Summary Analysis of 31 Groundwater Sustainability Plans in Critically Overdrafted Basins

Consideration of Selected Beneficial Users — Key Findings and Examples

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Acronyms and Abbreviations

AFY	acre-feet per year
CCR	California Code of Regulations
CWC	California Water Code
DAC	Disadvantaged Community
DWR	California Department of Water Resources
ft	feet
GDE	Groundwater Dependent Ecosystem
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
SCEP	Stakeholder Communication and Engagement Plan
SGMA	Sustainable Groundwater Management Act

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1. Introduction

The Sustainable Groundwater Management Act (SGMA) requires Groundwater Sustainability Agencies (GSAs) in high-and medium-priority groundwater basins to develop and implement Groundwater Sustainability Plans (GSPs) that provide detailed road maps for how groundwater basins will reach long term sustainability. GSPs for high-and medium-priority groundwater basins that have been designated as being in "critical overdraft" conditions were due in January 2020, while development of GSPs for the remaining high-and medium-priority groundwater basins are due in January 2022. One of the key criteria that the Department of Water Resources (DWR) must consider when evaluating whether a GSP is likely to achieve the sustainability goal for the basin is "Whether the interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected by the use of groundwater in the basin, have been considered" (23 California Code of Regulations [CCR] § 355.4(b)(4)).

In regard to this and other statutory requirements to consider and address the needs of all beneficial users in GSPs, our organizations, with the support of Water Foundation, collectively reviewed 31 GSPs in 16 critically overdrafted basins and subbasins listed below. Our organizations collectively submitted detailed formal comment letters to each GSA on the public draft GSPs as well as detailed formal comment letters to DWR on the final GSP documents, within the formal public review period.[1]

- Chowchilla Subbasin (DWR 5-22.05)
- Delta-Mendota Subbasin (DWR 5-22.07)
- Eastern San Joaquin Groundwater Subbasin (DWR 5-22.01)
- Indian Wells Valley Groundwater Basin (DWR 6-54)
- Kaweah Subbasin (DWR 5-22.11)
- Kern County Subbasin (DWR 5-22.14)
- Kings Subbasin (DWR 5-22.08)
- Madera Subbasin (DWR 5-22.06)
- Merced Subbasin (DWR 5-22.04)
- Paso Robles Subbasin (DWR 3-04.06)
- Pleasant Valley Basin (DWR 4-06)
- Salinas Valley – 180/400-Foot Aquifer Subbasin (DWR 3-04.01)
- Santa Cruz Mid-County Groundwater Basin (DWR 3-001)
- Tulare Lake Subbasin (DWR 5-22.12)
- Tule Subbasin (DWR 5-22.13)
- Westside Subbasin (DWR 5-22.09)

Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is a critical piece of a resilient California water portfolio, particularly in light of our changing climate. Our review focused on how well drinking water, climate change, stakeholder involvement, managed wetlands and groundwater dependent ecosystems were addressed in these GSPs. We evaluated how the interests of drinking water users (particularly disadvantaged community [DAC] members) and environmental beneficial users were considered in the development of the GSP and how potential impacts to these critical beneficial users will be considered and addressed during GSP implementation. Our review focused specifically on five elements: (1) identification and consideration of beneficial uses and users, (2) water budget, (3) notice and communication, (4) monitoring network, and (5) projects and management actions. The key elements our organizations evaluated as part of each GSP review are summarized in the box below; specific findings are discussed in the following sections. We relied upon DWR's regulations to make determinations of sufficiency for each plan and plan element.

Our organizations collectively reviewed 31 out of the 46 total GSPs that were developed for critically overdrafted basins. The reviews were prioritized towards those GSPs that were considered to be of high priority by our organizations due to the presence of: (1) small drinking water systems, (2) groundwater dependent ecosystems (GDEs), and (3) DACs. Prioritization also considered coverage and interest by our respective organizations, with the goal of selecting at least one GSP per critically overdrafted basin. Although we did not review all 46

submitted GSPs, the findings from our analysis are both valuable to inform GSP implementation and updates in critically overdrafted basins, and to inform the development and review of GSPs currently being drafted for the remaining high- and medium-priority basins.

For each of the five key elements, the following sections discuss: (1) the regulatory basis for consideration of beneficial users, (2) a summary of our review findings, (3) a discussion of how the GSPs should have more adequately addressed the key issues, and (4) a selection of "Model GSP Elements" from reviewed GSPs.

It is the goal of this analysis to share our findings in order to help inform and improve the development of GSPs for non-critically overdrafted basins, as well as to inform opportunities for improvement of GSPs for critically overdrafted basins.

