ISW has changed, and why it now excludes sections of the San Joaquin River where the GSAs had previously reported significant communication between the river and shallow groundwater; nothing in SGMA justifies excluding such shallow or perched groundwater from the definition of ISW. Notably, the GSP acknowledges shallow or perched groundwater above the "A-Clay" in the Aliso region, consistent with the previous Aliso GSP's acknowledgement of the existing ISWs in the San Joaquin River above milepost 106. (Draft GSP at p. 114.) This apparently improper exclusion of sections of the San Joaquin River could significantly affect the modeled streamflow depletions in the Sustainable Management Criteria chapter.

2. Water Budget

Mr. Kamman has identified a major calculation error in the water budget, which casts doubt on all of the Draft GSP's conclusions, including its sustainable yield calculations and its conclusion that it will reach sustainability by 2040. This is discussed on pages 3 through 5 of his attached comments. This error must be addressed in the final GSP.

As a matter of accounting, because the water budgets for both the land surface and groundwater water systems are interconnected, the inflow of one system must equal the outflow of the other. But the GSP's calculations of the water budgets for the two systems do not satisfy this requirement. Specifically, the GSP appears to reverse some of

---

[6] Letter from Thomas R. Johnson, SJRRP Restoration Administrator to Paul Gosselin, DWR (September 19, 2022), at p. 2, available at https://sgma.water.ca.gov/portal/service/gspdocument/download/9343 (accessed June 28, 2024).

[7] See San Joaquin River Exchange Contractors GSA et al., Groundwater Sustainability Plan for the San Joaquin River Exchange Contractors GSP Group in the Delta-Mendota Subbasin (5-022.07) (2022) Appendix I, pp. 141-146, available at https://sgma.water.ca.gov/portal/service/gspdocument/download/458 (accessed June 25, 2024); Aliso Water District GSA, Groundwater Sustainability Plan (2022), at pp. 2-26, 3-9 to 3-16, available at https://sgma.water.ca.gov/portal/service/gspdocument/download/8770 (accessed June 25, 2024).

the figures, such that the stream leakage outflow from the land surface water budget does not match the stream leakage inflow to the upper and lower aquifer groundwater budgets.

To make the calculation error in the draft GSP's water budget readily apparent, Mr. Kamman has combined information contained in Table WB-2 through WB-4 of the draft GSP into the table on page 3 of his comments. Mr. Kamman's table is reproduced below with columns and rows labeled for ease of identification:

		Column A	Column B
	Table H-1: Land Surface Water System	Inflow (AFY) Aquifer Seepage	Outflow (AFY) Stream Leakage
Row 1	Average (2003-2018)	101,000	79,000
	Table H-2: Upper Aquifer Groundwater System	Inflow (AFY) Stream Leakage	Outflow (AFY) Aquifer Seepage
Row 2	Average (2003-2018)	96,000	79,000
	Table H-3: Lower Aquifer Groundwater System	Inflow (AFY) Stream Leakage	Outflow (AFY) Aquifer Seepage
Row 3	Average (2003-2018)	5,000	0

Simply put, column A, row 1, the land surface budget inflow from stream-groundwater interaction (101,000 AFY), must equal the sum of column B, rows 2 and 3, the total groundwater budget outflow from stream-groundwater interaction (79,000 + 0 AFY), but it does not (101,000 ≠ 79,000).

Similarly, column B, row 1, the land surface budget outflow from stream-groundwater interaction (79,000 AFY), must equal the sum of column A, rows 2 and 3, the total groundwater budget inflow from stream-groundwater interaction (96,000 + 5,000 AFY), but it does not (79,000 ≠ 101,000).

As demonstrated by Mr. Kamman on page 4 of his comments, this error appears to result from a reversal of certain figures: an inflow rate was incorrectly assigned as an outflow rate, and vice versa.

As Mr. Kamman further explains on the same page, the consequences of this error are severe. When extrapolated to the full water budget, corrected figures show that, for the 2002-2018 period, the Basin has a negative 53,000 AFY change in storage, as compared to the negative 19,000 AFY reported in the Draft GSP. The difference is even starker for the 2019-2023 period, as the Draft GSP reports a negative 1,000 AFY change in storage, whereas the corrected figure is two orders of magnitude greater, at negative 111,000 AFY.

The same error persists in the projected water budget figures in Tables WB-6 through WB-8.

This error throws the entire water budget, including its safe yield figures, into question. The error must be addressed in the final GSP, and the model outputs relating to the SMCs also should be double checked to ensure that the error does not affect the modeled ISW depletions, among other items.[8]

3. Sustainable Management Criteria for Depletions of Interconnected Surface Water

The sustainable management criteria (SMCs) are at the heart of SGMA. They inform the public, GSAs, and state regulators whether the plan is working to achieve sustainability. If a GSP does not define "undesirable results" in compliance with SGMA, then negative effects traceable to unsustainable groundwater use can—and likely will—occur without triggering management actions. (See generally §§ 10721, defs. (u)-(x); 10727.2; SGMA Regs. § 354.26.) And if minimum thresholds and measurable objectives are not defined and not quantitively tied to undesirable result definitions, then they will not prevent the occurrence of undesirable results and will not trigger projects and management actions that could correct those undesirable results. (SGMA Regs. §§ 354.28-354.30, 354.42-44.)

But where SGMA requires detailed, quantitative SMCs that will define and protect against undesirable results, the Draft GSP continues to punt, ignoring available data, and failing to consider how pumping in the basin will affect listed species and the ecosystems they rely on.

CSPA acknowledges significant changes in the approach to development of SMCs for depletions of interconnected surface water. However, the approach still suffers from the same conceptual error that was at the root of the previous iterations of the GSP—a failure to grapple with the instream effects of those depletions on the beneficial uses of surface waters. These failures represent legal problems with the GSP that require significant amendments before it can be approved.

A. Undesirable Result Definitions

Despite the many changes made to the GSP since 2020, a fundamental flaw

[8] The information on the modeling approach that generated the ISW depletion figures is not sufficiently detailed for an outside party to attempt to correct its output based on corrections to the water budget.

remains: the GSP fails to identify when the *effects* of depletions of ISW become significant and unreasonable, as required by SGMA and its regulations. Instead, the GSP focuses on preventing depletions from exceeding those in the extreme drought year of 2014—a goal which it does not even achieve. The GSP must follow the language of SGMA and analyze when depletions have significant and unreasonable effects on instream habitat and other beneficial uses.[9]

SGMA defines an "undesirable result" as an "*effect*[] caused by groundwater conditions occurring throughout the basin." (§ 10721, def. (x) (emphasis added).) The ISW undesirable result is defined as "Depletions of interconnected surface water that have significant and unreasonable adverse *impacts* on beneficial uses of the surface water." (*Id.* § 10721, def. (x)(6), emphasis added.)[10]

The SGMA Regulations also require a discussion of "effects," in addition to groundwater conditions. The regulations require that a GSP "describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable *effects* for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin." (SGMA Regs. § 354.26, subd. (a), emphasis added.) This description must "include" at least:

> (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.
>
> (2) The criteria used to define when and where the *effects* of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable *effects* in the basin.
>
> (3) Potential *effects* on the beneficial uses and users of groundwater, on land uses and property interests, and other

[9] A comment letter from NOAA Fisheries stated that the San Joaquin River exceeded lethal temperatures for salmonids in every year from 2014-2016. (See Letter from Cathy Marcinkevage, NOAA Fisheries, to Paul Gosselin, DWR (Sept. 15, 2022) at p. 2, available at https://sgma.water.ca.gov/portal/service/gspdocument/download/9317 (accessed June 27, 2024).

[10] A GSP is required to demonstrate that undesirable results will not be present within 20 years of initial plan adoption. (*Id.* §§ 10721 defs. (u)-(x); 10727.2, subd. (b).)

> potential effects that may occur or are occurring from undesirable results.

(SGMA Regs. § 354.26(b), emphasis added.)

Notably, the regulations and the statute emphasize that the analysis of undesirable results include quantitative descriptions of the *effects* that depletions of ISWs have on beneficial uses. Section 354.26, subdivision (b)(2) requires description of the causal link between "groundwater conditions," the "effects" of those conditions, and when those effects become "undesirable results." The tipping point is where the exceedances of minimum thresholds cause "significant and unreasonable effects" in the basin.[11]

The Draft GSP attempts to sidestep this required analysis of effects. Missing from its discussion of undesirable results is discussion and analysis of the "effects" of groundwater conditions and the impacts of those effects on beneficial uses. The Draft GSP defines the undesirable result of depletions of ISW as "Depletions of ISW as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources or downstream beneficial uses and users." (Draft GSP at p. 248.) It then defines "the criteria for Undesirable Results for Depletion of ISW" as "Undesirable Results for Depletion of ISW would be experienced in the Basin if and when the [minimum threshold] MT is exceeded for two consecutive years caused by groundwater extraction within the Basin." (*Id.* at p. 250.) The minimum threshold, as discussed below, is set at the model-generated depletions in Summer and Fall of 2014 in the interconnected portion of the San Joaquin River. (*Id.* at p. 251.)

While the GSP gestures towards impacts on surface water users and environmental users (Draft GSP at p. 250), it fails to analyze "when and where" impacts on those users become significant and unreasonable (SGMA Regs. § 354.26, subd. (b)(1).) Instead, by pegging the definition to conditions in 2014—a historic drought year in the midst of a multi-year drought—the GSP simply assumes that any greater depletions are significant and unreasonable, while smaller depletions are not. This logic ignores the text of SGMA and the regulations, both of which require linking groundwater conditions with the "effects" of those conditions, and determining when those "effects" become significant and unreasonable. (See § 10721, def. (x)(6), SGMA Regs. § 354.26, subd. (b).) The text of the regulations and the statute requires separately analyzing "depletions"

---

[11] DWR has summed up the required approach in its Draft Sustainable Management Criteria Best Management Practice: "GSAs must consider and document the conditions at which each of the six sustainability indicators become significant and unreasonable in their basin, including the reasons for justifying each particular threshold selected." Department of Water Resources, Sustainable Management Criteria Best Management Practice (Draft) (2019) at p. 6, available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf (accessed June 27, 2024).

and their “effects”; to do otherwise renders language in governing laws surplusage. (See *Moyer v. Workmen’s Comp. Appeals Bd.* (1973) 10 Cal.3d 222, 230; *Bernard v. Foley* (2006) 39 Cal.4th 794, 811.) The GSP’s logic takes an improper shortcut by defining “undesirable results” solely by reference to a modeled depletions figure, without any significant consideration of what effects those depletions have on streamflows at key migration periods, temperatures, surface water quality, or other relevant conditions.[12]

Nor does the Draft GSP cite publicly available literature or refer to other regulatory processes that bear on streamflows in the San Joaquin watershed. GSPs must be supported by the “best available information and best available science.” (§ 113; SGMA Regulations section 355.4(b)(1).) For instance, as mentioned above, the San Joaquin River Restoration Program (SJRRP) is attempting to restore streamflows with the goal of reintroducing Chinook up to the confluence with the Merced River.[13] The relationship between loss of flow to groundwater, the effects of seepage on levee stability and agricultural land, and channel capacity are complex and deeply related to the management of groundwater in the basin.[14] (See Draft GSP at p. 249 [defining “groundwater management”].) Yet the SJRRP and its associated documents relating to groundwater and streamflow are not considered in the undesirable results section, nor are they cited in the References chapter.[15]

Further, the State Water Resources Control Board (State Board) is embarking on a years-long effort to update the Water Quality Control Plan for the Delta—an effort which will result in setting minimum flows for the Lower San Joaquin River and the Merced, Tuolumne, and Stanislaus Rivers.[16] The flow requirements adopted into the plan include maintaining 40 percent of unimpaired flow in Merced, Stanislaus, and Tuolumne Rivers from February through June, with a minimum flow of 1,000 cfs at Vernalis, just north of

---

[12] Ironically, the Groundwater Conditions chapter seems to assume that disconnection of a surface water body from groundwater would be an “undesirable result.” (Draft GSP at p. 174) But the discussion of undesirable results does not reach this conclusion, nor investigate whether such disconnections occurred during 2014 or during any other period.

[13] See generally San Joaquin River Restoration Program website, https://www.restoresjr.net/ (accessed June 25, 2024.) Representatives of the SJRRP have commented extensively on the interaction between the Delta-Mendota GSPs and the SJRRP. CSPA full incorporates their comments by references. See Letter from Donald Portz, SJRRP Manager to Paul Gosselin, DWR (Sept. 16, 2022), available at https://sgma.water.ca.gov/portal/service/gspdocument/download/9334 (accessed June 27, 2024.)

[14] See, e.g., San Joaquin River Restoration Program, Channel Capacity Report 2024 Restoration Year (2024), available at https://www.restoresjr.net/?wpfb_dl=2813 (accessed June 25, 2024).

[15] Certain SJRRP documents relating to subsidence are cited. (Draft GSP at pp. 166, 168, 181.)

[16] See State Water Resources Control Board, Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (2018) at pp. 23-32, available at https://www.waterboards.ca .gov/plans_policies/docs/2018wqcp.pdf (accessed June 25, 2024).

the Delta-Mendota Basin boundary.[17] The State Board also recently adopted Final Biological Goals for the Lower San Joaquin River, which include abundance, productivity, diversity, and spatial structure goals for salmonids.[18] The Draft GSP, however, is largely silent on the interaction between groundwater management and these programs. The failure to consider actual impacts of groundwater extractions and the pressing need to address surface water conditions in the San Joaquin River renders the Draft GSP unlawful.

In order to comply with SGMA, the GSAs must investigate the effects of low groundwater levels on the beneficial users of the interconnected surface waters—the species that rely on those waters—and then determine if those effects were significant and unreasonable. Reaches of the San Joaquin River that flow through the Delta-Mendota Subbasin are designated as having the following beneficial uses: warm- and cold-water freshwater habitat, warm- and cold-water migration, warm- and cold-water spawning, as well as wildlife habitat.[19] The Draft GSP fails to analyze the effects of historic depletions an continued depletions at either the minimum threshold or measurable objective; its failure to do so ignores the text of the statute and regulations and therefore violates SGMA.

It is not enough to assume, as the Draft GSP does, that any depletion pre-2015 need not be addressed. (See Draft GSP at pp. 248-49; see § 10727.2, subd. (b)(4).) 2014 was a uniquely dry year, with the lowest precipitation in the 2003-2023 period.[20] (Draft GSP at p. 185.) Yet groundwater extraction was above-average in 2014, implying that depletions caused by groundwater use were likely high that year. (See Draft GSP at Table WB-2.) Without analyzing the instream effects of pre-2015 depletions, the GSAs do not have the information to know whether those depletion levels were significant and unreasonable or not. Further, the GSP's own logic does not hold up. The Draft GSP states that "the Undesirable Results definition appropriately focuses on whether ISW has been depleted as a result of water management actions since the enactment of SGMA on

---

[17] *Id.* at p. 25. The flow objectives may be achieved by voluntary agreements, and other requirements and conditions apply. (*Id.* at pp. 25-32.)

[18] See generally State Board, Final Initial Biological Goals the Lower San Joaquin River (2023), available at https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/2024/20240206-final-initial-biological-goals-reso.pdf (accessed June 25, 2024).

[19] Central Valley Regional Water Quality Control Board, Basin Plan for The Sacramento River Basin and the San Joaquin River Basin (2019) at p. 2-12, available at https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201902.pdf (accessed June 28, 2024).

[20] Section 8.7 of the GSP, which presents the modeled depletion figures, does not present yearly figures. It provides aggregate figures for the 2003-2018 and the 2019-2023 periods, and for 2014 alone. (Draft GSP at p. 176.) It is therefore not possible to directly compare modeled depletions in 2014 to any other year.

January 1, 2015." (Draft GSP at p. 249.) But such an inquiry does not depend on depletion levels prior to January 1, 2015: the appropriate question is whether depletion levels are having a significant and unreasonable effect on beneficial uses.

And, by requiring two consecutive violations of the MT, this definition of undesirable result all but assures that the basin will experience 2014-level depletions. But the Draft GSP requires two consecutive years of these extreme conditions before an "undesirable result" is experienced. As a result, the Draft GSP would permit 2014 levels of depletions in up to half of years without the MT being exceeded. This is inconsistent with the Draft's logic, which states that keeping depletions below 2014 levels would be protective of beneficial uses. But 2014 was bookended by wetter years—the GSP would permit the basin to experience those extreme depletions every other year and still claim that no undesirable result was occurring. Nor is the Draft's logic in requiring two consecutive years of MT violations compelling: nowhere in SGMA is there a requirement that a depletion of ISW be "chronic" to be significant or unreasonable.[21] If the GSP concludes that any depletion greater than 2014 levels is significant and unreasonable, than it is internally inconsistent to conclude that the basin must endure two successive years of such depletions in order to qualify as an undesirable result.

Last, the failure to analyze the effects of the Draft GSP's undesirable results definitions extends to the discussion of Projects and Management Actions (PMAs) in Chapter 15 and Plan Implementation in Chapter 16. None of the PMAs discuss in any detail whether they will have negative effects on conditions in interconnected surface waters. And this is despite the fact that several may have direct effects on surface flows. These include the Del Puerto Creek reservoir project, the diversion of flows to recharge from the Chowchilla Bypass (along with infrastructure allowing additional diversions at lower flows) and reactivation of the Aliso Canal, the North Grassland Water Conservation and Water Quality Control Project, Los Banos Creek diversion projects. (Draft GSP at Table PMA-1.) All of these projects involve new or changed diversions from surface water systems, yet none analyze their effects on streamflows or the species that depend on such flows.

And Chapter 16's Pumping Reduction Plan, while it contains specific plans for overdraft and for when the MTs for groundwater levels, water quality, and subsidence are exceeded, contains no plan for exceedance of the ISW MT. Nor does it provide any analysis of whether the other implementation activities will protect ISWs and beneficial uses of surface water in any way.

---

[21] Compare § 10721, def. (x)(1) ("Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods") with *id.* def. (x)(6) (no such proviso for depletions of ISW).

B. Minimum Thresholds and Measurable Objectives

The Draft GSP's minimum thresholds (MTs) are set at "the Model-estimated depletion rate of 12,000 AFY within the interconnected portion of the San Joaquin River, as identified in Section 8.7, in the Summer and Fall of 2014 caused by groundwater use within the Basin, which reflects the most significant pre-SGMA depletion conditions." (Draft GSP at p. 251.) But the Draft GSP fails to comply with the regulations governing MTs.

The SGMA Regulations require minimum thresholds (MTs) to "represent a point in the basin that, if exceeded, may cause undesirable results." (SGMA Regs. § 354.28, subd. (a).) The minimum threshold description must "include," inter alia, "an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results," and "[h]ow minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." (*Id.* § 354.28, subds. (b), (b)(2), (b)(4).) The MT must also explain "[h]ow state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference." (*Id.* § 354.28, subd. (b)(5).) The minimum threshold for interconnected surface waters must "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." (*Id.* § 354.28, subd. (c)(6).) The MT must be "supported by" the "location, quantity, and timing of depletions of interconnected surface water." (*Id.* § 354.28, subd. (c)(6)(A).)

For the same reasons that the Draft GSP's undesirable result definition fails to grapple with the instream effects of the modeled depletions, the MT definition fails to show any connection to "the interests of beneficial uses and users." (SGMA Regs. § 354.28, subd. (b)(4).) And the MT fails to provide "location" or "timing" information, as it is simply a yearly depletion figure for the entire interconnected stretch of the San Joaquin River.[22] (*Id.* § 354.28, subd. (c)(6)(A).) Instead, the regulations require detailed, quantified analysis of the MT's effects on instream beneficial uses, and location- and timing-specific MTs rather than a generalized yearly MT.

And the MT discussion makes no attempt to explain how or whether the depletions envisioned by the MT will achieve flow and water quality standards, in violation of SGMA Regulations section 354.28(b)(5). As described above, the State Board and the SJRRP have set relevant flow standards for portions of the San Joaquin River within the basin. Instead, the GSP denies that there are standards for "Depletions of ISW". (Draft GSP at p. 253.) This misreads the regulation, which requires description of

---

[22] The failure to provide at least seasonal depletion MTs is surprising, given that the model is clearly capable of providing such figures. (See Draft GSP at Tables GWC-10 and -11.)

federal, state, and local standards that "relate to the relevant sustainability indicator."[23] Flow standards clearly "relate" to the depletions of ISW indicator because depletions due to groundwater management can affect surface water management throughout the San Joaquin watershed, from Friant Dam releases to water quality and flow in the Delta, with concomitant impacts on species and water users throughout this vast area. The purpose of the MT is to set a standard that is protective of the beneficial uses in the surface water: these beneficial uses, which include fisheries habitat, are protected by state standards and require analysis.

4. Other Issues

A. Temperature and Flow Management and Monitoring

GSAs are required to include "monitoring and management of . . . changes in surface flow and surface water quality that . . . are caused by groundwater extraction in the basin," when such conditions are present in the basin.[24] (§ 10727.2, subd. (d)(2).) The San Joaquin River is listed under Clean Water Act section 303(d) as impaired for temperature.[25] Yet the GSPs contain almost no discussion of water temperature or the effects of groundwater management on river temperatures, nor do they contain a plan to do so.

Moreover, section 10727.2, subdivision (f) requires monitoring "designed to detect" "flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin." This section further emphasizes the need for surface water temperature and flow management monitoring. Yet the Monitoring Network chapter makes no mention of surface water temperature monitoring. This violates SGMA.

---

[23] It is unsurprising that state entities had not regulated depletions of ISW prior to SGMA, because California famously lacked legislative regulation of groundwater prior to SGMA's enactment. Nonetheless, the DWR regulations state that the MT should explain how the MT relates to "relevant" standards, implying that standards governing values not directly tied to groundwater management, such as flow and surface water quality, should be addressed.

[24] The GSP does not contain a discussion of whether the factors in section 10727.2, subdivision (d) are applicable to the basin. But as discussed above, high temperatures attributable at least in part to groundwater extraction are potentially lethal to salmon and other species. Temperature impacts are therefore applicable to the basin for the purpose of section 10727.2, subdivision (d).

[25] State Water Resources Control Board, 2020-2022 California Integrated Report (Clean Water Act Section 303(d) List and 305(b) Report), App. H, available at https://www.waterboards.ca.gov/water_issues/programs/tmdl/2020_2022state_ir_reports_final/apx-h-2018-303d-list.xlsx (accessed June 28, 2024).

B. Waste and Unreasonable Use

The waste and unreasonable use doctrine, to which SGMA expressly must comply (§ 10720.1, subd. (b)), is codified in the California Constitution. It requires 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 ["[S]uperimposed 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."].)

It is unreasonable for continued groundwater extractions to lead to long-term negative impacts on listed species. And it is unreasonable for a GSP to fail to analyze those impacts as required by SGMA. By authorizing continued groundwater pumping in violation of SGMA, the GSP is authorizing waste and unreasonable use of water in violation of the law.

C. Public Trust Doctrine

The public trust doctrine applies to the waters of the State, and establishes 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." The public trust doctrine applies to groundwater where there is a hydrological connection between the groundwater and a navigable surface water body. (*Environmental Law Foundation v. State Water Resources Control Bd.* (2018) 26 Cal.App.5th 844 (*ELF*); *United States v. State Water Resources Control Bd.*, *supra*,182 Cal.App.3d at 106; see also *National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419, 426 ["[B]efore 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."].) In *ELF*, the court held that the public trust doctrine applies to "the extraction of groundwater that adversely impacts a navigable waterway" and that the government has an affirmative duty to take the public trust into account in the planning and allocation of water resources. (*ELF*, *supra*, 26 Cal.App.5th at 856-62.) The court also specifically held that SGMA does not supplant the requirements of the common law public trust doctrine. (*Id.* at 862-70.) The public trust doctrine imposes an "affirmative duty on the state to act on behalf of the people to protect their interest in navigable water." (*Id.* at 857.) The doctrine is expansive and flexible—public trust uses include not only navigation, commerce, and fishing, but also hunting, bathing and swimming. (*Ibid.)* Further, "an increasingly important public use is the preservation of trust lands 'in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments which provide food and habitat for birds and marine life, and which favorably affect the scenery and climate of the area.' " (*Ibid.* [quoting *San Francisco Baykeeper, Inc. v. State Lands Com.* (2015) 242 Cal.App.4th 202, 234].)

ELF held that the State Board's public trust obligation was independent of, and not limited by, its authority to oversee permitting. (*Id.* at 862 [quoting *National Audubon Society*, *supra*, 33 Cal.3d at 446-47].) Relying on *National Audubon Society v. Superior Court*, *ELF* held that state agencies have "an affirmative duty to take the public trust into account in the planning and allocation of water resources and to protect public trust uses whenever feasible." Further, *ELF* held that "SGMA does not . . . replace or fulfill public trust duties, or scuttle decades of decisions upholding, defending, and expanding the public trust doctrine." (*Ibid.*)

GSAs must comply with the holding of *Environmental Law Foundation v. State Water Resources Control Board* in deciding to adopt or approve GSPs. Pursuant to *ELF*, GSAs must: (1) identify any public trust resources within each basin; (2) identify any public trust uses within each basin; (3) identify and analyze the potential adverse impact of groundwater extractions on public trust resources and uses; and (4) determine the feasibility of protecting public trust uses and protect such uses "whenever feasible." Notably, the public trust doctrine is not limited by SGMA's concepts of "significant and unreasonable" impacts.

Yet the Draft GSP contains no public trust analysis or findings. As a result, the Draft GSP is in violation of the public trust doctrine.

* * *

For the reasons stated in this letter, the Draft GSP contains deficiencies that render it out of compliance with SGMA. We urge the GSAs to address these deficiencies before it is approved.

Sincerely,

Nathaniel H. Kane

Nathaniel Kane
Executive Director
Environmental Law Foundation

Encl.: Exhibits A-C

Exhibit A

June 24, 2024
Attorney-Client Work Product

Mr. Nathaniel Kane, Executive Director
Environmental Law Foundation
1222 Preservation Park Way, Suite 200
Oakland, CA 94612

Subject: Review of Groundwater Sustainability Plan for the Delta-Mendota Subbasin
June 2024 Public Review Draft

Dear Mr. Kane:

I am a hydrologist with thirty-five years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. I have been providing professional hydrology and geomorphology services in California since 1991 and routinely manage projects in the areas of surface- and groundwater hydrology, water supply, water quality assessments, water resources management, and geomorphology. Most of my work has been in the Coast Range watersheds of California. My areas of expertise include: characterizing and modeling watershed-scale hydrologic and geomorphic processes; evaluating surface- and ground-water resources/quality and their interaction; assessing hydrologic, geomorphic, and water quality responses to land-use changes in watersheds and causes of stream channel instability; assisting and leading in the development of CEQA environmental compliance documents and project environmental permits; and designing and implementing field investigations characterizing surface and subsurface hydrologic and water quality conditions. I earned a Master of Science degree in Geology, specializing in sedimentology and hydrogeology as well as an A.B. in Geology from Miami University, Oxford, Ohio. I am a Certified Hydrogeologist (CHG #360) and a registered Professional Geologist (PG #5737) in the state of California. A copy of my resume is attached.

I have been retained by the Environmental Law Center to review the June 2024 Public Review Draft Groundwater Sustainability Plan (GSP) for the Delta-Mendota Subbasin, California, and evaluate if the GSP conforms with Articles of the Sustainable Groundwater Management Act (SGMA). Based on my review, it is my professional opinion that the Draft GSP contains a number of deficiencies and should be considered incomplete. The rationale for this opinion is based on multiple findings presented below.

1. Chapter 8 – Current and Historical Groundwater Conditions

a) The second to last sentence in Section 8.2.2 states, "Based on the number of reported dry wells by water year over time, the most dewatered wells occur in the year immediately following extreme droughts, such as 2015." These impacts are an undesirable result. The MT for the groundwater level indicator SMC is equivalent to the minimum water levels in 2015. However, this statement also implies dewatered wells during less extreme year types, which have water levels higher than the 2015 MT. Thus, the GSP fails to define a quantitative groundwater level when well dewatering occurs that is more conservative than the 2015 MT.

b) The sentence that bridges pages 173 and 174 of Section 8.7 (Interconnected Surface Water Systems) states, "Hence, once a surface water body has become disconnected from the underlying groundwater system, the surface water depletion rate is independent of future changes (i.e., reductions) in groundwater levels and aquifer storage." This is not necessarily true. If groundwater levels drop below the streambed due to over pumping, that management action maintains stream depletion rates from disconnected surface water bodies until groundwater levels recover and intersect the stream channel. So, depletion rate remains due to over pumping and hydraulic disconnection.

c) The first sentences of Section 8.71 state, 1) that the ISW analysis in the Basin relies on natural surface water bodies delineated in the USGS National Hydrography Dataset (NHD), and 2) that perennial and intermittent surface water bodies are most likely to be ISW. The NHD represents features such as rivers, streams, canals, lakes, ponds, coastline, dams and stream gauges. There appear to be many perennial ponded areas within the central portion of the Subbasin that are not addressed as ISW in the GSP. Therefore, the GSP should be considered incomplete in its designation and analysis of ISW.

d) Section 8.7.1 of the GSP also indicates that the methodology to identify potential ISW within the Basin includes surface water bodies with nearby groundwater elevations less than 30 feet below the streambed elevation. In executing this methodology, the GSP uses groundwater table elevations from Spring 2014 and streambed elevations based on LiDAR data. I have several concerns about the validity of this approach. First, 2014 (pre-SGMA) was a critically dry year-type within a multi-year drought period. Groundwater elevations during this year were significantly lower than prior non-dry year periods due to drought and heavy groundwater pumping as well as in 2015. This results in increased depths to groundwater below the stream as compared to groundwater table elevations that occur during normal or wetter year-type periods when more surface water bodies would be characterized as potential ISW. For example, groundwater level hydrographs for the Upper Aquifer presented in Figure GWC-10 indicate groundwater elevations are 60- to 100-feet higher in years prior to the 2012-2014 drought period and using these pre-drought groundwater levels would identify a greater number and/or length of potential ISW.

   The second concern with the GSP methodology is the use of LiDAR data to estimate streambed elevations. LiDAR does not penetrate surface water bodies and the return elevations are representative of the water surface elevation not the streambed. Depending on the amount of water flowing in the stream, this method may elevate the estimated streambed elevation and skew the identification of potential ISW.

   A third concern is the comparison of groundwater elevations at wells that are up to two miles from the surface water feature being evaluated. Given the Upper Aquifer water table surfaces are sloped (i.e., not flat) in the Subbasin, the use of groundwater level to streambed differences from well and stream gage point two miles apart can lead to invalid comparisons with regards to determining the depth to groundwater directly below the streambed (i.e., stream gage point).

e) Section 8.7.2 (Model-Calculated Streamflow Depletions) provides seasonal depletion rates for pre-SGMA, historical, and current periods. However, as required under SGMA, this section of the GSP does not describe or evaluate how streamflow depletions would affect threatened and endangered species that are considered environmental users of groundwater and/or surface water.

2. Chapter 9 – Water Budget Information

The Subbasin water budget presented in the GSP consists of inflows and outflows to a land-surface water system and groundwater system water budgets. The Land Surface Water System budget represents the total amount of water entering and leaving the Subbasin on the ground surface, while the Groundwater System budget represents the total amount of water entering and leaving the groundwater system. Per Table WB-2, you will see that the annual inflow and outflows to the Land Surface Water System are equal, leading to no annual "Change in Storage." These budgets are interlinked in that several water budget components account for water moving between the Land Surface and Groundwater systems. An example is stream-groundwater interactions, where stream leakage signifies a loss of streamflow to groundwater and aquifer seepage signifies a gain of streamflow from groundwater. When accounting for these processes, 1) stream leakage is considered an outflow from the Land Surface Water System and inflow to the Groundwater System budget, and 2) aquifer seepage is considered an outflow from the Groundwater System budget and inflow to the Land Surface Water System budget.

In reviewing the respective water system budgets presented in Table WB-2 through WB-4[1] it appears that stream-groundwater interactions are not accounted for correctly between the Land Surface Water and Groundwater System budgets. This is demonstrated by tracking the exchange of average historic (2003-2018) stream leakage and aquifer seepage values between the Land Surface Water and Groundwater system budgets. The following tables summarize the stream leakage and aquifer seepage values presented in the GSP.

Table WB-2: Land Surface Water System	Inflow (AFY) Aquifer Seepage	Outflow (AFY) Stream Leakage
Average (2003-2018)	101,000	79,000

Table WB-3: Upper Aquifer Groundwater System	Inflow (AFY) Stream Leakage	Outflow (AFY) Aquifer Seepage
Average (2003-2018)	96,000	79,000

Table WB-4: Lower Aquifer Groundwater System	Inflow (AFY) Stream Leakage	Outflow (AFY) Aquifer Seepage
Average (2003-2018)	5,000	0

[1] Table WB-2 tabulates annual land surface water system inflows and outflows while Tables WB-3 and WB-4 present annual inflows and outflows to the Upper Aquifer and Lower Aquifer groundwater systems, respectively.

According to the Land Surface Water System Table WB-2, aquifer seepage inflow to the streams is 101,00 AFY and stream leakage outflow from the stream to the aquifer is 79,000 AFY. However, these values do not translate to the correct inflow/outflow columns in the Groundwater System budgets. The stream leakage outflow from the Land Surface Water System budget should sum to the same value as the stream leakage inflow in the Groundwater System budgets (stream leakage contributes to both the Upper and Lower Aquifers, the sum of which should be equal to the Land Surface Water System stream leakage value). Similarly, the aquifer seepage values should be equal in the Land Surface Water and Groundwater system budget Tables above.

This error is significant as it renders the GSP groundwater system water budget analyses and estimates of safe yield incorrect. For example, correcting the historic and current period average water budget values yields significantly different estimates of changes in groundwater storage. It is assumed that the stream leakage and aquifer seepage values presented in the Land Surface Water System inflow and outflow Table WB-2 are correct as the annual inflows and outflows balance out (i.e., zero change in storage) as is expected when following standard hydrologic water budget accounting methods of surface water systems without significant storage reservoirs. When applying the Land Surface Water System values for stream leakage and aquifer seepage to the Groundwater System budgets, the resulting loss of groundwater storage is much greater than originally estimated. This is demonstrated in the following reproduction of the Upper Aquifer groundwater system water budget (GSP Table WB-3) where stream leakage and aquifer seepage are correctly assigned. The upper table presents the original GSP values in Table WB-3, while the lower table presents the corrected stream-groundwater exchange of water.

GSP Table WB-3 (Original): Upper Aquifer Groundwater System

		INFLOWS (AFY)				OUTFLOWS (AFY)					
	WYT	GW recharge	SW-GW interaction inflow (stream leakage)	Sub GW inflow	TTL INFLOWs	GW Extractions	Losses Vadose	SW-GW interaction outflow (aquifer seepage)	Sub GW Outflow	TTL Outflows	Delta Storage
2003-2018	Average	356,000	96,000	158,000	610,000	261,000	104,000	79,000	185,000	629,000	-19,000
2019-2023	Average	420,000	132,000	192,000	744,000	329,000	107,000	77,000	232,000	745,000	-1,000

GSP Table WB-3 (Corrected): Upper Aquifer Groundwater System

		INFLOWS (AFY)				OUTFLOWS (AFY)					
	WYT	GW recharge	SW-GW interaction inflow (stream leakage)	Sub GW inflow	TTL INFLOWs	GW Extractions	Losses Vadose	SW-GW interaction outflow (aquifer seepage)	Sub GW Outflow	TTL Outflows	Delta Storage
2003-2018	Average	356,000	79,000	158,000	593,000	261,000	104,000	96,000	185,000	646,000	-53,000
2019-2023	Average	420,000	77,000	192,000	689,000	329,000	107,000	132,000	232,000	800,000	-111,000

This same error for accounting of surface water-groundwater interaction occurs in the current period (2019-2023) water budgets presented in Tables WB-2 through WB-4, and the projected water budgets (2024-2073) presented in Tables WB-6 through WB-8. Based on these incorrect water budgets, the Draft GSP should be considered deficient until the Land Surface Water and Groundwater System water budget accounting for surface water-groundwater interactions are reconciled. It isn't clear to me if this same accounting error originates or transfers to the groundwater model. Regardless, the inaccurate water budgets call into question the validity of the interconnected surface water (ISW) depletion estimates, changes in groundwater storage, safe yield, and subsidence presented in the GSP. More importantly, without an accurate quantification of current, historical, and projected groundwater conditions, meaningful SMC can not be developed and those presented in the GSP should be considered incomplete.

3. Chapter 10 – Sustainable Management Criteria (SMC) for Chronic Lowering of Groundwater Levels
Beyond my opinion regarding the validity of SMC just discussed, I have additional concerns about the SMC presented in the GSP.

a) GSAs are required to select MTs based on avoiding undesirable results and significant and unreasonable impacts to beneficial uses and users. The established Minimum Thresholds (MT) for Chronic Lowering of Groundwater Levels permit undesirable results. The MT description permits a certain number of drinking water wells to go dry annually or cumulatively by 2014 (see item 3.c below). The GSP's well impact analysis also indicates numerous wells go dry (see Table SMC-3). Dry wells are an undesirable result; however, the GSA's have determined that a certain number of wells going dry is acceptable (i.e., are not a significant and/or unreasonable impact). However, this threshold of acceptance is not justified in the GSP with any sort of socioeconomic or other quantified impact assessment – it appears arbitrary.
b) The process for establishing the MT is flawed and not completed pursuant to SGMA regulations. The GSA's assessed impacts to wells after establishing minimum thresholds rather than determining the effects that would be significant and unreasonable to the uses and users of groundwater and then setting minimum thresholds to avoid those conditions.
c) The GSP does not correctly define or quantify undesirable results. Specifically, the GSP does not describe the specific effects of chronic lowering of groundwater levels and depletion of supply that would be significant and unreasonable and would therefore constitute an undesirable result. Instead, the GSP states that an undesirable result would occur if groundwater level decline exceeded the established MT if one of the following occurs: 1) groundwater levels decline below the MT in 25% or more of the representative monitoring sites (RMS); 2) more than 10 drinking water wells are dry in any given year, or 3) more than 170 drinking water wells are cumulatively reported dry by 2040 (10 wells per year over 17 years).

   Stated another way, the GSAs need to define and quantify a value or threshold that avoids undesirable results and then use that value as the MT. GSAs can't just select the historic minimum value as the MT without demonstrating that higher magnitude MT values won't result in undesirable results. For example, the MT is set at 2015 minimum groundwater levels. I agree that there were undesirable results during this time of minimum groundwater levels (i.e., basin clearly in overdraft). However, the GSP does not demonstrate that a MT set 1-foot higher won't result in undesirable results.

4. Chapter 10 – SMC for Reduction in Groundwater Storage
The unreasonable result for the Reduction in Groundwater Storage includes a reduction in usable groundwater storage of more than 10% in each aquifer relative to the Fall 2014 useable groundwater storage volume. The year 2014 (pre-SGMA) was a critically dry year-type within a multi-year drought period. Groundwater elevations in the Upper Aquifer wells during this year were consistently lower than 2015 (Figure GWC-10). In addition, groundwater storage was 45,000 acre-feet less in 2014 than 2015 (Table WB-3 and Figure WB-3). Thus, using Fall 2014 (pre-SGMA) storage as the threshold for the undesirable results is already lower than the SGMA January 1, 2015, baseline period storage level. Thus, the starting "Fall 2014" storage values presented in Table SMC-4 are lower than what they would have been on January 1, 2015. Thus, the change in Upper Aquifer storage between Fall 2014 to the 2015 MT would be greater than the 10% (-893,624 AF) value presented in the Table SMC-4. Thus, either the definition of undesirable results or Reduction in Groundwater Storage MT should be revised.