Key Elements of GSP Analysis

Identification and Consideration of Beneficial Uses and Users

- Disadvantaged Communities (DACs) identified in the GSP
- Direct impacts of Undesirable Results, Measurable Objectives, and Minimum Thresholds on DACs analyzed in the GSP
- Cumulative or indirect impacts of Minimum Threshold triggers on DACs evaluated in the GSP
- Identification of Groundwater Dependent Ecosystems (GDEs) are complete and consistent with guidance

Water Budget

- Incorporation of climate change
- Consideration of climate change in the three main components of the water budget
- Consideration of wet and dry scenarios per DWR guidance
- Inclusion of water demands for native vegetation
- Inclusion of water demands for managed wetlands

Notice and Communication

- Documentation of how DACs and environmental stakeholders were given opportunities to engage
- Inclusion of a Stakeholder Communication and Engagement Plan (SCEP)
- Outreach during implementation included in the SCEP or GSP

Monitoring Network

- Inclusion of well depths in the proposed monitoring network
- Monitoring wells overlayed with DACs and GDEs to identify potential impacted areas
- Inclusion of a plan to identify and fill data gaps in the monitoring network

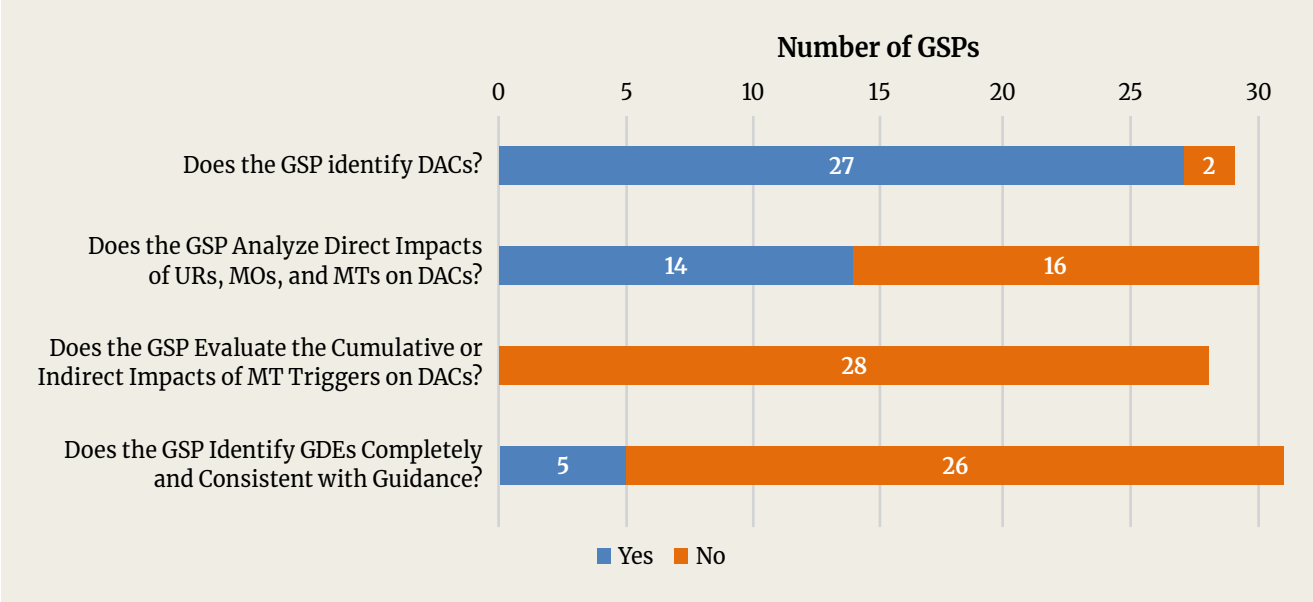
Projects and Management Actions

- Overdraft addressed in the first five years
- An implementation schedule and funding plan are included for Projects and Management Actions
- Potential impacts to water quality identified in Projects and Management Actions

2. Identification and Consideration of Beneficial Uses and Users

The results of our organizations' assessment of how GSPs handled the identification and consideration of critical drinking water and environmental beneficial users are summarized in Chart 1 below. Findings are discussed in detail in the following sections.

Chart 1. Identification and Consideration of Beneficial Uses and Users



The total number of GSPs for each question does not always sum to 31 because the question is not applicable to some GSPs. For example, for the question "Does the GSP identify DACs," total number of GSPs is 29 because there are no state-identified DACs in the corresponding basins for the remaining 2 GSPs. Note: URs = undesirable results, MOs = measurable objectives, MTs = minimum thresholds.