5. Chapter 10 – SMC for Degraded Water Quality

The GSP indicates that annual ISW streamflow depletions would average over 12,000 AFY due to in-subbasin groundwater pumping, with highest seasonal depletions occurring in the spring and summer (Table GWC-11). Reduced stream flows are more susceptible to warming than un-depleted flows. The GSP provides no explanation or justification of how the Degraded Water Quality SMC will be protective of Basin Plan temperature Water Quality Objectives or any other biological temperature requirements for surface water beneficial users. Thus, this section of the GSP should be considered deficient in the establishment of Degraded Water Quality SMC.

6. Chapter 10 – SMC for Interconnected Surface Water

This section of the GSP fails to sufficiently define the processes and criteria necessary to define undesirable results on beneficial users of surface water in the basin. This description should include the cause of past or future undesirable results by surface water depletions due to groundwater use in the subbasin. The GSP does not provide any rationale for how the 12,000 annual stream flow depletion rate is protective to beneficial users (including environmental users) and undesirable results.

7. Chapter 14 – Monitoring Network

Figures GWC-64 and -65 identify Del Puerto Creek as an “Uncertain/Likely Disconnected” ISW. In Section 8.9.5, the GSP makes the following statement.

> “Insufficient groundwater elevation data exist in the shallow Upper Aquifer zone near ISW bodies, and insufficient streamflow data (stage and flow rate) exist along the ISW, particularly around Del Puerto Creek. In response to these data gaps and uncertainties, the GSAs have substantially expanded the Basin’s Representative Monitoring Network and are taking other measures to fill data gaps, as described in Section 14.2.6. As more data become available, these inherent uncertainties will be proportionally improved to better reflect the actual conditions in the Basin.”

However, Section 14 of the GSP proposes no groundwater wells or stream gaging stations on or in the vicinity of Del Puerto Creek (see Figure MN-10) to address the ISW monitoring data gap. There are also only four (4) paired wells and stream gages along the 90-mile stretch of the “Potential ISW/Likely Connected” San Joaquin River reach that could be used to understand and/or validate model results and estimated surface water depletion rates. Therefore, it is my opinion that the ISW monitoring component of the GSP is deficient in addressing the stated data gaps related to ISW identification and quantification of surface water-groundwater exchange.

Please feel free to contact me with any questions regarding the material and conclusions contained in this letter.

Sincerely,

Greg Kamman, PG, CHG
Senior Ecohydrologist

Greg Kamman, PG, CHG
Senior Ecohydrologist

Education

MS, 1989, Geology, Sedimentology and Hydrogeology, Miami University, Oxford, OH

BA, 1985, Geology, Miami University, Oxford, OH

Professional Registration

1993, Professional Geologist, California, #5737

1995, Certified Hydrogeologist, California, #360

Professional Experience

cbec, inc., eco-engineering, West Sacramento, CA, Senior Ecohydrologist, 2020-present

Kamman Hydrology & Engineering, Inc., San Rafael, CA, Principal Hydrologist/Vice President, 1997-2020

Balance Hydrologics, Inc., Berkeley, CA , Sr. Hydrologist/ Vice President, 1994-1997

Geomatrix Consultants, Inc., San Francisco, CA, Project Geologist/Hydrogeologist, 1991-1994

Environ International Corporation, Princeton, NJ, Sr. Staff Geologist/Hydrogeologist, 1989-1991

Miami University, Oxford, OH, Field Camp Instructor and Research Assistant, 1986-1989

Greg Kamman is a professional geologist and certified hydrogeologist with over 30 years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. He specializes in directing and managing projects in the areas of surface and groundwater hydrology, stream and tidal wetland habitat restoration, water supply and water quality assessments, water resources management, and geomorphology. Mr. Kamman has worked extensively throughout California's coastal watersheds and estuaries, and on multiple projects in Oregon and Hawaii.

Mr. Kamman's experience and expertise includes evaluating surface and groundwater resources and their interaction, stream and wetland habitat restoration assessments and design, characterizing and modeling basin-scale hydrologic and geologic processes, assessing watershed hydraulic and geomorphic responses to land-use change , and designing and conducting field investigations characterizing surface and subsurface hydrologic and water quality conditions. Greg commonly works on projects that revolve around sensitive fishery, wetland, wildlife, and/or riparian habitat enhancement within urban and rural environments. Mr. Kamman performs many of these projects in response to local, state (CEQA) and federal statutes (NEPA, ESA), and other regulatory frameworks. Mr. Kamman frequently applies this knowledge to the review and expert testimony on state and federal water operation plan EIR/EIS reports, Groundwater Sustainability Plans, Habitat Conservation Plans, and biological assessments.

Mr. Kamman is accustomed to working multi-objective projects as part of an interdisciplinary team including biologists, engineers, planners, architects, lawyers, and resource and regulatory agency staff. Mr. Kamman is a prime or contributing author to over 360 technical publications and reports in the discipline of hydrology, the majority pertaining to the protection and enhancement of aquatic resources. Mr. Kamman has taught the following courses: stream restoration through U.C. Berkeley Extension (2001-2008); wetland hydrology through San Francisco State University's Romberg Tiburon Center (2007 and 2012-2014); and presented webinars (2020) to California Water Boards staff on hydrologic and hydraulic modeling. He has devoted his career to the protection, enhancement and sustainable management of water resources and associated ecosystems.

SELECTED EXPERIENCE

Floodplain Management Projects

Flood Reduction, Mitigation Planning, and Design on Yreka Creek, Siskiyou County, CA
City of Yreka as subcontractor to WRA, Inc., 2008-2010

Mr. Kamman completed a series of field and hydraulic model investigations for restoration planning and design along Yreka Creek to reduce flood hazards and potential damage to the City's water treatment plant and disposal field infrastructure. This work also addresses and satisfies dike repair mitigation conditions stipulated by state resource agencies. While achieving these goals, Mr. Kamman tailored analyses and study objectives to assist the City in: enhancing the ecological floodplain restoration along Yreka Creek; providing opportunities for expanded public access and trail planning consistent with the goals of the Yreka Creek Greenway Project; and improving the water quality of Yreka Creek.

Key elements of this work included: review and synthesize existing information; identify and analyze the feasibility for three conceptual alternatives; and conceptual design and report preparation. Funding for implementation of restoration work over such a large area was a significant concern to the City. Therefore, designs identify and define phasing in a fashion that gives the City flexibility in implementation.

SELECTED EXPERIENCE *(CONTINUED)*

West Creek Drainage Improvement Assessment, Marin County, CA
Marin County Flood Control, 2006-2008

Mr. Kamman prepared a study focused on characterizing existing flood conditions and developing and evaluating flood reduction measures along West Creek in Tiburon. The work was completed through the implementation of hydrologic and hydraulic feasibility and design assessments. The conceptual design and analysis of potential flood reduction strategies (alternatives) was completed through the development of a HEC-RAS hydraulic model that simulates historic, existing and proposed project flood conditions. It was intended that the conceptual design developed under this scope of work would be of sufficient detail and quality to initiate project permitting and the environmental compliance process and documentation. Opportunities for riparian corridor and aquatic habitat enhancement were also considered and integrated into the conceptual design. Mr. Kamman also developed and assessed six alternative flood hazard reduction measures. The hydraulic model results for each alternative were compared against baseline conditions in order to evaluate their ability to alleviate flood hazards.

Gallinas Creek Restoration Feasibility Assessment, Marin County, CA
San Francisco Bay Institute, 2003-2005

Mr. Kamman completed a feasibility assessment for restoration of Gallinas Creek in northern San Rafael. Restoration will require removal of a concrete trapezoidal flood control channel and replacement with an earthen channel and floodplain in a “green belt” type corridor. Work included the collection of field data and development of a HEC-RAS hydraulic model to evaluate and compare existing and proposed project conditions. Designs must continue to provide adequate flood protection to the surrounding community. The study also includes and evaluation of existing habitat values, potential habitat values, and restoration opportunities and constraints.

Hydrologic and Hydraulic Evaluation for Trinity County Bridge Replacement, Trinity County, CA
Trinity County Planning Department, 2002

Mr. Kamman completed technical peer review of peak flow estimates and hydraulic design parameters associated with the replacement of 4 bridges across the upper Trinity River in Trinity County, California. A primary study component was accurately predicting the magnitude and frequency of flood releases from Trinity Dam. Numerous flood frequency analytical approaches were evaluated and used throughout this study.

Restoration of Lower Redwood Creek Floodway and Estuary, Humboldt County, CA
California State Coastal Conservancy and Humboldt County DPW, 2002-2003

Mr. Kamman provided technical review for the development of a hydraulic model to evaluate river and estuary restoration alternatives along the lower portions of Redwood Creek between Orrick (Highway 1) and the Pacific Ocean. This work was completed to evaluate the feasibility for creek/estuary restoration alternatives developed by the County, and effects on flood hazards along this flood-prone reach.

In order to better address and evaluate the current flood hazards along the entire floodway and identify potential flood hazard reduction measures, Mr. Kamman was retained to update HEC-2 models previously prepared by the Army Corps, and to evaluate the impacts of vegetation encroachment (increased roughness) and sediment deposition on floodway conveyance. Mr. Kamman expanded the Corps hydraulic model with newly completed channel surveys and channel roughness observations. The impetus for this work was to assist the County in identifying mutually beneficial strategies for ecosystem restoration and flood hazard reduction. Technical work was completed under close coordination and communication with county engineers. Study results and findings were presented at public meetings of local area landowners and stakeholders.

Tembladero Slough Small Community Flood Assessment, Monterey County, CA
Phillip Williams & Associates, Ltd., 1997

Mr. Kamman completed a flood information study of Tembladero Slough near Castroville on behalf of the San Francisco District Corps of Engineers. The purpose of this work was to identify and document local flood risks existing in the community and propose potential floodplain management solutions as part of the Corps 1995/1997-flood recovery process. Work centered on conducting a field reconnaissance, reviewing available historical data, and conducting discussions/interviews with local landowners and agency personnel.

Fluvial Projects

Muir Woods National Monument Bank Stabilization Plan for Conlon Creek, Marin County, CA
Golden Gate National Parks Conservancy (GGNPC), 2018-present

Mr. Kamman developed a grading and drainage plan for the Conlon Avenue Parking Lot, located adjacent to Redwood Creek and sensitive Coho salmon habitat. More recently, he has assisted GGNPC and the NPS in assessing the planning and design for creek bank stabilization and ecological enhancement at a failed culvert on a tributary channel at the project site. This work includes constructing a HEC-RAS model to evaluate: culvert removal and channel design; fish passage; and water quality impacts. Work is currently in development of 50% engineering design.

Hydrology and Hydraulic Assessments for Design of Butte Sink Mitigation Bank Project, Colusa County, CA
WRA, Inc., 2017-2018

Mr. Kamman was retained to provide hydrology and hydraulic modeling support in the development of design and Draft Prospectus for the Butte Sink Mitigation Bank (Bank). This work entailed developing the necessary hydrology information, hydraulic model and documentation to support further design, environmental compliance and agency approvals/permitting of the Bank. The main objective of work was to develop a design that provides the necessary ecological conditions and functions for successful establishment and operation of the Bank.

Lagunitas Creek Salmonid Winter Habitat Enhancement Project, Marin County, CA
Marin Municipal Water District, 2013-2018

Mr. Kamman designed and led a study to evaluate opportunities to enhance winter habitat for coho and other salmonids in Lagunitas Creek and its largest tributary - Olema Creek. This work was done as a two-phase assessment and design effort. The first phase (completed in 2013) included a winter habitat assessment to evaluate existing juvenile salmonid winter habitat in Lagunitas Creek and lower Olema Creek. The results of this assessment were used to prioritize winter habitat needs, and identify opportunities for winter habitat enhancement to increase

SELECTED EXPERIENCE *(CONTINUED)*

the winter carrying capacity of coho salmon and steelhead. The second phase (completed in 2017) consisted of a designing winter habitat enhancements. These enhancements focused on restoring floodplain and in-channel habitat structures. Winter habitat enhancement work also needed to consider potential impacts to or benefits for California freshwater shrimp (Syncaris pacifica), a federally endangered species.

This work included field reconnaissance, topographic surveys and the preparation of final design drawings at nine different project sites. An overall self-maintaining design approach was developed to guide individual project plan, with minimal earthwork and disturbance to existing riparian and wetland habitat. Self-sustained, natural evolution of a multi-thread channel within a more active floodplain is a desired outcome of project actions. Design elements and structures are intended to enhance or restore natural hydrologic processes to promote geomorphic evolution of more active high flow (side) channels and floodplain. Design elements include construction of 24 individual log structures.

Lower Miller Creek Management and Channel Maintenance, Marin County, CA
Las Gallinas Valley Sanitary District, 2013-2015

Mr. Kamman was commissioned to formulate and implement a plan for sediment removal and improved flood flow conveyance in the Lower Miller Creek channel. The need for improved flood and sediment conveyance is driven by the following factors. Progressive accumulation of course sediment in the project reach had reduced area wide discharge efficiencies along Miller Creek and at District outfalls. The District had an immediate need to dredge Lower Miller Creek to protect existing operations and facilities. Miller Creek supports a population of federally listed Steelhead, and adjacent wetland areas potentially support other state and federally listed special status species. Therefore, permitting requirements and cost efficiency required minimizing the extent and frequency of channel excavation/maintenance that may adversely impact habitats in the wetland and riparian corridor.

The design objective of the project was to define and optimize an integrated channel maintenance, flood, and sediment management plan, that protects existing facilities from stream and coastal flood hazards. The plan's objective was to minimize costs and ecological impacts of future anticipated and designed maintenance activities required under District operations. Working with District Staff, Mr. Kamman developed a suite of potential project alternatives and identified a preferred approach. Mr. Kamman completed all CEQA compliance (IS/MND) and permitting. Mr. Kamman also managed and directed development of engineered drawings and assisted in bid document preparation.

Mr. Kamman provided site assessment, long term management planning and channel maintenance support to the Sanitary District to maintain flood conveyance, manage sediment aggrading at District outfalls, and improve ecological values in the intertidal Bayland reaches of Miller Creek. The creek supports multiple federal and state listed endangered species. Initial work included completing hydraulic and geomorphic assessments to characterize causes of channel aggradation, and quantify sediment yields. Assessments included evaluation of climate change impacts on habitat and flood hazards, and water quality modeling of District outfalls to quantify tidal exchange and dilution. Based on this analysis and supporting biological resource assessments, Mr. Kamman identified alternatives for channel maintenance, performed a cost benefit assessment of dredging alternatives, and is assisted the District in developing short and long term management objectives. Mr.Kamman also led a multidisciplinary design team in the preparation of engineering plans and specifications as well as permits and environmental compliance documents.

Vineyard Creek Channel Enhancement Project, Marin County, CA
Marin County Department of Public Works, 2007-2013

Mr. Kamman managed the preparation of designs and specifications for a flood conveyance and fish habitat and passage improvement project on Vineyard Creek. Creek corridor modifications included replacing the box culvert at the Center Road crossing with a free span bridge or bottomless arch culvert (civil and structural design by others), providing modifications to the bed and bank to eliminate erosion risks to adjacent properties and improve water quality, promoting active channel conveyance of both water and sediment, and providing improved low and highflow fish passage, improved low flow channel form and enhanced in-stream habitat, repairing eroding banks, and expanding/enhancing adjacent channel floodplains. The riparian corridor was replanted to provide a low-density native understory, "soft" bank erosion protection, and increased tree canopy along the tops of banks. Mr. Kamman prepared the JARPA for the project and conducted permit compliance and negotiations with all participating resource agencies. Designs and permitting also address the known presence of Native American artifacts. This work was contracted under an expedited design schedule and phased construction was initiated the summer of 2008 and continued the summer of 2009.

Bear Valley Creek Watershed and Fish Passage Enhancement Project, Marin County, CA
The National Park Service and Point Reyes National Seashore Association, 2005-2013

Working on behalf of the NPS and PRNSA, Mr. Kamman completed a watershed assessment and fish passage inventory and assessment for Bear Valley Creek. Work included a geomorphic watershed assessment and completing field surveys and hydraulic modeling (including flood simulations) of ten road/trail crossings to identify and prioritize creek and watershed restoration efforts while considering and addressing current flooding problems at Park Headquarters – a major constraint to channel restoration efforts that would likely exacerbate flooding. Mr. Kamman also completed a suite of conceptual restoration designs (Phase 1) including: the replacement of two county road culvert crossings with bridges; channel creation through a ponded freshwater marsh (former tidal marsh); and replacement of 4 trail culverts with prefabricated bridges; and associated in-channel grade control and fishway structures. Engineered drawings and specifications were also developed for some of these sites to assist PORE with emergency culvert replacements after damages sustained during the New Year's Eve flood of 2005. Mr. Kamman also directed geotechnical, structural and civil design of project components.

Two projects were completed in 2006 on emergency repair basis resulting from flood damages suffered during the New Year's Eve storm of 2005. The two most recent projects were constructed in 2013, consisting of a large bank repair and adjacent to main access road/trail and culvert replacement further upstream on same road. The bank repair utilized bioengineering approaches including engineered log revetments and log diversion vanes.

SELECTED EXPERIENCE *(CONTINUED)*

Kellogg Creek Restoration Project, Contra Costa County, CA
Olberding Environmental on behalf of the Contra Costa County Water District, 2012-2013

Mr. Kamman led the development of PS&E to restore 3,000 linear feet of riparian and associated creek corridor habitat. Project was designed as compensatory mitigation for direct and indirect impacts to jurisdictional waters from the Los Vaqueros Reservoir Expansion Project that Contra Costa Water District. Work included field investigations and data analysis to characterize hydrologic/ geomorphic conditions and numerical modeling to optimize desired inundation and hydroperiods. Work was completed under subcontract to.

Miller Creek Sanitary Sewer Easement Restoration, Marin County, CA
Las Gallinas Valley Sanitary District, 2010

Working on behalf of the District, Mr. Kamman completed field surveys and technical feasibility studies to develop engineering plans and specifications for a stream bank restoration project to protect an exposed sanitary sewer pipeline, stabilize incised banks, and promote an ecologically healthy stream corridor along an approximately 50 linear foot damaged reach of Miller Creek. The design includes backfill and materials to accommodate construction of a vegetated stabilized slope. The eroded bank repair included design of a 1:1 Envirolok vegetated slope with geogrid reinforced soil lifts extending eight to ten feet back from the slope face. One-quarter-ton rock will be placed in front of the Envirolok wall at the toe of the reconstructed bank to provide added scour protection. In order to perform the work, the project site will be dewatered. An existing felled tree perpendicular to the creek flow will be relocated and secured into the right creek bank with root wad remaining in active channel. All work on the bank and within the creek bed must be completed pursuant to project permits due to presence of steelhead trout.

California Coastal Trail Planning and Design at Fitzgerald Marine Reserve, San Mateo County, CA
WRA, Inc., 2008-2009

Mr. Kamman provided hydrology and hydraulics expertise in the planning and design for the 0.25-mile segment of the California Coastal Trail at the Fitzgerald Marine Reserve. The project was overseen by the San Mateo County Parks Department. This segment of Coastal Trail provides improved access from the trailhead to the beach as well as a free span bride over Vicente Creek. Greg completed the field surveys and hydraulic modeling to assist an interdisciplinary team to design the project. Understanding the hydrology of Vicente Creek and quantifying flood conditions was critical to successfully designing and constructing the free span bridge. He also evaluated how creek hydrology and coastal wave processes interact at the beach outfall in order to identify opportunities and constraints to beach access improvements (which will include crossing the creek on the beach) during both wet and dry season conditions in order to evaluate both permanent and seasonal crossing design alternatives.