For a complete review of all additional elements that must be present in order to protect drinking water, particularly for disadvantaged communities, see the Human Right to Water Scorecard, developed by several of our organizations.[2] For a complete review of how well GSPs are meeting the needs of environmental beneficial users, including interconnected surface waters and groundwater dependent ecosystems, refer to SGMA Signals: Managing Groundwater for Nature, currently under development by The Nature Conservancy.[3]

2.1 Does the GSP Identify Beneficial Uses and Users?

In accordance with California Water Code (CWC) § 10723.2, the GSA "shall consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans." The interests named in CWC § 10723.2 include, among others: (1) domestic well owners, (2) municipal well operators, (3) public water systems, (4) environmental users of groundwater, (5) "surface water users, if there is a hydraulic connection between surface and groundwater bodies," (6) California Native American tribes, and (7) "disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems." GSPs are further required to include "A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties" (23 CCR § 354.10 (a)). Further, one of the primary criteria for which DWR is required to evaluate the sufficiency of GSPs is "(4) Whether the interests of the beneficial uses and users of groundwater in the basin,

and the land uses and property interests potentially affected by the use of groundwater in the basin, have been considered" (23 CCR § 355.4(b)(4)).

Despite these requirements, as identified in Chart 1, GSPs often either failed to or did not completely identify critical drinking water and environmental beneficial uses and users.

2.2 Does the GSP Identify DACs?

Under SGMA, DACs are defined as communities where the average median household income is less than 80% of the state's median household income. To ensure that all beneficial users of groundwater can participate in the SGMA process, DACs must be identified and their input solicited in the development and implementation of GSPs. DWR and other organizations have provided guidance documents for adequate and effective stakeholder communication and outreach, which outline approaches for engaging beneficial users.[4,5] Additionally, DWR developed a DAC Mapping Tool,[6] which provided data on the location of DACs around the state based on census data. As shown on Chart 1, 27 of the 31 GSPs reviewed by our organizations (approximately 87%) clearly and transparently identified the presence of DACs.

Most GSAs identified the presence of DACs using the data provided by DWR or similar methods. In order to provide a complete description of these beneficial users, however, the GSAs should include much more detail regarding the characteristics of the population and their use of groundwater. This information is necessary for the GSA and GSP-reader to: fully understand the specific interests and water demands of these beneficial users; to support the development of water budgets using the best available information per 23 CCR § 354.18 (e); and to support the development of sustainable management criteria per 23 CCR § 354.28 (b)(4)). Ideally, a GSP should:

- Identify each DAC by name and location on a map;
- Describe the size of the population in each DAC;
- Identify the sources of drinking water for DAC members, including an estimate of how many people rely on which source (e.g., domestic wells, state small water systems, and public water systems); and
- Identify the sources of water for each water system (e.g., what percentage is supplied by groundwater).

During our review, we did not identify any GSP that clearly provided all of this information in its discussion of beneficial uses and users. However, we do note that some GSPs presented some of these elements quite well.

Model GSP Elements

- The Eastern San Joaquin Groundwater Authority GSP maps DACs on Figure 1-8, acknowledges that 182 of the 433 community water systems in the GSA serve DACs, provides the location and population served for each of these community water systems (Appendix 1-f), and maps the locations of domestic wells (Figure 1-12).[7]
- The GSP for the Eastern Kaweah GSA provides maps of average well depths by section, dividing those maps among agricultural (Figure 2-24), domestic (Figure 2-25) and public supply wells (Figure 2-26).[8]

2.3 Does the GSP Identify GDEs Completely and Consistent with Guidance?

GDEs are defined as a beneficial user under SGMA and refer to ecological communities or species that depend on groundwater emerging from aquifers or occurring near the ground surface (23 CCR § 351 (m)). Each GSP is required to provide a description of current and historical groundwater conditions in the basin, including data

from January 1, 2015, to current conditions, based on the best available information, including: "Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information" (23 CCR § 354.16 (g)). In order to facilitate identification of GDEs, DWR has made a Natural Communities Commonly Associated with Groundwater viewer available and The Nature Conservancy has developed a detailed guidance document, *Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act*, among other tools.[9] Despite these available resources, only five (approximately 16%) of the 31 GSPs reviewed by our organizations, identified GDEs consistent with The Nature Conservancy guidance (as shown on Chart 1, above).

In general, we found that GSPs often incorrectly applied The Nature Conservancy's guidance.[10] GSPs should characterize groundwater conditions within GDEs by (1) accurately determining depth to groundwater using land surface elevation, and (2) utilizing groundwater data from multiple years and seasons to characterize historic and current groundwater conditions.

In addition to these considerations, and in absence of specific detailed studies of the natural communities that proves a lack of reliance on groundwater, GSPs should conservatively assume that the Natural Communities Commonly Associated with Groundwater areas are all *potentially* GDEs. GSPs should include all potential GDEs in their assessment of potential impacts and sustainability, as well as develop a plan to monitor and further evaluate the presence and condition of potential GDEs.