Hydrologic Assessment and Conceptual Design for Conservation and Wetland Mitigation Bank Project, Stanislaus County, CA
WRA, Inc., 2009

Working as a subcontractor to WRA, Inc., Mr. Kamman provided hydrology, geomorphology and engineering support for the planning and design for a Conservation and Wetland Mitigation Bank on the San Joaquin River, in the Central Valley near Newman, California. The property is currently owned by the Borba Dairy Farms. The primary objective of the study was to characterize the hydrologic and geomorphic controls on the spatial distribution of habitat types. To meet this objective, Mr. Kamman's assessment included: (1) collecting and synthesizing hydrologic data to characterize existing and historic streamflow, geomorphic and shallow groundwater conditions; (2) filling a data gap by collecting topographic data of hydrologic features; (3) developing a hydraulic model capable of predicting water surface profiles for a range of design flows; and (4) quantifying the linkage between surface water/groundwater conditions and specific vegetation communities and habitat types through implementation of reference site assessments. Mr. Kamman also provided conceptual design and permitting support in evaluating habitat enhancement and creation opportunities on the site.

Redwood Creek Floodplain and Salmonid Habitat Restoration, Marin County, CA
Golden Gate National Recreation Area and Golden Gate Parks Conservancy, 2005-2008

Mr. Kamman lead development of a preferred project alternative and final project design drawings and specifications for a floodplain and creek restoration and riparian corridor enhancement effort on lower Redwood Creek above Muir Beach at the Banducci Site. A primary objectives of the project was to: improve salmonid passage/rearing/refugia habitat; riparian corridor development to host breeding by migratory song birds; and wetland/pond construction to host endangered red-legged frog. The preferred design includes: excavation along the creek banks to create an incised flood terrace; engineered log deflector vanes; removing and setting back (constructing) approximately 400-feet of levee; creating in- and off-channel salmonid rearing and refugia habitat; reconnecting tributary channels to the floodplain; and creating California red-legged frog breeding ponds. Designs were completed in 2007 and the project constructed in the summer of 2007.

Considerable hydraulic modeling was completed to evaluate and develop means to help reduce chronic flood hazards to surrounding roadways and properties. Alternatives that included set-back levees and road raising were developed and evaluated. Detailed and careful hydraulic (force-balance) analyses and computations were completed as part of engineered log deflector designs. These were unique and custom designed structures, building on past project efforts and in consultation with other design professionals.

This project demonstrates Mr. Kamman's ability to work closely with the project stakeholders to develop a preferred restoration alternative in a focused, cost-effective and expedited fashion. This was achieved through close coordination with the NPS and the effective and timely use of design charrette-type meetings to reach consensus with participating stakeholders. Conceptual through full PS&E were completed on-time and on-budget in 2007 and was project constructed in the fall of 2007. Mr. Kamman worked closely with NPS staff to "field fit" the project, by modifying grading plans to protect existing riparian habitat. Mr. Kamman also provided construction management and oversight to floodplain grading and installation of engineered log structures. Based on field observations, the project is performing and functioning as desired.

Pilarcitos Creek Bank Stabilization Project, San Mateo County, CA
TRC Essex, 2006-2007

Mr. Kamman directed field surveys and technical modeling analyses to develop restoration design alternatives for a Bank Stabilization Project on Pilarcitos Creek

SELECTED EXPERIENCE *(CONTINUED)*

in unincorporated San Mateo County, California. This work included hydrology and hydraulic design and preparation of plan sheets and technical specifications as well as a revegetation plan. Due to the importance of protecting an existing gas mainline, the design package will be completed in close coordination with TRC Essex geotechnical staff and revegetation subcontractor and PG&E civil staff. Design feasibility analyses focused on developing hydraulic design criteria for the project, including: estimates of design flood flow magnitudes (2-, 5-, 10-, 25-, 50- and 100-year floods); water surface elevation estimates for a suite of design floods; associated average channel velocities and shear stresses; and estimates for riprap sizing for channel bank toe protection. Plan sheets, technical specifications and cost estimates were provided for review and approval.

Watershed Assessments

Evaluation of Project Impacts on Oregon Spotted Frog, Klamath County, OR
Oregon Water Watch and Earthjustice, 2016-2019

Mr. Kamman designed a suite of hydrologic, hydraulic and geomorphic studies to evaluate proposed change operations of the Crane Prairie, Wickiup and Crescent Lake dams and reservoirs as related to harm to Oregon spotted frogs. Work began with analyzing impacts associated with proposed water delivery operations and developing a proposed alternative prioritizing protection and enhancement of frog habitat. This work followed with a technical review and critique of the USFWS's Biological Assessment. Work included preparation of four declarations for the clients.

Tennessee Hollow Creek Riparian Corridor Restoration, San Francisco County, CA
Presidio Trust, 2001-present

Mr. Kamman has been leading and assisting the Trust and Golden Gate National Recreation Area (GGNRA) in the planning and design on over a dozen multi-objective riparian corridor restoration and watershed management projects in the Tennessee Hollow/Crissy Marsh watershed since 2001. Specific project objectives include: daylighting creeks; riparian corridor restoration; expanding Crissy Marsh; enhancing recreation, education, archeological, and cultural resource opportunities; improving water quality discharges to San Francisco Bay; and remediation of numerous landfills within the watershed. Typical initial phases of work focus on characterizing surface and groundwater conditions within each project area and identifying opportunities and constraints to restoration of natural wetlands and creek/riparian corridors. Notable challenges of this work include restoring heavily disturbed natural resources in an urban setting while integrating designs with recreation, archeology/cultural resources, education and remediation programs. Mr. Kamman has acted as lead hydrologist and designer on eight separate reaches in the 271-acre Tennessee Hollow Creek watershed and several other projects within and in the vicinity of Mountain Lake.

All task authorizations under these on-call and individual design contracts and included hydrology and water quality assessments and conceptual restoration planning and design. The project areas overlapped both the Presidio Trust and NPS-GGNRA management areas. Preliminary construction cost estimates for project alternatives within the Tennessee Hollow watershed range from $10- to $20- million. Several restoration projects are also tied to providing mitigation for the current San Francisco Airport expansion and Doyle Drive Seismic Improvement projects. Several projects have been constructed since 2012 (Thompson's Reach, El Polin Loop), two projects (East Arm Mtn. Lake and YMCA Reach) were constructed in 2014, and MacArthur Meadow restoration in 2016.

This work illustrates the Mr. Kamman's ability to complete a broad variety of hydrologic analyses, including: multiple years of rigorous and thorough surface water and groundwater hydrologic and water quality monitoring throughout the entire watershed to characterize and quantify existing hydrologic conditions; development of a detailed watershed-scale water budget for existing and proposed land-used conditions (capturing existing and proposed vegetation cover types and land use activities) to calculate groundwater recharge estimates input into the numerical watershed model; preparation of EA sections on water resources and water quality (NEPA compliance) regarding Environmental Conditions, proposed Impacts, and Proposed Mitigations associated with the project; preparing detailed alternative plans; and coordination and preparation of engineered plans/specifications for construction. All work was completed on budget and in a timely fashion.

Mountain Lake Water Budget, San Francisco County, CA
Presidio Trust, 2012-2017

Mr. Kamman was retained to develop a water balance model for Mountain Lake in the Presidio of San Francisco. Through development of a water balance model, the Trust seeks to understand: the major source(s) of inflow to both Mountain Lake; anticipated seasonal (monthly) changes in water level relative to various outflow assumptions; and the relationship of surface and groundwater interaction. This information gained from this study will be used to: 1) better understand and manage lake levels for ecological habitats; 2) identify flood storage capacity of Mountain Lake and fluctuations in lake level under various storm conditions; 3) better understand and maintain wetland habitat in the east arm; and 4) complete mass balance calculations to assess water quality in and feeding into the lake.

To implement this study, Mr. Kamman developed a water budget model to identify and quantify the primary water inputs and outputs to the lake and determine major controls over water storage. Primary water budget variables analyzed includes: precipitation; evaporation/evapotranspiration; groundwater exchange; and surface runoff. This study also included a long-term field investigation completed between 2012 and 2016 to: identify all point source inputs such as culverts and drainage outlets; identify diffused surface runoff inputs from surrounding lands, including a golf course; better characterizing the function and performance of the primary lake outfall structure; monitor groundwater levels surrounding the lake; and continuously monitor lake water level and storage over a mult9i-year period. These data were used to quantify water budget variables used to build the water budget model. Precipitation and barometric pressure data used in the model was provided by the Trust maintained weather station. Model daily evaporation estimates came from a variety of local area gauges maintained by state agencies.

The water budget model developed for this study is successful in accurately simulating historic water level conditions. The model using a daily time-step appears more accurate than model using a weekly time-step, but both provide reasonable agreement with observed conditions. The model is highly sensitive to groundwater exchange with the lake. The water budget is also a proven useful tool for the design and analysis of improvements to the lake outfall structure and establishing flood storage needs to protect the adjacent highway.

SELECTED EXPERIENCE *(CONTINUED)*

Cordilleras Creek Hydrologic Assessment, San Mateo County, CA
City of Redwood City, 2002-2003

Mr. Kamman assisted the Cordilleras Creek Watershed Coordinator in planning, seeking funding, and implementing a hydrologic and biologic assessment of the Cordilleras Creek watershed. Work completed included completing a full creek reconnaissance and channel stability assessment, preparation of a watershed assessment work plan, presentations at public meetings, and study/review of flooding issues in the watershed. Challenges faced in this predominantly privately owned watershed include removal of numerous fish passage barriers and educating/coordinating property owners.

Capay Valley Hydrologic and Geomorphic Watershed Assessment, Yolo County, CA
Yolo County RCD, 2008-2010

Mr. Kamman designed and supervised a hydrologic, geomorphic watershed assessment, and conceptual restoration design for the Capay Valley segment of Lower Cache Creek . Funding for the project was from a CALFED Watershed Program grant. The Capay Valley reach of Cache Creek experiences considerable stream bank erosion, which contributes to downstream sedimentation. The channel instability also threatens adjacent homes and can negatively impact the riparian habitat along the creek that functions as an important wildlife corridor from the Western Coastal Range to the Yolo Bypass. Additionally, a significant proportion of methylmercury transported into the Bay-Delta originates from the Cache Creek watershed. The main goal of this proposed study is to address both the causes and the aforementioned consequences of bank erosion.

The assessment was designed to evaluate and quantify changes in hydrologic and geomorphic conditions in response to historical changes in land-use and water development (e.g., diversions, reservoir construction, groundwater pumping, etc.). This assessment also evaluated how historic human induced changes in hydrologic and geomorphic conditions affect riparian ecology in terms of the lost or altered floodplain area, character, and inundation frequency. A key product of this assessment was to distinguish between “natural” and “accelerated” bank erosion, and to identify the underlying causes (both natural and anthropogenic) so that appropriate solutions can be developed. Desired outcomes of the study included: reduce bank erosion by developing restoration designs for typical trouble sites; produce a ranking system to prioritize sites for stabilization and restoration; contribute to community education through watershed science education and the Yolo STREAM Project outreach program; improve water quality through reduction in accelerated erosion; and contribute to riparian corridor restoration and support the RCD’s Wildlife Conservation Board funded efforts to remove non-native tamarisk and around from the creek corridor. Work was completed through a broad spectrum of field and analytical investigations that received close review by the RCD, stakeholders, and a Technical Advisory Committee.

Ventura River Unimpaired Flow and Habitat Assessment, Ventura County, CA
City of Buenaventura and Nautilus Environmental, 2006-2007

Mr. Kamman completed a hydrology feasibility assessments as part of evaluating the reuse of Ojai Valley Sanitary District (OVSD) effluent for other beneficial uses. Currently, OVSD discharges treatment plant effluent to the lower Ventura River. The City and OVSD recognize that the reduction in the discharge of treated effluent to the Ventura River could have an environmental effect on sensitive and endangered species. In light of these concerns, this study was conducted to determine if a reuse project is feasible without significant environmental harm.

The assessment included hydrologic and geomorphic field and analytical assessments of past (unimpaired), current and proposed surface and groundwater flow conditions over a wide range of dry- through wet water year-types. The main objective if these analyses was to determine the linkage to water quality and aquatic habitat conditions including: flow durations; extent of gaining vs. losing reaches; low flow inundation/wetted area; and influence on barrier beach dynamics. Mr. Kamman collaborated with a team of other professionals to prepare a facility plan documenting the analyses and conclusions of respective water recycling investigations.

Hydrologic Analysis of FERC Minimum Flows on Conway Ranch Water Rights, Mono County, CA
Law Office of Donald Mooney, 2001-2002

Mr. Kamman completed a hydrologic analysis to evaluate if FERC’s proposed Minimum Flow Plan for Mill Creek would interfere with the exercise of the Conway Ranch’s water rights from Mill Creek. The approach to this analysis was to quantify the duration of time the Conway Water right was met under historic gaged and simulated proposed Minimum Flow Plan conditions. The primary objective of the analysis was to evaluate impacts during the winter period when flows are typically limited due to water storage as snow pack. Minimum Flow Plan conditions were simulated by developing a spreadsheet model that redistributes actual (historic) Lundy Lake releases in a fashion that maintains a minimum flow of 4 cfs to Mill Creek to accommodate the downstream Southern California Edison’s (SCE) power plant. The analysis period for both historic and simulated Minimum Flow Plan conditions consisted of water years (WY) 1990 through 1998 to capture an exceptionally diverse range of wet and dry year-types.

The primary method used to quantify changes in flow between historical and simulated Minimum Flow Plan conditions was to prepare and compare flow duration curves for each condition during both the winter and summer periods during a variety of water year types. Model results were tabulated for each conditions to determine the differences in the percentage of time target flows were equaled or exceeded. Based on these findings, Greg was contracted to complete more in-depth monthly modeling.

Groundwater Management Projects

Assessments of Groundwater-Surface Water Interaction, Stanislaus County, CA
The Law Offices of Thomas N. Lippe, APC and California Sportfishing Protection Alliance, 2015-present

Since 2015, Mr. Kamman has been assessing groundwater conditions within Stanislaus County and evaluating potential impacts of groundwater pumping on surface water flow and aquatic habitat of the Stanislaus, Tuolumne and San Joaquin Rivers. Mr. Kamman completed a comprehensive review and synthesis report of available groundwater and interconnected surface water (ISW) reports and data. Using available soils, geology and hydrology information, Mr. Kamman also delineated and mapped subterranean streams and Potential Stream Depletion Areas (PSDAs) to identify stream corridors susceptible to adverse impacts from groundwater pumping. This information is intended to help Groundwater Sustainability Agencies identify potential impacts to ISW.

SELECTED EXPERIENCE *(CONTINUED)*

Most recently, Mr. Kamman has been retained to review and comment on 7 Groundwater Sustainability Plans (GSPs) for critically overdraft groundwater subbasins within or adjacent to Stanislaus County. This review focused on how GSPs address Groundwater Dependent Ecosystems (GDE) and ISW. Comments included recommendations on monitoring and study plans to identify and quantify impacts of groundwater pumping on stream flow rates and associated ecological habitats.

Assessment of Surface Water-Groundwater Interaction, Humboldt County, CA
Friends of the Eel River (FOER), 2020-present

Mr. Kamman is currently providing technical assistance in understanding surface water-groundwater interactions in the Lower Eel River Valley. Work includes reviewing and synthesizing available reports and hydrologic data and providing a science-based opinion on the role groundwater plays in supporting stream flow and aquatic habitats. This analysis addresses conditions and changes associated with seasonal and long-term wet-dry cycles. Data gaps will be identified and documented during the analysis.

This work is being completed to support FOER efforts at protecting aquatic resources within the framework of current water management practices and the public trust doctrine under California law. Additionally, this work includes providing hydrologic and hydrogeologic review, comment and recommendations during development of the basin's Groundwater Sustainability Plan (GSP) under the California Sustainable Groundwater Management Act (SGMA).

Scott Valley Subbasin Technical Hydrogeologist Assistance, Siskiyou County, CA
Klamath Tribal Water Quality Consortium and Quartz Valley Indian Reservation, 2019-present

Mr. Kamman is providing technical review and comment on the groundwater models and associated studies in the Scott Valley groundwater subbasin under the Sustainable Groundwater Management Act (SGMA) process. Work includes: review of groundwater models; synthesis and review of available groundwater quality data; assisting to identify constituents of concern; and review of the planning and technical studies being used to develop a basin Groundwater Sustainability Plan (GSP).

Middle Russian River Valley Shallow Groundwater Storage Enhancement Study, Sonoma County, CA
Friends of the Eel River, 2016

Working on behalf of Friends of the Eel River, Mr. Kamman completed a study to identify and quantify the volume of recoverable aquifer storage along two independent 6-mile reaches within the alluvial fill valley of the Russian River. The approach to this study was to quantify how channel incision has reduced shallow groundwater levels and quantify how much aquifer storage can be increased if channel bed elevations are restored to historic levels. The goal of this investigation was to identify feasible approaches to increase groundwater storage that would off-set losses associated with the termination of out-of-basin diversions from the Eel River. This work was completed through: intensive review and mapping of available groundwater level data; quantification of aquifer hydraulic properties; and calculating the shallow aquifer storage volume. In total, reclaiming the shallow aquifers within these two areas yield a total added storage volume of over 20,000 AF.

Green Gulch Farm (GGF)/Zen Center Water Resources Investigation, Marin County, CA
Green Gulch Farm, 1998-2019

Mr. Kamman completed a multi-phase study to evaluate the short- and long-term water uses and resources at GGF. Work was initiated by developing comprehensive water usage/consumption estimates and assessing available water resources, including spring, surface water, and ground water sources. Water demand estimates included quantifying potable and agricultural water usage/demands. Once reliable water supplies were identified and water usage/demand figures calculated, Mr. Kamman provided recommendation for improvements to water storage and distribution systems, land-use practices, conservation measures, treatment methods, waste disposal, and stream and habitat restoration. The initial phase of work included: in-depth review of available reports and data; review of geology maps and aerial photography; review of water rights and historic land use records; field reconnaissance including year-round spring flow monitoring; mapping and quantifying existing runoff storage ponds; and surface water peak- and base-flow estimates.

The second phase of work included identification of possible groundwater sources and siting and installation of production wells. This included sighting three drilling locations, obtaining County and State well drilling permits for a domestic water supply; coordination and oversight of driller; and directing final well construction. Upon completion of a well, Mr. Kamman directed a well pumping yield test and the collection and analysis of water quality samples (including Title 22) for small water supply system use. The final phase of work included assisting GGF with water treatment system options at the well head and integration of the groundwater supply into an existing ultra-violet light treatment system servicing spring water sources. Work was completed in 2000 with a budget of approximately $25,000, including all driller and laboratory subcontracting fees.

Stanford Groundwater Assessments, Santa Clara County, CA
Stanford University Real Estate Division, 2012-2016

Mr. Kamman provided technical hydrogeologic services to evaluate groundwater conditions and drainage requirements associated with the construction of several new facilities on or near Page Mill Road. The main objective of this study is to determine the seasonal depth to groundwater beneath the project site under existing and potential future conditions and provide an opinion on if the project is required to comply with the City of Palo Alto, Public Works Engineering Basement Exterior Drainage Policy (effective October 1, 2006). This work included obtaining and reviewing available technical reports, maps and literature pertaining to groundwater conditions in the project vicinity. Based on this review, we have prepared a letter report of findings and recommendations.

Bodega Bay Wetland Water Supply, Sonoma County, CA
Friends of Bodega Bay, 2007

Mr. Kamman Conducted an evaluation of the groundwater underflow feeding a large coastal wetland in Bodega Bay and recommended mitigation measures for potential losses in supply associated with proposed residential development in recharge areas. Work included: long-term monitoring of ground water quality and supply; monitoring surface water and spring flow and water quality; assessing and characterizing the interaction between surface and subsurface water sources during different seasons and water year-types; developing a detailed water budget for the site to assess impacts to recharge areas; and developing a number of physical solutions to mitigate for recharge losses.

SELECTED EXPERIENCE *(CONTINUED)*

L.A. Department of Water and Power, Groundwater Recharge Facility Operation Study, Los Angeles County, CA
ICF Consulting, 2006

Working as a subcontractor to ICF Consulting of Laguna Niguel, California, Mr. Kamman provided technical assistance in the hydraulic modeling of sediment accumulation in selected spreading ground facilities owned and operated by the Los Angeles Department of Public Works. The object of this work is to evaluate changes in infiltration and groundwater recharge rates over time within the spreading grounds in association with sediment accumulation from turbid waters.

Corde Valle Golf Club Surface-Groundwater Interaction Study, Santa Clara County, CA
LSA Associates, 2004

On behalf of LSA Associates of Pt. Richmond, CA, Mr. Kamman completed a 3rd party independent review of available reports and data sets (boring logs, well water levels, groundwater quality, aquifer pump-test, and surface water monitoring) to evaluate if pumping of the Corde Valle irrigation well is adversely impacting flow in West Llagas Creek. This investigation was implemented in response to a concern expressed by California Department of Fish and Game staff regarding the potential for differential drying of the West Branch of Llagas Creek along Highland Avenue. The analysis was also complicated by the likely effects of pumping from surrounding off-site wells.

Aquifer Testing for Tennessee Hollow Watershed Project, San Francisco County, CA
Presidio Trust, 2002

The Mr. Kamman assisted in the design and implementation of an aquifer test at the Presidio of San Francisco. We prepared an aquifer test work plan and conducted step-drawdown and constant-rate aquifer tests at the site using both manual and electronic data collection methods. This work included interpretation of the aquifer test results using software-based solution methods and prepared a written summary of methods and findings. In addition, Mr. Kamman located, coordinated and managed a drilling effort for the logging and installation of several groundwater monitoring wells in the project area to address identified data gaps.

San Joaquin River Riparian Corridor Restoration Project, San Joaquin Valley, CA
McBain-Trush, 2002

Mr. Kamman completed an assessment of historic and existing shallow groundwater conditions beneath and adjacent to the San Joaquin River between Friant Dam and the Merced River. This work focused on reviewing available reports and flow/groundwater- level data to characterize surface water and groundwater interaction and implications for riparian vegetation, water quality and fishery habitat restoration. Hydrologic analyses were performed to identify the location and seasonal evolution of losing and gaining reaches an implication on future restoration planning and design efforts. The main deliverable for this analysis was a report section focused on describing the historical changes in regional and local groundwater conditions in the San Joaquin Valley and evolution of anthropogenic activities (e.g., groundwater withdrawals, irrigation drainage systems and return flows, development of diversion structures, changes in land-use; and introduction of CVP/State Water Project deliveries) and associated impacts on deep/shallow groundwater levels, surface water flows, and surface and groundwater quality.

Tidal, Estuarine & Coastal Projects

Quartermaster Reach Wetland Restoration Project, San Francisco County, CA
Presidio Trust, 2006-present

Mr. Kamman was retained in 2006 as part of a multi-disciplinary team to develop restoration alternative designs for a 10-acre filled and paved site marking the historic confluence of Tennessee Hollow Creek and Crissy Marsh adjacent to San Francisco Bay. The Trust's planning documents define the main objectives for Tennessee Hollow restoration as: a) "Restoration [of Tennessee Hollow] will expand riparian habitat and allow for an integrated system of freshwater streams and freshwater, brackish, and tidal marsh, re-establishing a connection to Crissy Marsh" and b) "Restore and protect Tennessee Hollow as a vibrant ecological corridor". The project is located within the setting of a National Park and a National Historic Landmark District. Thus, another goal for the project is to protect the area's historic buildings and sensitive cultural and archeological resources to the extent possible, to enhance visitor experience to the area, and to integrate creek restoration with other urban land uses.

Mr. Kamman provided H&H technical input and consultation to the design team to develop a restoration project consisting of a creek-brackish marsh-salt marsh interface and associated upland habitats. His work included evaluating surface water, groundwater and tidal sources. In addition, the development of a hydrodynamic model has informed and guided a preferred project design, including evaluation of storm surge, road crossing and Tsunami impacts to the project. A technical challenge addressed with the use of the model included predicting and quantifying salt/brackish marsh habitat zones within the restored wetland in response to periodically but prolonged closed-inlet conditions to Crissy Marsh - a water body that serves as the downstream connection to the proposed project.

Another unique challenge to this project includes integrating restoration planning and design efforts with the replacement and retrofit of Doyle Drive, the main on/off-ramp for the Golden Gate Bridge, being replaced along the entire northern boundary of the Presidio. Mr. Kamman is providing long-term technical review of this project to the Trust with respect to impacts to water resources and associated existing ecological habitats. The Quartermaster project also falls within the managerial jurisdiction of both the Presidio Trust and NPS-GGNRA, requiring work in close cooperation with both Presidio Trust and National Park Service (NPS) staff.

Salt River Ecosystem Restoration Project, Humboldt County, CA
Humboldt County RCD, 2005-2019

Mr. Kamman provided hydrology, engineering and environmental compliance services towards the planning and design of river and tidal wetland restoration on the Salt River (Eel River Delta plain) near Ferndale, California, in Humboldt County. The purpose of the Salt River Ecosystem Restoration Project (SRERP) is to restore historic processes and functions to the Salt River watershed. These processes and functions are necessary for re-establishing a functioning riverine, riparian, wetland and estuarine ecosystem as part of a land use, flood alleviation, and watershed management program. The Salt River Project has three components: 1) dredging the lower Salt River and lower Francis Creek from near the Wastewater Treatment Plant downstream for 2.5 miles; 2) restoring 247 acres of wetland estuary habitat in the lower Salt River within the 440-acre former

SELECTED EXPERIENCE *(CONTINUED)*

dairy; and 3) reducing sediment inputs from tributary watersheds. The Salt River Project was designed using an “ecosystem approach” to address hydrology, sedimentation, and fish and wildlife habitat.

As part of project feasibility assessment, Mr. Kamman completed a hydrologic and water quality monitoring program, and developed a MIKE11 hydrodynamic model of the lower Salt River and Eel River estuary in Humboldt County, for the Humboldt County RCD. The purpose of this work was to complete a hydrologic, geomorphic, and hydraulic modeling assessments of the character and dominant physical processes controlling flow of water and sediment through the lower Salt River. Land use changes in the area have caused significant aggradation and infilling of the Salt River, significantly reducing tidal exchange, fish passage, and exacerbating flooding in upland areas. A primary goal of this study is to evaluate the feasibility of proposed restoration elements intended to increase tidal prism and exchange and in-channel sediment scour and transport. The desired outcome is a sustained increase in river conveyance capacity to improve drainage of surrounding flood-prone lands and improve aquatic, wetland, and riparian habitat.

As part of project development and feasibility assessment, Mr. Kamman completed a hydrologic and water quality monitoring program and MIKE11 hydrodynamic model development of the lower Salt River and Eel River estuary in Humboldt County for the Humboldt County RCD. The purpose of this work is to complete a hydrologic, geomorphic, and hydraulic modeling assessments of the character and dominant physical processes controlling flow of water and sediment through the lower Salt River. Land use changes in the area have caused significant aggradation and infilling of the Salt River, significantly reducing tidal exchange, fish passage, and exacerbating flooding in upland areas. A primary goal of this study is to evaluate the feasibility of proposed restoration elements intended to increase tidal prism and exchange and in-channel sediment scour and transport. The desired outcome is a sustained increase in river conveyance capacity to improve drainage of surrounding flood-prone lands and improve aquatic, wetland and riparian habitat.

Western Stege Marsh Restoration Project, Contra Costa County, CA
Tetra Tech, 2008-2010

Mr. Kamman provided technical hydrology and wetland hydraulics support to post-project monitoring of the Western Stege Marsh Restoration Project. His involvement began by providing an independent technical review of previous year’s hydrologic monitoring results to evaluate the proposed monitoring success criteria and the rationale used to develop these criteria. This work entailed reviewing historic monitoring data and available natural slough channel geometry data-sets for San Francisco Bay area marshes. Mr. Kamman’s study approach was to independently develop desired and sustainable channel geometry relationships for natural, healthy San Francisco Bay salt-marshes and compare them to the published success criteria. Greg was also retained to implement the Year 4 post-project hydrologic monitoring, with modifications to aid in better linking hydrologic processes to ecological conditions and function within the restored marsh. This work consisted of completing more targeted water level monitoring and channel geometry surveys in reference marsh areas containing desired physical and ecological attributes. These data were used to develop geomorphic success criteria (target channel geometry) more tailored to the project marsh and augment the criteria provided in available literature. Working closely with the project team of scientists, Mr. Kamman compared these hydrologic monitoring results to available vegetation surveys to better assess the overall success and evolutionary trend of the marsh.

Giacomini Wetland Restoration Project, Marin County, CA
The National Park Service and Point Reyes National Seashore Association, 2003-2012

Mr. Kamman managed a multi-year project for the NPS in the design and feasibility analysis of a tidal wetland, riparian, and freshwater marsh complex, on the 500-acre Giacomini Dairy Ranch, at the south end of Tomales Bay. The project began in 2003 and included hydraulic, hydrologic, and geomorphic assessments to characterize existing physical conditions, developing restoration alternatives, and completing hydrologic feasibility analyses. Restoration alternatives evaluated creation of a mosaic of subtidal through upland wetland and riparian habitat zones, as well as improvements to salmonid passage, red-legged frog habitat, tidewater goby habitat, and clapper-rail habitat. Emphasis was placed on completing detailed studies to quantify project-induced changes in flood frequency, magnitude and duration, impacts on water quality to local groundwater supply wells, and changes in sediment and water quality conditions in Tomales Bay.

Beginning in 2006, Mr. Kamman managed and assisted design engineers, preparing plans, specification, and cost estimates for a three phased construction schedule, that was completed in the summer of 2008. This project illustrates Mr. Kamman’s ability to complete a broad variety of hydrologic feasibility analyses, including flood frequency analyses for contributing watersheds, reproducing historic flood events through numerical modeling, flow duration analysis and evaluation of environmental flow regimes, development of a water budget for created freshwater marsh and frog breeding ponds, sediment yield estimates, completing field monitoring (flow, water level, groundwater level, sediment, and water quality monitoring) to characterize existing site hydrologic and geomorphic conditions (fluvial and tidal), wind-wave setup and run-up for levee stability determination and construction design, coordinating and performing topographic and hydrographic surveys, performing hydrodynamic and water quality modeling of existing and alternative conditions, developing detailed construction cost estimates preparation of technical reports and design drawings and specifications in support of NEPA/CEQA environmental compliance, and public meeting presentation and participation. In addition, Mr. Kamman managed staff in the generation of DEM and TIN models of the existing site and all action alternatives. All work was completed on budget and in a timely fashion, despite repeated expansions to the project boundary and last minute changes driven by endangered species issues.

Critical Dune Habitat Restoration to Protect Threatened and Endangered Species, Marin County, CA
The National Park Service, 2009-2010

Mr. Kamman provided and managed engineering, design, and implementation planning support for the restoration of 300 acres of critical dune habitat at Abbots Lagoon within the NPS Point Reyes National Seashore. He developed engineered drawings, technical specifications and engineer’s cost estimates, and assisted NPS in defining a range of methodologies suitable to local conditions and sensitive flora and fauna. This area of the park supports the best remaining intact dune habitat, including some of the largest remaining expanses of two rare native plant communities: American dune grass (Leymus mollis) foredunes, and beach pea (Lathyrus littoralis). European beach grass and iceplant were removed from

SELECTED EXPERIENCE *(CONTINUED)*

the project site using mechanical removal and hand removal techniques. The project goal was to remove these invasive species from approximately 135 acres of prime dune habitat in the 300-acre project site, while not impacting sensitive species and habitats. The intended result was to remobilize this historic dune field and restore their natural form and migratory processes.

This project illustrates Mr. Kamman's ability to work closely with NPS staff to balance habitat protection and restoration across the landscape. As part of project design, he developed grading plans, and specified work flow, equipment movement and access routes which minimize impacts to special status species. Extensive fencing and exclusions zone planning was required to protect existing native habitats, and minimize tracking of plant stock to or through restored sties. In addition work elements had to be structured and prioritized to maximize ground work subject to budgetary constraints and work flow uncertainties. All work has been completed on budget and in a timely fashion, even with repeated expansions to the project boundary and affected area and last minute changes driven by endangered species issues.

Lower Gualala River and Estuary Assessment and Management Plan, Mendocino County, CA
California State Coastal Conservancy and Gualala River Watershed Council, and Sotoyome RCD, 2002-2005

Mr. Kamman worked with fisheries biologists to evaluate the hydrologic and water quality conditions in the lower Gualala River and estuary and identify and evaluate potential impacts to summer rearing habitat for salmonids and other aquatic organisms. This work included: assessing how the impacts of upstream land use (logging and water diversions) have altered water delivery and water quality to the Lower River and estuary over time; characterizing the physical coastal and riverine processes controlling opening and closure of the estuary inlet and lagoon morphology; monitoring and characterizing real-time and seasonal changes in lagoon water level and water quality; and evaluating the sediment transport capacity and geomorphic condition of the lower river and estuary. Mr. Kamman took the lead in developing and editing a management plan for the lagoon, prescribing actions to preserve, protect and enhance ecological habitats (with emphasis on salmonids) within the lagoon and lower Gualala River.

This project was completed on-time and on-budget and demonstrates Mr. Kamman's ability to integrate physical, water quality and biological data and information into a coherent and understandable description of the interrelated processes controlling the aquatic ecology of a lagoon system. A big challenge on this project was completing a high-quality and defensible field monitoring program on a "shoe-string" budget. The outcome of this study provides important understanding on how and why steelhead are surviving in a heavily logged (95% private ownership) watershed. The management plan prescribes recommendations to preserve and protect the lagoon as primary rearing habitat for steelhead.

Suisun Bay Tidal Wetland Restoration Design, Contra Costa County, CA
East Bay Regional Park District and LSA Associates, 1999-2005

Mr. Kamman provided hydrologic design services to the restoration of a 55-acre tidal wetland on Suisun Bay. The design will maximize habitat for special status fish species, and (to the extent possible) habitat for other special status animal and plant species. Working with a multi-disciplinary design team, Mr. Kamman assisted in developing a design based on analysis of habitat needs, tidal hydrodynamic and geomorphic processes, sedimentation rates and soil characteristics. Project tasks included: a site analysis defining existing ecological and hydrologic conditions; a hydrologic and biological restoration opportunities and constraints analysis to define restoration and management objectives; and hydrodynamic and sedimentation modeling to evaluate design alternatives. The final restoration and management plan included a grading plan, landscape revegetation plan and monitoring and maintenance plans. This work again illustrates his capabilities in the characterization of physical site conditions, development and feasibility analysis of project alternatives, and preparation of preliminary designs of sufficient detail to allow for environmental compliance through the CEQA/NEPA process.

Santa Clara River Estuary and Lower River Assessment, Ventura County, CA
Nautilus Environmental on behalf of the City of Ventura, Public Works Department, 2003-2004

Mr. Kamman directed a hydrologic and geomorphic assessment of the lower Santa Clara River and estuary. This work was completed for prime contractor in an effort to assist with re-permitting of treated effluent discharges to the estuary. The proposed study entailed characterizing existing and historic hydrologic and physiographic conditions and an assessment of historic changes in inflow to the estuary. This task included a comprehensive review and evaluation of available hydrologic reports and flow data within the watershed to characterize changes in flow associated with development of numerous water projects within the Santa Clara River basin. The main deliverable from this analysis was the development of a historic unimpaired flow record to the estuary based on regional regression analyses and water operations modeling. Within the estuary, Mr. Kamman designed and conducted a multi-year monitoring program of water levels, water quality (temperature, dissolved oxygen, salinity, and pH), and sand-spit morphology in order to evaluate inlet opening/closure frequency and associated changes in aquatic habitat (esp. tidewater goby) and other ecologic communities. A considerable portion of this subtask included detailed coastal process analysis (including wave power analyses and littoral sand transport), which, considered with the inflow analysis, provides a basis to evaluate the seasonal cycle of barrier beach buildup and destruction.

This project illustrates Mr. Kamman's ability to complete a broad variety of hydrologic and coastal process analyses under strict regulatory oversight. A premier study completed on this project was the development of a detailed water and salinity budget model for the estuary to evaluate the impacts of a wide variety of proposed and modified estuary inflow regimes to determine potential future water level and salinity conditions in the lagoon and impact on frequency of inlet breaching. In addition to coordinating and implementing a variety field monitoring and surveys, Mr. Kamman also provided real-time information and input to informational and negotiation meetings with state resource and regulatory agencies.

Eden Landing Ecological Reserve Restoration, Alameda County, CA
East Bay Regional Park District, 2000-2003

Mr. Kamman developed and completed hydraulic and hydrodynamic modeling assessments for the design of an approximately 1000-acre tidal marsh restoration in former Cargil salt manufacturing ponds, located a mile inland of San Francisco Bay. The restoration goals required balancing the desires to restore tidal marsh conditions to the site, while maintaining and enhancing the open water and salt

SELECTED EXPERIENCE *(CONTINUED)*

panne habitats preferred by resident and migratory shorebirds. The restoration plan also needed to incorporate restoration objectives with remediation of high soil salinities resulting from past salt production, subsided ground elevations, dredging of new channels to the bay, existing infrastructure constraints, public access for the San Francisco Bay Trail, and preservation of several important cultural and historical sites. Hydraulic design objectives include maximizing both interior circulation and tidal exchange between the restoration parcel and the bay. A series of one-dimensional unsteady hydrodynamic models (MIKE11) were used to design the channel network, identify high velocity areas requiring erosion protection, and characterize expected habitat conditions. An important component of this design and feasibility assessment was to translate desired ecological habitat conditions identified in the EIR into specific hydrologic design criteria, considering channel velocities, scour, sediment transport, tidal water inundation frequencies and seasonality of ponding. Mr. Kamman worked closely with EBRPD civil engineers, assisting with the translation of hydraulic design criteria into final engineered drawings and specifications.

Wetland & Pond Projects

Design of California Red-Legged Frog Breeding Ponds, San Francisco Bay Area (various), CA
The National Park Service and Golden Gate National Parks Conservancy, 1997-present

Mr. Kamman has lead or provided hydrologic and engineering design assistance to the sighting and design of nearly two dozen breeding ponds for California red-legged frog throughout the San Francisco Bay Area. Work has been completed in Marin, Sonoma, Solano, Contra Costa, Alameda, and Santa Clara Counties under the auspices of numerous federal, state, and local county/city agencies. A common study approach consists of an initial site reconnaissance of watershed conditions and identification of potential sites. The reconnaissance is followed by a surface water hydrologic sufficiency analysis using available meteorologic and stream flow information. An important variable sought during pond sighting is the presence of migration corridors between known breeding areas and/or perennial water sources. Based on in-depth research and post-project monitoring, Mr. Kamman has refined or developed site-specific evapotranspiration estimates, which commonly do not match standard applied values. Accurate evapotranspiration rates are necessary if ponds are intended to periodically dry-down as a means to preclude undesired species such as bullfrog or mosquito fish. In many instances, a seasonal groundwater-monitoring program is implemented in order to better investigate and quantify potential and seasonal groundwater contributions. Other design challenges we commonly experience include: design of impermeable liners for ponds located in upland areas or highly permeable soils; hydraulic analyses and design of outfalls/spillways; sedimentation management/maintenance approaches; and requirements of inoculum and water used to line and fill the pond, respectively.

Hydrologic Feasibility Assessment for Mana Plain Wetland Restoration Project, Kauai, HI
State of Hawaii Department of Land and Natural Resources, 2010-2019

Working on behalf of the Mana Plain Wetland Restoration Partnership, Mr. Kamman completed a hydrologic feasibility assessment for the Mana Plain Wetland Restoration Project proposed by the State of Hawaii Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) on the island of Kauai. The Mana Plain Wetland Restoration Project site is approximately 105 acres of low-lying abandoned sugarcane fields immediately north of the Kawaiele Waterbird Sanctuary and east of the Pacific Missile Range Facility. The purpose of the Mana Plain Wetland Restoration Project is to maximize the area of constructed wetlands within the restoration site. Palustrine emergent wetlands within the project will create habitat for four species of endangered Hawaiian waterbirds and other sensitive species, including: Hawaiian stilts; Hawaiian ducks; Hawaiian coots; Hawaiian moorhen; migratory waterfowl; and migratory shorebirds. The Mana Plain is of vital importance for the recovery of endangered waterbirds species. This restoration project will be designed to provide important breeding and feeding wetland habitats on an island where; 1) wetlands have been severely degraded, and 2) mongoose, an introduced predator, have not been established.

Mr. Kamman's work on this project included technical assessments and development of proposed restoration alternatives. Analyses completed included: a synthesis of the physical site setting (topography, geology, hydrogeology and soil); reviewing available data to characterize site meteorology, surface water drainage, water quality, and groundwater conditions; preparing a detailed water budget to describe the characteristics and processes of surface water and groundwater movement into and through the project area; evaluating project feasibility, water supply alternatives and costs; and completing a flood hazard impact assessment to evaluate potential project benefits and impacts to local area flooding. Working with the project partners, Mr. Kamman developed a preferred project alternative and supported in preparation of the project Environmental Assessment document. Mr. Kamman's firm was also retained by the State of Hawaii to develop engineering designs of the project.

MacArthur Meadow Wetland Restoration, San Francisco County, CA
Presidio Trust, 2013-2016

Mr. Kamman has been working on over a dozen independent wetland and creek restoration planning and design efforts within the Presidio of San Francisco since 2001. Most recently (2016), he developed a wetland restoration grading plan for the MacArthur Meadow Wetland Restoration Project in the central portion of the Tennessee Hollow watershed. As part of the site assessment, Greg characterized and modeled surface and groundwater interactions and identified a unique opportunity to restore 4 acres of mixed meadow, natural wetlands and creek/riparian corridor. This was possible due to the discovery of shallow groundwater conditions beneath this historically disturbed landscape. Various design components were integrated into the grading plan in order to enhance groundwater recharge and storage in the Meadow, while retarding runoff and drainage out of the wetland, including: daylighting storm drain runoff into the Meadow; reconfiguring internal channel alignments to enhance channel habitat and groundwater recharge; creation of wetland depressions to retain and recharge surface water; and removal of fill material to decrease the depth to the water table. Notable challenges of this work include restoring heavily disturbed natural resources in an urban setting while integrating designs with archeology/cultural resources, education and remediation programs.

Dragonfly Creek Restoration Project, San Francisco County, CA
Presidio Trust, 2007-2011

Mr. Kamman designed and managed hydrologic monitoring and analysis studies in support of planning and design for riparian and wetland habitat restoration along approximately 500-linear feet of the Dragonfly Creek corridor near Fort Scott of the Presidio of San Francisco. Work has included completing subsurface

SELECTED EXPERIENCE *(CONTINUED)*

investigations including the installation of shallow wells and a sharp-crested weir with recorder to gauge creek flows. Mr. Kamman assisted in the development and selection of a preferred project alternative, considering on-site cultural resource protection, education and resource management issues (including flood control). Mr. Kamman prepared permit applications. Major components of the project included removal of significant fill and building foundations and installation of a new creek road crossing that will maintain the historical alignment, function and architectural character of a culturally significant roadway. Mr. Kamman oversaw development of PS&E for this project, which will create mitigation wetlands for a highway earthquake retrofit project that passes through the Park.

This project illustrates Mr. Kamman's ability to complete a broad variety of hydrologic analyses, including: surface water and groundwater hydrologic monitoring to characterize and quantify existing hydrologic conditions; rainfall-runoff modeling; hydraulic modeling of flood and scour conditions (including road crossing); preservation of existing wetland habitat and vegetation communities; integration with other Presidio Trust programs; and contracting flexibility to assist in conceptual planning and environmental compliance without increasing project design costs.

Mori Point Sensitive Species Habitat Enhancement Project, San Mateo County, CA
Golden Gate National Recreation Area and Golden Gate National Parks Conservancy, 2005-2011

Mr. Kamman provided hydrologic analyses, sighting and engineering design (PS&E) for three California red-legged frog breading ponds within the 105-acre Mori Point area. These efforts were completed in association and collaboration with a larger Coastal Trail improvement and ecosystem restoration effort. Quarrying and off-road vehicle use have left this site heavily scarred. The focus of restoration work was to protect the endangered San Francisco garter snake and the threatened red-legged frog. Most of this work will be focused on invasive species removal and enhancing endangered species habitat. As part of species habitat improvement, Mr. Kamman worked with project ecologists to design the ponds to optimize breeding habitat for California red-legged frog.

Work started with an initial site reconnaissance and study of watershed conditions and identification of potential sites. The reconnaissance was followed by a surface water hydrologic sufficiency analysis using available meteorological and stream flow information and installation and monitoring of shallow piezometers to quantify the proximity and seasonal variability in depth to water table. An important variable sought during pond sighting was the presence of migration corridors between known breeding areas and/or perennial water sources. Based on in-depth research and post-project monitoring for other ponds they created in the San Francisco Bay area, Mr. Kamman refined site-specific evapotranspiration estimates. Accurate evapotranspiration rates are necessary if ponds are intended to periodically dry-down as a means to preclude undesired species such as bullfrog or mosquito fish.

Other design challenges experienced included: design of impermeable liners for ponds located in upland areas or highly permeable soils; hydraulic analysis and design of outfalls/spillways; sedimentation management/maintenance approaches; and requirements of inoculum and water used to line and fill the pond, respectively. Mr. Kamman has designed numerous ponds for the NPS and affiliates within the Bay Area, including Mori Point (constructed 2007), Banducci (constructed 2007) and Giacomini (Phase I and Phase II constructed in 2007 and 2008) project sites.

Hydrologic Assessment and Restoration Feasibility Study for Shadow Cliffs Regional Recreation Area, Alameda County, CA
East Bay Regional Park District, 2009-2010

Mr. Kamman developed and implemented an assessment to identify groundwater levels and supplemental water supplies that will sustain seasonal wetland restoration areas and riparian habitats under an altered future hydrologic regime. This work will inform a forthcoming Land Use Plan Amendment for park occupying a series of former gravel quarry pits. Work included: obtaining and synthesizing available surface water and groundwater data to characterize existing hydrologic and water supply conditions and seasonal variability; quantifying the likely changes in groundwater conditions and quarry pit lake levels in association with changes in regional water transmission and groundwater recharge operations; and identifying, developing and evaluating a suite of ecosystem restoration alternatives. Other important project objectives include: improving habitat for waterfowl and wildlife; broadening recreational use; enhancing visitor education and wildlife interpretation; improve park aesthetics. Mr. Kamman evaluated a preferred park and ecosystem enhancement alternative that involves diverting high winter flows from an adjacent arroyo. This project demonstrates Greg's ability to characterize hydrologic conditions and quantify the relationship between groundwater, surface water and wetland habitat conditions, both under existing conditions and in predicting future hydrologic and ecologic conditions under an altered hydrologic regime (i.e., lower groundwater table).

Laguna Salada Marsh and Horse Stable Pond Restoration Project, San Mateo County, CA
Tetra Tech, 2007-2009

Mr. Kamman provided technical hydrology and hydraulics support to the planning and conceptual restoration design of Laguna Salada marsh and Horse Stable Pond, located adjacent to Sharp Park Golf Course in the town of Pacifica, California. The primary objectives of the project are: to reduce flood impacts within the project vicinity; improve sustainable ecological habitat for the endangered San Francisco garter snake and the threatened California red-legged frog; better understand and characterize the hydrologic and water quality conditions/processes affecting flood and ecological habitat conditions within the project vicinity; provide an effective pumping operation plan to meet ecological objectives; and develop appropriate hydrologic analytical approaches and models to assist Tetra Tech and the San Francisco Recreation and Park Department in the planning and design for marsh, pond, and creek restoration. The project is also a unique opportunity to connect this resource with the California Coastal Trail, the Bay Area Ridge Trail, and the surrounding GGNRA lands.

Mr. Kamman's work included completing a comprehensive review of available hydrologic and site information and implementing selected field investigations to develop and calibrate an integrated hydrology-flood routing-pond water operations model that will quantify the volume and depth of water moving through the project system. The investigation will also further characterize shallow groundwater conditions and water quality with respect to effects on Laguna Salada and Horse Stable Pond. Analytical and numerical modeling tools are being used to better characterize existing hydrologic and water quality conditions and to assist in identifying project opportunities and constraints as well as evaluate potential restoration design components - all necessary to inform a sustainable

SELECTED EXPERIENCE *(CONTINUED)*

and successful restoration design.

Tolay Lake Restoration Feasibility Assessment, Sonoma County, CA
Sonoma County Agricultural Preservation and Open Space District, 2003

Mr. Kamman completed a detailed hydrologic feasibility analysis to evaluate a suite of potential freshwater lake and wetland restoration alternatives. Sites were evaluated under existing watershed land-use practices and under existing and forecasted water demands (in the form of existing water rights/applications). Analysis consisted of developing a detailed water budget model to simulate alternative restored lake inundation areas and depths under median and dry year conditions, as well as a 50-year historic period (1947-1997) displaying highly variable rainfall and runoff supplies. Three lake restoration alternatives were evaluated based on existing topography and likely historic lake configurations. The restoration alternatives include lakes with storage volumes equivalent to 136-, 1100-, and 2550-acre feet.

Haypress Pond Decommissioning and Riparian and Channel Restoration, Marin County, CA
Golden Gate National Recreation Area (GGNRA), 2001-2002

This project restored 170 meters of historic creek and riparian habitat through removal of Haypress Pond dam in Tennessee Valley within GGNRA. The goals of the project were to alleviate long-term maintenance needs and eliminate non-native bullfrog habitat threatening native California red-legged frog habitat in adjacent watersheds.

Working with the Park biologist, Mr. Kamman developed designs to decommission the dam and restore natural riparian and meadow habitat. This work included: characterization of existing topographic conditions; design of a channel profile through the proposed restoration project reach; preparation of a grading plan for the restoration project; and hydrologic and hydraulic analyses to evaluate the performance of the creek channel and flood plain below the former dam during a variety of flows. Challenges of this work included integrating sediment reuse into plans and construction phasing.

Damon Slough Site Seasonal Wetland Design, Alameda County, CA
Port of Oakland, 1999-2001

Working on behalf of the Port of Oakland, Mr. Kamman completed extensive surface and groundwater monitoring and data analyses to develop a detailed water budget to assist in the evaluation and design of a 7.5 acre seasonal freshwater wetland. Primary project objectives included a design that would provide shorebird/waterfowl roosting habitat, minimize impacts to existing seasonal wetland areas, and lengthen the duration of ponding through the end of April to promote use by migratory birds. In addition to developing hydrologic design criteria, responsibilities included development of grading plans to accommodate a local extension of the Bay Trail and wetland outlet works.

Water Quality Projects

Chicken Ranch Beach Soil and Groundwater Quality Investigation and Restoration Planning, Marin County, CA
Tomales Bay Watershed Council, 2007-present

Mr. Kamman is leading scientific and engineering efforts for a wetland and riparian corridor restoration project on Third Valley Creek and Chicken Ranch Beach in Inverness, California. The main project goals are to create a self-sustaining riparian and wetland system (requiring minimal operation and maintenance) and eliminate public exposure to high levels of bacteria that exist in a site drainage ditch discharging to the beach. The design will likely include establishing a blend of habitats, including: riparian stream corridor, seasonal/perennial freshwater marsh, and tidal/saltwater marsh.

Current efforts have included the development and implementation of a soil and groundwater quality investigation to delineate the source of elevated bacteria levels. This work includes: the collection and testing of depth-discrete soil samples; groundwater well installation, sampling and testing; and surface water sampling and testing; analysis of laboratory results; and reporting, including recommendations for further/expanded investigations. Mr. Kamman coordinated this time-sensitive sampling and analysis (six hour hold times) with Brulje and Race Laboratories in Santa Rosa.

Lower Miller Creek Channel Maintenance and Material Reuse Sampling Analysis Plan, Marin County, CA
Las Gallinas Valley Sanitary District, 2015

Mr. Kamman was commissioned to formulate and implement a plan for sediment removal and improved flood flow conveyance in the Lower Miller Creek channel. Accumulation of course sediment in the project reach had reduced discharge efficiencies at District outfalls. Miller Creek supports a population of federally listed Steelhead and adjacent wetland/marsh areas potentially support other state and federally listed special status species. Working with District Staff, Greg developed a suite of potential project alternatives and identified a preferred approach. Mr. Kamman completed all CEQA compliance (IS/MND), permitting and oversaw development of engineered plans and specifications.

In order to evaluate if reuse of excavated material from 2,655 feet of creek corridor in upland areas was feasible, Mr. Kamman developed and implemented a Sampling Analysis Plan (SAP) pursuant to U.S. Army Corps Guidance for Dredging Projects within the San Francisco District. Sample collection, sample handling, and analysis were performed in accordance with the SAP. Results for analytes were compared to a variety of screening criteria to determine the material's suitability for reuse in aquatic environments. A full suite of chemical and physical analyses were performed on soil samples collected from 16 locations, including: metals, PAHs, PCBs, pesticides, TOC, specific conductance, pH, sulfides, percent moisture and grain-size. Mr. Kamman managed all aspects of this effort including reporting and presentations/negotiations at multi-agency meetings through the Corps Dredge Materials Management Office (DMMO).

Lower Pitkin Marsh Hydrologic and Water Quality Monitoring, Sonoma County, CA
Sonoma Land Trust, 2008-2010

Mr. Kamman was retained to develop and implement a hydrologic and water quality monitoring program at Lower Pitkin Marsh outside of Forestville, California. The Pitkin Marsh area is one of the most valuable complexes of mixed riparian woodland and thicket, freshwater marsh, wet meadow, oak woodland and grassland in Sonoma County. The complex interaction of surface water, ground water, and scattered seeps and springs on the site creates unusual hydrologic conditions that promote a rare assemblage of plant species which includes several endemics. The primary objective of the hydrologic monitoring program was to understand the annual and season sources of both surface and ground water supplying wetlands. Hydrologic and water quality monitoring was

SELECTED EXPERIENCE *(CONTINUED)*

initiated during the winter wet season of 2008/09 and will be conducted for a 12-month period through the ensuing summer dry-down and into the following wet season. Understanding how groundwater levels, spring flow and creek flow rates recede from winter wet to summer dry conditions will provide an important understanding and quantification of the seasonal variability in water supplies feeding selected wetland types. General water quality parameters (temperature, pH, specific conductance, and ORP) are measured at all monitoring locations during each visit. Nutrients (N and P) are measured in selected surface water and groundwater samples collected during at least three monitoring events, including a winter high flow, spring high base flow and summer low baseflow.

Pescadero Lagoon Restoration and Enhancement, San Mateo County, CA
California State Coastal Conservancy, 2005-2006

Mr. Kamman was retained to support restoration and water quality enhancement planning efforts in Pescadero Lagoon. In 2005-2006, he completed a synthesis of available hydrologic and water quality information in responding to requests for development of a hydrodynamic and water quality model of the lagoon. This model was considered as a means to identify causes for repeated fish-kills in the lagoon that occurred during initial breaching of the inlet. Mr. Kamman assisted in preparing a synthesis and model development feasibility report from this effort.

Water Temperature Simulations for Trinity River Fish and Wildlife Restoration Project, Trinity County, CA
Trinity County Planning Department, 1994-2004

For over a decade, Mr. Kamman completed a number of hydrology and water quality investigations in support of alternative feasibility studies on the Trinity River Fish and Wildlife Restoration Project in direct support of the Trinity River Restoration EIR/EIS. Studies involve assessing the effects of proposed flow alternatives on water temperature within and downstream of Lewiston Reservoir. Mr. Kamman was responsible for data collection, processing, and flow/temperature modeling of Lewiston Reservoir as part of a coordinated evaluation including other Trinity River system models. Another study included evaluating how project operations could be implemented or modified to optimize Lewiston Lake release temperatures to meet downstream temperature criteria and compensate for increased warming of the river associated with side channel and feather edge restoration activities. Mr. Kamman continues to evaluate how more recent water projects (raising Shasta Dam, Sites Reservoir, and the Waterfix tunnels) consider and integrate with the Trinity Restoration Project.

Upper Eel River Unimpaired Flow and Water Temperature Assessments, Humboldt County, CA
CalTrout, 1997-1999

Mr. Kamman evaluated changes in the natural flow regime of the upper Eel River, and developed an Upper Eel River proposed release schedule to enhance downstream Chinook and Steelhead spawning and rearing habitat. This work was triggered by proposals set forth by PG&E as part of their Potter Valley Project FERC relicensing process. Work consisted of two main investigations. The first included reviewing results of a ten year PG&E study and development of multivariate regression and stream reach (SSTEMP) temperature models to assess the effects proposed flow alternatives would have on downstream temperatures. The second investigation consisted of characterizing unimpaired flow conditions and developing a daily unimpaired flow record for use in project operation models.

Selected Litigation Support Projects

Kamman, G.R., 2019, Review of Deschutes Basin Habitat Conservation Plan (DBHCP) and Associated Draft Environmental Impact Statement (DEIS). Prepared for: Water Watch of Oregon, Center for Biological Diversity and Associates for the West, November 22, 55p.

Kamman, G.R., 2019, Review of Draft PEIR, California Vegetation Treatment Program (CalVTP). Prepared for: Shute, Mihaly & Weinberger LLP, August 2, 8p.

Kamman, G.R., 2019, Oral Testimony of Greg Kamman for Agricultural Order 4.0 requirements discussion, Public meeting before the Central Coast (Region 3) California Water Board, Watsonville City Council Chambers, Watsonville, CA, March 21.

Chartrand, A.B., and Kamman, G.R., 2019, Comments to Central Coast Regional Water Quality Control Board Ag. Order 4.0 regulatory requirement options and proposed Requirement Options Tables. Prepared for: The Otter Project and Monterey Coastkeeper, January 22, (8p.), 5 tables and Monitoring Reporting Plan (MRP; 26p.).

Kamman, G.R., 2019, Review of Draft Environmental Impact Report/Statement, Sites Reservoir Project. Prepared for: Pacific Coast Federation of Fisherman's Association (PCFFA) and Save California Salmon, January 21, 45p.

Kamman, G.R., 2018, Review of Amendments to the Sonoma County Cannabis Ordinance, California. Prepared for: Shute, Mihaly & Weinberger LLP, August 3, 10p.

Kamman, G.R., 2018, Written Testimony of Greg Kamman for Part 2 of the California Waterfix Change of Diversion Hearing before the State Water Resources Control Board, November 28, 10p.

Kamman, G.R., 2018, Oral Testimony of Greg Kamman for Part 2 of the California Waterfix Change of Diversion Hearing before the State Water Resources Control Board at Joe Serna Jr.-CalEPA Building, Sacramento, CA, April 16.

Kamman, G.R., 2017, Review Comments: PAD and SD1, FERC Relicensing of Potter Valley Project (PVP). Professional declaration prepared for: Friends of Eel River, July 31, 8p.

Kamman, G.R., 2017, Review Comments, Draft Environmental Impact Report, Fish Habitat Flow and Water Rights Project. Professional declaration prepared for: Friends of Eel River, March 8, 18p.

Kamman, G.R., 2016, Review of Draft General Waste Discharge Requirements for Vineyard Dischargers in the Napa River and Sonoma Creek Watersheds. Prepared for: Law Offices of Thomas N. Lippe APC, December 12, 4p.

Kamman, G.R., 2016, Review of Middle Green Valley Specific Plan Project, Second Revised Recirculated Draft Environmental Impact Report, Solano County, CA, Sch# 2009062048. Professional Declaration Prepared for: Law Offices of Amber Kemble, October 25, 3p.

SELECTED EXPERIENCE *(CONTINUED)*

Kamman, G.R., 2016, Review of Draft EIR for General Waste Discharge Requirements for Vineyard Dischargers in the Napa River and Sonoma Creek Watersheds. Prepared for: Law Offices of Thomas N. Lippe APC, September 14, 81p.

Kamman, G.R., 2016, Second Declaration of Greg Kamman Plaintiff's Joint Motion for Preliminary Injunction, Prepared for Center for Biological Diversity (Plaintiff) v. U.S. Bureau of Reclamation, Case No. 6:16-cv-00035-TC (Recovery for Oregon Spotted Frog, Upper Deschutes Basin, Oregon) , March 11, 11p.

Kamman, G.R., 2016, Declaration of Greg Kamman Plaintiff's Joint Motion for Preliminary Injunction, Prepared for Center for Biological Diversity (Plaintiff) v. U.S. Bureau of Reclamation, Case No. 6:16-cv-00035-TC (Recovery for Oregon Spotted Frog, Upper Deschutes Basin, Oregon) , February 4, 8p.

Kamman, G.R., 2015, Sharp Park Project Impacts to Laguna Salada. Prepared for National Parks Conservation Association and Wild Equity Institute, April 14, 1p.

Kamman, G.R., 2014, Review of Middle Green Valley Specific Plan Project, Revised Recirculated Draft Environmental Impact Report, Solano County, CA, Sch# 2009062048. Professional Declaration Prepared for: Law Offices of Amber Kemble, August 11, 11p.

Kamman, G.R., 2012, Deposition of Gregory Richard Kamman, R.G., C.H.G., Schaefer vs. City of Larkspur, CA, Superior Court of the State on California, County of Marin. August 23, 2012.

Kamman, G.R., 2012, Technical review comments to Biological Assessment, Sharp Park Safety, Infrastructure Improvement and Habitat Enhancement Project. Prepared for Wild Equity Institute, August 3, 11p.

Kamman, G.R., 2012, Proposed Hardy-based Environmental Water Allocation (EWA) Input for WRIMS Model Simulation, Klamath River Basin. Prepared for: Yurok Tribe, July 20, 5p.

Kamman, G.R., 2012, Review of groundwater conditions and modeling report by S.S. Papadopulos & Associates, Inc., Scott Valley, California. Prepared for: Yurok Tribe, 4p.

Kamman, G.R., 2011, Supplemental Declaration of Greg Kamman regarding Laguna Salada, Wild Equity Institute v. City and County of San Francisco, et al., Case No.: 3:11-CV-00958 SI, United States District Court, Northern District of California, San Francisco Division. Prepared for Wild Equity Institute, November 4, 50p.

Kamman, G.R., 2011, Declaration of Greg Kamman regarding Laguna Salada, Wild Equity Institute v. City and County of San Francisco, et al., Case No.: 3:11-CV-00958 SI, United States District Court, Northern District of California, San Francisco Division. Prepared for Wild Equity Institute, September 23, 7p.

Kamman, G.R., 2010, Review of Sonoma County Water Agency NOP (issued 9/29/10) Fish Habitat Flow and Water Rights Project. Professional declaration prepared for: Friends of Eel River, November 8, 7p.

Kamman, G.R., 2007, Independent Model Review for Klamath Settlement Negotiations, Klamath Independent Review Project (KIRP). Prepared for Northcoast Environmental Center, November 9, 19p.

Kamman, G.R., 2007, Review of Negative Declaration for File No. UPE04-0040, Gualala Instream Flow. Professional declaration prepared for Friends of the Gualala River, October 21, 2p.

Kamman, G.R., 2003, Evaluation of potential hydrologic effects, Negative Declaration for THP/Vineyard Conversion, No. 1-01-171 SON, Artesa Vineyards, Annapolis, CA. Professional declaration prepared for Friends of the Gualala River, May 19, 9p.

Kamman, G.R., 1999, Review of Final Supplemental Environmental Assessment, Cirby-Linda-Dry Creek Flood Control Project. Professional declaration prepared for: Monty Hornbeck, Sunrise Office Park Owners Association; Bill Kopper/John Gabrielli, Attorneys at Law; and Sharon Cavello/Cathie Tritel, Placer Group Sierra Club, May 24, 10p.

Kamman, G.R., 1995, Variable Water Resources Available in the Area of Salinas, California. Declaration prepared for Price, Postal, and Parma, Santa Barbara, California, May, 6p.

Conference Presentations

Kamman, G.R., 2018, Water is Life! A hydrologist's eye on the Gualala River. Presented to: Friends of the Gualala River and public, Gualala Arts Center, Gualala, CA, May 3.

Kamman, G.R. and Kamman, R.Z., 2015, Landscape Scale Urban Creek Restoration in Marin County, CA - Urban Creek Restoration: Interfacing with the Community. 33rd Annual Salmonid Restoration Conference, March 11-14, Santa Rosa, CA.

Kamman, G.R., 2015, Enhancing Channel and Floodplain Connectivity: Improving Salmonid Winter Habitat on Lagunitas Creek, Marin County, CA - Beyond the Thin Blue Line: Floodplain Processes, Habitat, and Importance to Salmonids. 33rd Annual Salmonid Restoration Conference, March 11-14, Santa Rosa, CA.

Kamman, G.R., 2012, The role of physical sciences in restoring ecosystems. November 7, Marin Science Seminar, San Rafael, CA.

King, N. and Kamman, G.R., 2012, Preferred Alternative for the Chicken Ranch Beach/Third Valley Creek Restoration Project. State of the Bay Conference 2012, Building Local Collaboration & Stewardship of the Tomales Bay Watershed. October 26, Presented by: Tomales Bay Watershed Council, Inverness Yacht Club, Inverness, CA.

King, N. and Kamman, G.R., 2010, Chicken Ranch Beach Restoration Planning by TBWC. State of the Bay Conference 2010, A Conference about Tomales Bay ant its Watershed. October 23, Presented by: Tomales Bay Watershed Council, Inverness Yacht Club, Inverness, CA.

SELECTED EXPERIENCE *(CONTINUED)*

Higgins, S. and Kamman, G.R., 2009, Historical changes in Creek, Capay Valley, CA. Poster presented at American Geophysical Union Fall Meeting 2009, Presentation No. EP21B-0602, December.

Kamman, G.R. and Higgins, S., 2009, Use of water-salinity budget models to estimate groundwater fluxes and assess future ecological conditions in hydrologically altered coastal lagoons. Coastal and Estuarine Research Federation 20th Biennial Conference, 1-5 November, Portland, OR

Bowen, M., Kamman, G.R., Kaye, R. and Keegan, T., 2007, Gualala River Estuary assessment and enhancement plan. Estuarine Research Federation, California Estuarine Research Society (CAERS) 2007 Annual Meeting, 18-20 March, Bodega Marine Lab (UC Davis), Bodega Bay, CA

Bowen, M. and Kamman, G.R., M., 2007, Salt River Estuary enhancement: enhancing the Eel River Estuary by restoring habitat and hydraulic connectivity to the Salt River. Salmonid Restoration Federation's 25th Salmonid Restoration Conference, 7-10 March, Santa Rosa, CA.

Magier, S., Baily, H., Kamman, G., and Pfeifer, D, 2005, Evaluation of ecological and hydrological conditions in the Santa Clara River Estuary with respect to discharge of treated effluent. In: Abstracts with Programs, The Society of Environmental Toxicology and Chemistry North America 26th Annual Meeting, 13-17 November, Baltimore Convention Center, Baltimore, Maryland.

Baily, H., Magier, S., Kamman, G., and Pfeifer, D, 2005, Evaluation of impacts and benefits associated with discharge of treated effluent to the Santa Clara River Estuary. In: Abstracts with Programs, The Society of Environmental Toxicology and Chemistry North America 26th Annual Meeting, 13-17 November, Baltimore Convention Center, Baltimore, Maryland.

Kamman, G.R., Kamman, R.Z., and Parsons, L., 2005, Hydrologic and Hydraulic Feasibility Assessments for Ecological Restoration: The Giacomini Wetland Restoration Project, Point Reyes National Seashore, CA. In: Abstracts with Programs, The Geological Society of America, 101st Annual Cordilleran Section Meeting, Vol.37, No. 4, p. 104, Fairmont Hotel, April 29-May1, 2005, San Jose, CA.

Kamman, G.R., 2001. Modeling and its Role in the Klamath Basin – Lewiston Reservoir Modeling. Klamath Basin Fish & Water Management Symposium, Humboldt State University, Arcata, CA, May 22-25.

Kamman, G.R., 1998, Surface and ground water hydrology of the Salmon Creek watershed, Sonoma County, CA. Salmon Creek Watershed Day, May 30, Occidental, CA.

Kamman, G.R., 1998. The Use of Temperature Models in the Evaluation and Refinement of Proposed Trinity River Restoration Act Flow Alternatives. ASCE Wetlands Engineering and River Restoration Conference Proceedings, Denver, Colorado (March 22-23, 1998).

Hecht, B., and Kamman, G.R., 1997, Historical Changes in Seasonal Flows of the Klamath River Affecting Anadromous Fish Habitat. In: Abstracts with Programs Klamath Basin Restoration and Management Conference, March 1997, Yreka, California.

Hanson, K.L, Coppersmith, K.J., Angell, M., Crampton, T.A., Wood, T.F., Kamman, G., Badwan, F., Peregoy, W., and McVicar,T., 1995, Evaluation of the capability of inferred faults in the vicinity of Building 371, Rocky Flats Environmental Technology Site, Colorado, in Proceedings of the 5th DOE Phenomena Hazards Mitigation Conference, p. 185-194, 1995.

Kamman, G.R. and Mertz, K.A., 1989, Clay Diagenesis of the Monterey Formation: Point Arena and Salinas Basins, California. In: Abstracts with Programs, The Geological Society of America, 85th Annual Cordilleran Section Meeting, Spokane Convention Center, May 1989, Spokane, Washington, pp.99-100.

Exhibit B

Law Offices of
THOMAS N. LIPPE, APC

201 Mission Street
12th Floor
San Francisco, California 94105

Telephone: 415-777-5604
Facsimile: 415-777-5606
Email: Lippelaw@sonic.net

October 11, 2019

Mr. Andrew Garcia
San Luis & Delta-Mendota Water Authority
842 6th Street
Los Banos, CA 93635
Telephone: (209)832-6229
By email to: andrew.garcia@sldmwa.org

Re: California Sportfishing Protection Alliance Comments on the Northern and Central Delta-Mendota Regions - Public Draft Groundwater Sustainability Plan.

Dear Mr. Garcia:

This office represents the California Sportfishing Protection Alliance (CSPA) regarding your review and adoption of the Northern and Central Delta-Mendota Regions - Public Draft Groundwater Sustainability Plan (Plan).

CSPA objects to your adoption of the Plan because it does not meet the requirements of the Sustainable Groundwater Management Act or the GSP Emergency Regulations at Title 23, Cal. Code Regs. section 350 et seq. (GSP Rules), as more fully explained in comments submitted by Hydrogeologist Greg Kamman under separate cover on this date.

The Plan does not satisfy GSP Rule 355.4(b)(1) because the Plan's description of the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are not reasonable or supported by the best available information and best available science.

The Plan does not satisfy GSP Rule 355.4(b)(3) because the sustainable management criteria and projects and management actions identified in the plan are not commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the Plan.

The Plan does not satisfy GSP Rule 355.4(b)(5) because the Plan does not contain or present substantial evidence to conclude that the projects and management actions identified to achieve sustainable yield are effective or feasible or not likely to prevent undesirable results or to ensure that the basin is operated within its sustainable yield.

These deficiencies are described in more detail in Mr. Kamman's October 11, 2019, comments.

For example, Section 354.16 of the GSP Regulations (Groundwater Conditions) states, "Each Plan shall provide a description of current and historical groundwater condition in the basin, including data from January 1, 2015, to current conditions, based on the best available information…."

The Plan improperly uses Water Year 2013 data to represent "current conditions." Per the GSP regulations, the Plan must present data at least as recent as January 1, 2015, and must present data "from January 1, 2015 to" the present where available. The Plan provides no explanation as to why data from 2016, 2017 or 2018 is not presented as required by the regulations. As Mr. Kamman observes, 2013 was a drought year; while 2017 and 2018 were not drought years. Consequently, there was more demand for groundwater in 2013 than in 2017 and 2018.

Also, in addition, the draft Plan's identification of Groundwater Dependent Ecosystems is derived from data from DWR and TNC, but the draft plan then "excludes seasonally-managed areas and wetlands" dependent "on applied surface water." (Plan, p. 5-172.) This exclusion is inconsistent with the Plan's inclusion of the areas mapped by DWR and TNC as long as the area's depth to groundwater is less than 30 feet. If 30-feet depth to groundwater is a reliable criterion for GDE areas that are not seasonally-managed areas or wetlands dependent on applied surface water, it should be a reliable criterion for GDE areas that are seasonally-managed areas/wetlands dependent on applied surface water.

Put another way, the fact that GDE vegetation or wetland features may be partially "dependent" on applied surface water does not mean the GDE is not also partially dependant on groundwater or would not be entirely dependent on groundwater if surface were no longer applied. Indeed, the Plan recognizes that "Management and protection of GDEs may require more focus on land use or irrigation activities more so than groundwater management." (Plan, p. 5-173.) The contemplated use of changing irrigation activities to maintain GDEs reflects the facts that GDEs may be dependent on both groundwater and surface water, and an area's partial dependence on surface water should not exclude it from classification as a GDE.

In addition, section 6.3.2.1.2 states: "Long-term reductions in storage are not anticipated for either principal aquifer so long as groundwater levels are managed above minimum thresholds." (Plan p. 6-13.) This conclusion is directly contradicted by the change in aquifer storage figures for the Upper Aquifer presented by Mr. Kamman, which show long-term downward trend in storage for the Upper Aquifer, even with implementation of proposed Projects and Management Actions.

CSPA urges the Authority to not adopt the Plan in its current form; to revise the draft Plan to remedy these informational deficiencies; and to recirculate the revised Plan for public comment.

Thank you for your attention to this matter.

Very Truly Yours,

Tom Lippe

Thomas N. Lippe

AD002a North Central Delta Mendota.wpd

Exhibit C

Kamman Hydrology & Engineering, Inc.
539 Bret Harte Road, San Rafael, CA 94901
Telephone: (415) 491-9600
Facsimile: (415) 680-1538
E-mail: greg@KHE-Inc.com

October 11, 2019

San Luis & Delta-Mendota Water Authority
842 6th Street
Los Banos, CA 93635
Via email: andrew.garcia@sldmwa.org

Subject: Review of Public Draft Groundwater Sustainability Plan
For the Northern and Central Delta-Mendota Regions

Dear Sir/Madame:

I am a hydrologist with over thirty years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. I have been providing professional hydrology and geomorphology services throughout California since 1989 and routinely manage and lead projects in the areas of surface- and groundwater hydrology, water supply, water quality assessments, water resources management, and geomorphology. A copy of my resume is attached.

On behalf of the California Sportfishing Protection Alliance, I have been retained by the Law Offices of Thomas N. Lippe, APC to review and evaluate the Public Draft Groundwater Sustainability Plan (GSP) for the Northern and Central Delta-Mendota Regions, especially as it pertains to groundwater interaction with the San Joaquin River. Based on my review, it is my opinion that the GSP is deficient in many areas. The rationale for this opinion is based on the findings presented below.

1. **Page 5-89, Section 5.3, Sentence starting with, "This section..."**
   The current conditions in the GSP is represented by Water Year (WY) 2013 conditions. WY 2013 is out-dated when compared to the year (2020) that this plan represents. Section 354.16 of the GSP Regulations (Groundwater Conditions) states, "Each Plan shall provide a description of current and historical groundwater condition in the basin, including data from January 1, 2015, to current conditions, based on the best available information…" The WY2013 period used in the GSP to represent "current conditions" predates the "current condition" period stipulated in GSP regulations.

2. **Page 5-94, Section 5.3.2.4, Sentence starting with, "Due to insufficient..."**
   Due to insufficient data, groundwater elevation contour maps for the Lower Aquifer for the spring and fall of 2013 could not be prepared. This is another issue with choosing WY 2013 to represent current conditions. A different and preferably more current year should be considered. The GSP fails to fully describe current groundwater conditions.

3. **Page 5-170, Section 5.3.7.2, Sentence starting with, "The San Joaquin..."** Section 354.16 of the GSP Regulations stipulates that each plan describe current and historic groundwater conditions in the basin based on the best available information. With regard to Interconnected Surface Water Systems, I would like you to be aware of a study completed by Kamman Hydrology & Engineering, Inc.[1], which delineates subterranean streams and Potential Stream Depletion Areas (PSDA) along the San Joaquin River. PSDA's are areas where groundwater pumping could potentially cause stream depletion. A link to this report and associated maps is provided in the footnote below for reference and integration into the GSP.

4. **Page 5-170, Section 5.3.7.2, Sentence starting with, "The San Joaquin..."** The GSP only addresses interconnected surface water systems along the San Joaquin River north of Newman, California, where the river is characterized as a gaining stream. This constitutes only 1/3rd of the river length within the Delta-Mendota Subbasin boundary. South (upstream) of Newman, the Nature Conservancy (2016) characterizes groundwater and stream interaction along the San Joaquin River as a mix of gaining and losing reaches, but dominated by gaining reaches. The GSP fails to fully characterize the interconnected surface water conditions along the San Joaquin River within the Subbasin boundary. Understanding and properly managing and protecting these interconnected surface- and groundwater systems is important as there are significant GDE's and associated resources like fish, riparian vegetation and wetlands along the entire length of River in the Subbasin.

5. **Page 5-172, Section 5.3.7.6, Sentence starting with, "The NCCAG dataset..."** The GSP Regulations define "groundwater dependent ecosystem" (GDE) as ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. Section 354.16 of the Regulations stipulate that Plans identify (current and historic) GDEs within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information. As stated on page 5-172, the Natural Communities Commonly Associated with Groundwater (NCCAG) database, developed by DWR, CDFW and The Nature Conservancy (TNC), is used to identify GDEs within the Delta-Mendota Subbasin. The GSP then describes a methodology to further screen available information and establishes the following standards to identify GDEs:

[1] Kamman Hydrology & Engineering, Inc., 2018, Delineating subterranean streams and Potential Stream Depletion Areas, Lower Stanislaus and Tuolumne River Watershed. Draft Technical Memorandum prepared for: Law Offices of Thomas N. Lippe, APC, July 23, 9p. and 15 sheets. https://www.dropbox.com/s/2ser942wkeb5d3v/PSDA-mapping-Tech-Memorandum_v1%2Bquads.pdf?dl=0

(1) Areas with depths to groundwater levels greater than 30 feet were eliminated unless the vegetation identified in those areas were consistent with species with deep root systems (e.g. live oaks);
(2) Seasonally-managed areas and wetlands were eliminated due to their dependence on applied surface water; and
(3) A 100-foot buffer was applied around the San Joaquin River within the Northern Delta-Mendota Region to include all communities in the NCCAG dataset as potential GDEs, except where professional juedement and local knowledge determined GDEs were not present.

A problem with this GDE screening methodology is the failure to acknowledge that GDEs may depend on shallow groundwater regardless of the presence of applied surface water sources. For example, wetlands within or adjacent to irrigated agriculture may not rely on that irrigation for survival; if they did, we would expect to find wetlands growing in all irrigated lands. In addition, the presence and sustainability of perennial surface water in Central Valley Rivers is controlled by many factors (e.g., groundwater inflow, reservoir operations, irrigation drainage, etc.). Information presented in the GSP indicate significant contributions of groundwater flow to "gaining" reaches of the San Joaquin River. The riparian and wetland vegetation bordering these gaining reaches are surely sustained to some degree by this groundwater inflow to the river and the shallow groundwater conditions that likely accompany gaining reaches. The interconnected condition is also likely influenced significantly by seasonal and long-term wet and dry cycles. However, the GSP does not quantify the relative spatial or temporal contributions of groundwater supply to riparian habitats. Instead, the GPS simply dismisses these habitats as GDE's under the assumption that perennial flow is sustained through the summer by agricultural deliveries or tailwater. Therefore, it is my opinion that the process of elimination of GDEs as presented in the GSP is seriously flawed and does not correctly recognize or delineate GDEs in the basin.

6. **Page 5-173, Section 5.3.7.6, Sentence starting with, "As a result..."**
The GSP states, "*Management and protection of GDEs may require more focus on land use or irrigation activities more than groundwater management*." This is a bizarre statement because the GSP eliminates areas mapped as GDEs if they are, "*seasonally-managed areas and wetlands due to dependence on applied surface water*." Per the GDE screening methodology described above, the "management and protection" practices being suggested for GDEs would eliminate these areas from consideration as a GDE.

7. **Page 5-185, Section 5.4.3, Sentence starting with, "The current water budget..."**
The GSP states, "*The current water budget year is defined as WY2013. While "current water budget conditions" are defined in the GSP Emergency Regulations §354.18(c)(1) as the year with "the most recent population, land use,*

and hydrologic conditions," WY2015, WY2016 and WY2017 were not thought to be representative of the Delta-Mendota Subbasin under "normal" or "average" conditions. Response to the most recent drought began in WY2014 with some initial fallowing of lands. By WY2015 and WY2016, which are both classified as dry years, more lands were fallowed throughout the Subbasin in response to multiple dry year conditions. Agricultural production was higher in WY2017, compared to WY2015 and WY2016, but the delivery allocations from the Central Valley Project (CVP) came late in the season, so a considerable amount of land was still fallowed. By WY2018, agricultural land production increased and was similar to conditions in WY2013, however complete datasets were not yet available for use in the water budgets. Therefore, the Coordination Committee agreed that WY2013 represents the most recent water year with a complete data set representing typical demands and supplies."

WY 2013 is a critically dry year-type falling within the 2012-2016 recent drought period, which heavily influences the meteorology, hydrology and water operations reflected in the associated "current conditions" water budget. There are more current years reflecting normal or average conditions. For example, Figures 5-84 and 5-85 (page 5-120) indicate that 2017 and 2018 were wet and average year types respectively. During WY2017, there was little change in aquifer storage in both the upper and lower aquifers, suggesting water operations balanced with available supplies. WY2017 also better representative of "current conditions" as it post-dates January 1, 2015 and reflects an average water operational period. WY2018 would also be a suitable when complete datasets become available.

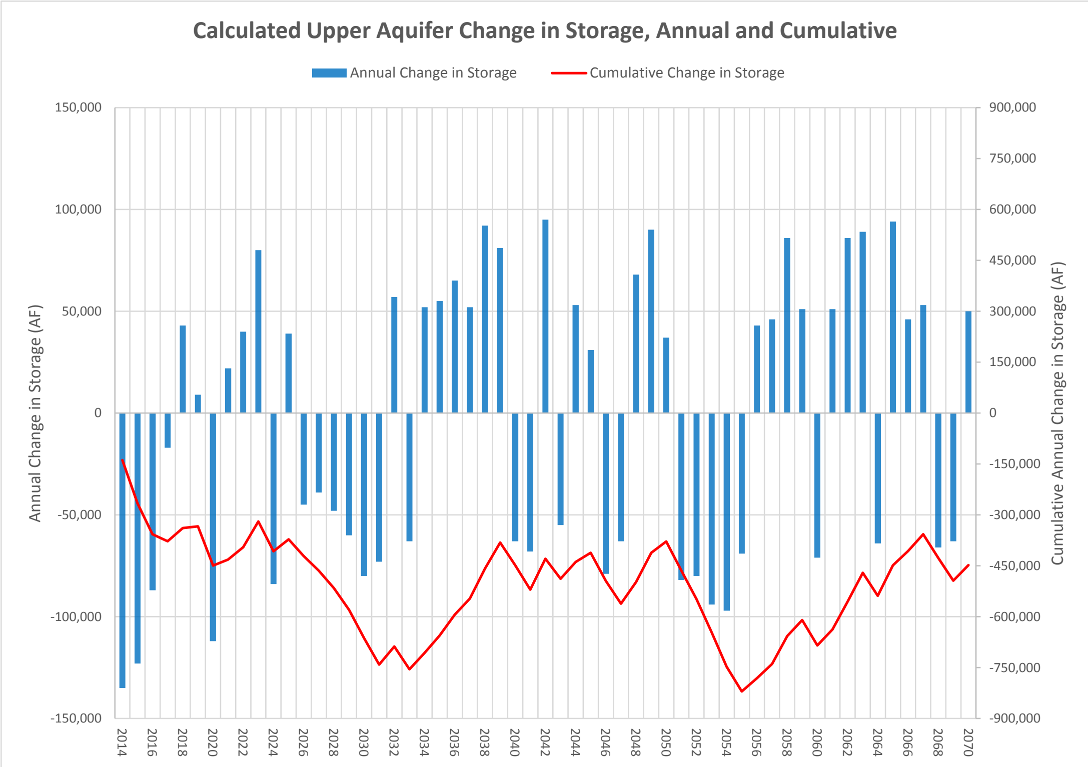
8. **Page 5-186, Section 5.4.3, Sentence starting with, "Streamflow Climate Change..."**
California Department of Water Resources (DWR) has developed a document (July 2018) entitled, Guidance for Climate change *Data Use During Groundwater Sustainability Plan Development* (Guidance Document). This document explains the DWR-provided climate change data, including how the data were developed, the methods and assumptions used for data development, and how they can be used in the development of a projected water budget. DWR has prepared climatological, hydrological and water operations datasets. This Guidance Document also describes tools and processes relevant to perform climate change data analysis (i.e., incorporating climate change analysis into projected water budgets, with and without numerical surface water/groundwater models). The data and methods described in the Guidance Document are optional and other local analysis and methods may be used.

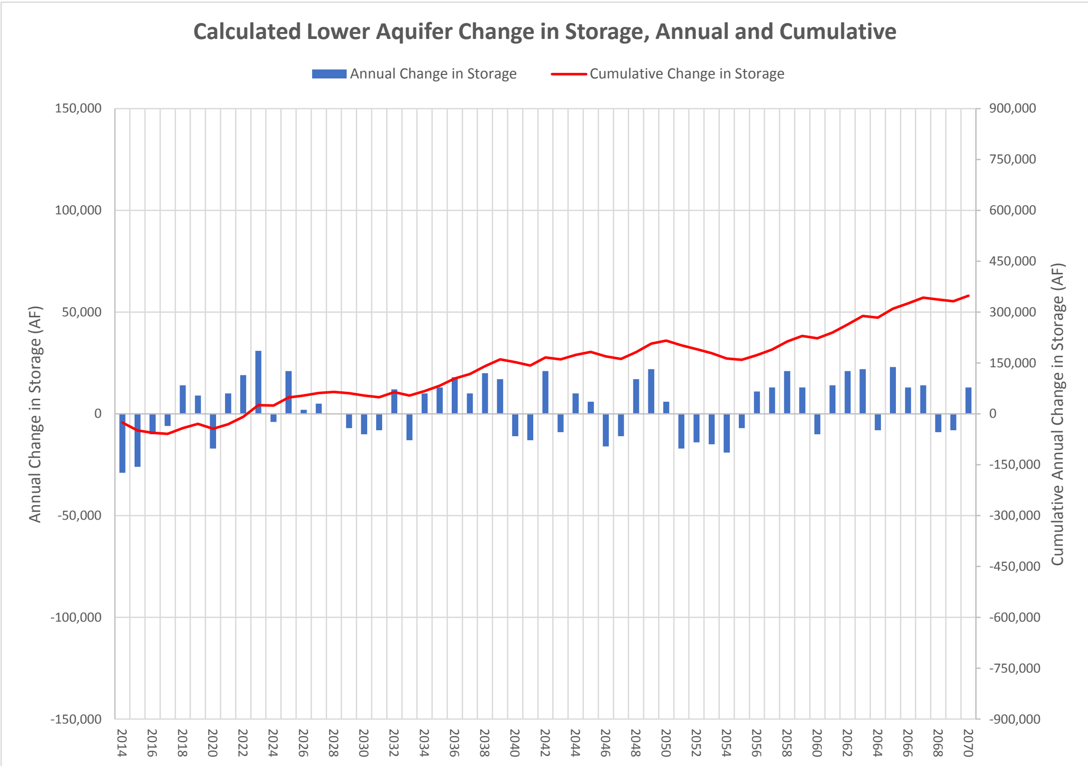
The projected (climate change) water budgets presented in the GSP utilize much of the climatological datasets. However, stream flow climate change factors from DWR were not applied – the proposed GSP considers them out-of-date and considers the result of using them as producing skewed (unreasonable) results for future surface water deliveries. Instead, the GSP states that GSA member agencies provided estimates for anticipated future surface water deliveries that were used in the water budget calculations. However, there is no discussion on the methods and assumptions used for data development, and how climate change was integrated into data values. Therefore, there is no way to evaluate the validity or applicability of these water budget variables with the information provided in the GSP. These information deficiencies should be remedied before approving the GSP.

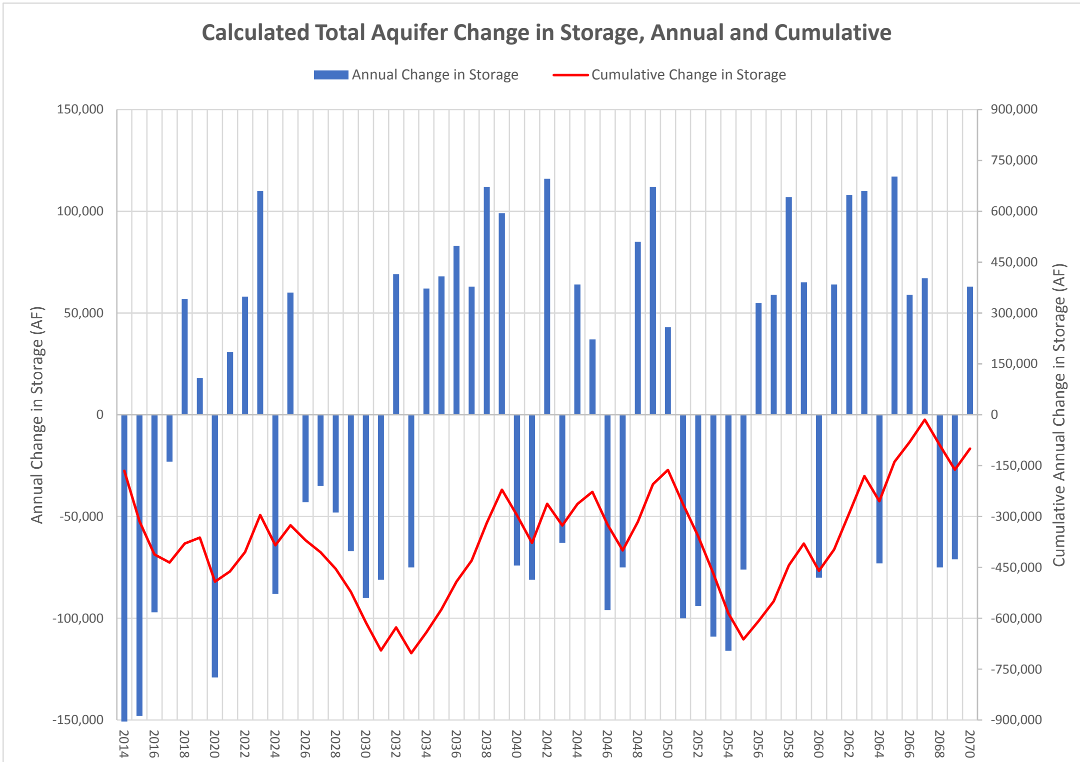
9. **Page 5-189, Section 5.4.4, Sentence starting with, "The selected alternative..."** The GSP uses a spreadsheet modeling approach for water budget development in lieu of numerical groundwater modeling. The spreadsheet modeling approach does not account for surface water-groundwater interaction and is therefore not an "equally effective method" (see *§354.18(e))* to numerical modeling with respect to identification on interconnected surface water systems and estimating the quantity and timing of depletions of those systems.

10. **Page 5-234, Section 5.4.10, Sentence starting with, "With the addition..."** Based on the results of the Projected Annual Groundwater Budget with Climate Change and Projects & Management Actions, the subbasin should still be considered in a state of overdraft. Although water results indicate a trend of recovery and surplus storage in the Upper Aquifer, the Upper Aquifer displays a long-term trend in storage decline. To better visualize results for this water budget, the annual and cumulative change in storage volumes for the Upper Aquifer, Lower Aquifer and Total (combined Upper and Lower Aquifers) were plotted. These plots are presented below.

    The plot of cumulative change in storage for the Upper Aquifer indicates multi-year periods of large fluctuations in storage, but a long-term trend in declining storage. The GSP states that over the WY2014 to WY2070 period, the average annual change in Upper Aquifer storage is -4,000 AF and the average annual change in Lower Aquifer is +3,000 AF. This statement in itself indicates the Upper Aquifer is in overdraft and long-term decline under this water budget scenario. Based on the graphs below, I estimate that the long-term annual change (deficit) in Upper Aquifer storage is twice as high (-8000 AFY) as that reported in the GSP (-448,000 AF divided by 56 years). I also estimate an annual change in storage in the Lower Aquifer is +6214 AFY (+348,000 AF divided by 56 year) and the total annual change in storage of the Upper and Lower combined is -1785 AFY (-100,000 AF divided by 56 years). Although the proposed Projects and Management Actions presented in the GSP will address overdraft sustainable management of the Lower Aquifer, the GSP has not demonstrated sustainable management for the Upper Aquifer, which provides a much larger percentage of total groundwater supply in the subbasin than the lower aquifer.


Calculated Upper Aquifer Change in Storage, Annual and Cumulative
Annual Change in Storage
Cumulative Change in Storage
Annual Change in Storage (AF)
Cumulative Annual Change in Storage (AF)
150,000
100,000
50,000
0
-50,000
-100,000
-150,000
900,000
750,000
600,000
450,000
300,000
150,000
0
-150,000
-300,000
-450,000
-600,000
-750,000
-900,000
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
2052
2054
2056
2058
2060
2062
2064
2066
2068
2070


Calculated Lower Aquifer Change in Storage, Annual and Cumulative
Annual Change in Storage
Cumulative Change in Storage
Annual Change in Storage (AF)
Cumulative Annual Change in Storage (AF)
150,000
100,000
50,000
0
-50,000
-100,000
-150,000
900,000
750,000
600,000
450,000
300,000
150,000
0
-150,000
-300,000
-450,000
-600,000
-750,000
-900,000
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
2052
2054
2056
2058
2060
2062
2064
2066
2068
2070



11. **Page 5-235, Section 5.4.11, Sentence starting with, "This analysis resulted..."**
The GSP presents a description and formula for estimating sustainable yield. However, the Upper or Lower Aquifer estimates are not reproducible using this formula and the water budget result tables presented earlier in the GSP. Therefore, the draft GSP should be revised to provide more detailed explanation of these calculations, including a sample calculation so the reader can understand and verify how they are quantified, and then recirculated from public comment.

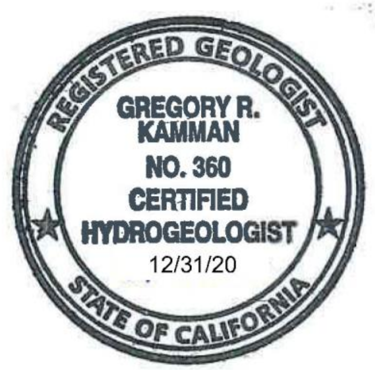
12. **Page 6-12, Section 6.3.2, Sentence starting with, "Reduction of Groundwater"**
This section indicates that the GSP uses groundwater levels minimum thresholds as a proxy for the reduction of groundwater storage sustainability indicator. The plots of annual and cumulative annual change in groundwater storage presented above are very helpful in identifying and understanding long-term trends in aquifer storage. I recommend that in lieu of (or in addition to) using groundwater levels as a proxy, water budgets and the resulting annual and cumulative aquifer storage graphics (like those above) should be used as a more meaningful groundwater storage sustainability indicator. The data to maintain current annual water budgets would be required. The existing GSP and future reporting graphs can be used to define and track undesirable results, minimum thresholds, measureable objectives, and interim milestones for the reduction in groundwater

storage. For example, one measureable objective may be positive or neutral trends in long-term cumulative storage. An example minimum threshold may be maintaining a neutral or positive long-term average change in annual storage for both the Upper and Lower Aquifers.

Please feel free to contact me with any questions regarding the material and conclusions contained in this letter.

Sincerely,

Greg Kamman, PG, CHG
Principal Hydrologist



Attachment - Kamman Resume

Greg Kamman, PG, CHG
Principal Hydrologist

EDUCATION	1989	M.S. Geology - Sedimentology and Hydrogeology Miami University, Oxford, OH
	1985	A.B. Geology Miami University, Oxford, OH
REGISTRATION	No. 360 No. 5737	Certified Hydrogeologist (CHG.), CA Professional Geologist (PG), CA
PROFESSIONAL HISTORY	1997 - Present	Principal Hydrologist/Vice President Kamman Hydrology & Engineering, Inc. San Rafael, CA
	1994 - 1997	Senior Hydrologist/Vice President Balance Hydrologics, Inc., Berkeley, CA
	1991 - 1994	Project Geologist/Hydrogeologist Geomatrix Consultants, Inc., San Francisco, CA
	1989 - 1991	Senior Staff Geologist/Hydrogeologist Environ International Corporation, Princeton, NJ
	1986 - 1989	Instructor and Research/Teaching Assistant Miami University, Oxford, OH

SKILLS AND EXPERIENCE

As a Principal Hydrologist with 30 years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology, Mr. Kamman routinely manages projects in the areas of surface- and ground-water hydrology, stream and wetland habitat restoration, water supply, water quality assessments, water resources management, and geomorphology. Areas of expertise include: stream and wetland habitat restoration; characterizing and modeling basin-scale hydrologic and geologic processes; assessing hydraulic and geomorphic responses to land-use changes in watersheds and causes of stream channel instability; evaluating surface- and ground-water resources and their interaction; and designing and implementing field investigations characterizing surface and subsurface conditions; and stream and wetland habitat restoration feasibility assessments and design. In addition, Mr. Kamman commonly works on projects that revolve around sensitive fishery, wetland, wildlife and/or riparian habitat enhancement. Mr. Kamman performs many of these projects in response to local, state (CEQA) and federal statutes (NEPA, ESA), and other regulatory frameworks. Thus, Mr. Kamman is accustomed to working within a multi-disciplined team and maintains close collaborative relationships with biologists, engineers, planners, architects, lawyers, and resource and regulatory agency staff. Mr. Kamman is a prime or contributing author to over 80 technical publications and reports in the discipline of hydrology – the majority pertaining to ecological restoration. Mr. Kamman routinely teaches courses on stream and wetland restoration through U.C. Berkeley Extension and San Francisco State University's Romberg Tiburon Center.

PROFESSIONAL SOCIETIES & AFFILIATIONS	Groundwater Resources Association of California Society for Ecological Restoration International California Native Plant Society

539 Bret Harte Road, San Rafael, CA 94901
Telephone: (415) 491-9600 Fax: (415) 680-1538 Email: greg@khe-inc.com