Model GSP Elements

Based on our review, Grassland GSA appropriately identified potential GDEs, using the best available data including the Natural Communities Commonly Associated with Groundwater dataset and a Ducks Unlimited wetland delineation dataset. Consistent with The Nature Conservancy guidance document, the GSA identified all possible GDE areas (Section 2.5.12) and in the absence of additional data to confirm their presence, included potential GDE areas in their evaluation of impacts to GDEs.

2.4 Does the GSP Analyze Direct Impacts to Undesirable Results, Measurable Objectives, and Minimum Thresholds on DACs?

Per 23 CCR § 354.26 (b)(3), the description of Undesirable Results shall include "Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." The description of minimum thresholds shall include "How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests" (23 CCR § 354.28 (b)(4)).

In order to evaluate how proposed minimum thresholds could affect the interests of drinking water users, the GSPs should evaluate both the direct impacts of minimum thresholds (e.g., an assessment of how many wells will be dewatered at proposed minimum threshold groundwater levels) and indirect impacts (e.g., changes in water quality that may arise from lowering of groundwater levels). Many DACs rely on domestic wells or small public water systems, which often have very different characteristics from agricultural wells or larger urban water supply wells, and thus are more vulnerable to changes in water level and water quality. As shown on Chart 1 above, only 14 (approximately 45%) of the GSPs analyzed direct impacts of Undesirable Results, measurable objectives, and minimum thresholds on DACs, and as discussed further in the following section, none of the GSPs included a thorough evaluation of cumulative or indirect impacts to DACs.

In order to evaluate the direct impacts of water level minimum thresholds on DAC domestic well users and small water systems per 23 CCR § 354.28 (b)(4)), each GSP should include the following analyses:

- Calculate and transparently present on maps the anticipated change in water levels for measurable objectives and minimum thresholds (separately) relative to current groundwater conditions. These maps should clearly identify the locations of beneficial users, including DACs, populations dependent on domestic wells for drinking water, and small community water systems.
- Include maps reflecting anticipated water level contours if measurable objective and minimum threshold values are met at all monitoring locations, including anticipated effects of measurable objectives and minimum thresholds set by adjacent GSAs. Include a discussion of anticipated changes in groundwater gradients and the effects this can have on beneficial users, including the potential for changes in water quality (an indirect impact of water level change), to the extent such analysis is supported by available data.
- Identify the location and number of domestic wells that would be anticipated to be impacted at the measurable objectives and minimum thresholds, utilizing well construction information available in DWR's Well Completion Report Map Application. Include an estimate of the population anticipated to be affected under these conditions.
- Identify the location and number of public water system wells that would be anticipated to be impacted at the measurable objectives and minimum thresholds. Include an estimate of the population anticipated to be affected under these conditions.
- If Undesirable Results are defined as being the point at which a certain percentage of wells exceed their minimum thresholds, the GSP should evaluate potential scenarios where these conditions are met and quantify and present the anticipated impacts to beneficial users (domestic well users, small community water system customers, and DACs) at these conditions.

This approach is similar to that used in two Central Valley-focused studies of impacts to domestic wells under SGMA.[11] Because measurable objective conditions are expected to be more representative of the typical conditions once a basin has reached sustainability, we also recommend that these analyses be done for water level measurable objectives as well, thus bounding the likely range of impacts expected to occur through SGMA implementation.

In most cases, the assumptions used significantly underestimate the impacts to DACs. The Kings River East GSP[12] does at least include some of these recommended analyses. Specifically, Figures 4-3 and 4-4 of the Kings River East GSP identify the number of domestic wells per section where the minimum threshold and measurable objective, respectively, are at a depth that would result in the wells becoming non-functional.[13] This analysis revealed that 22% of domestic wells would be expected to be directly impacted at minimum threshold water levels and identifies the location of those impacted beneficial users within the GSA. Analyses such as these support the GSA's ability to develop a project or management action to mitigate impacts (or Undesirable Results) to beneficial users that are a direct result of GSP implementation.

An evaluation of direct impacts of water quality minimum thresholds on DACs is facilitated by the selection of minimum thresholds relative to drinking water standards for areas with drinking water users, particularly those reliant on domestic wells (which typically do not include any type of water treatment). In cases where current basin conditions do not allow for water quality minimum thresholds to be set relative to drinking water standards, it is important for the GSP to identify: (1) the population dependent on domestic wells in areas that would exceed drinking water standards, and (2) the sufficiency of small public water systems to treat water to drinking water standards without addition of, or upgrade to, treatment systems.

2.5 Does the GSP Evaluate the Cumulative or Indirect Impacts of Minimum Threshold Triggers on DACs?

Each GSA shall describe in its GSP the processes and criteria relied upon to define Undesirable Results applicable to the basin (23 CCR § 354.26 (a)). The description of Undesirable Results shall include "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" (23 CCR § 354.26 (b)(2)). As shown on Chart 1, none of the GSPs reviewed evaluated the cumulative or indirect impacts of minimum threshold triggers on DACs.

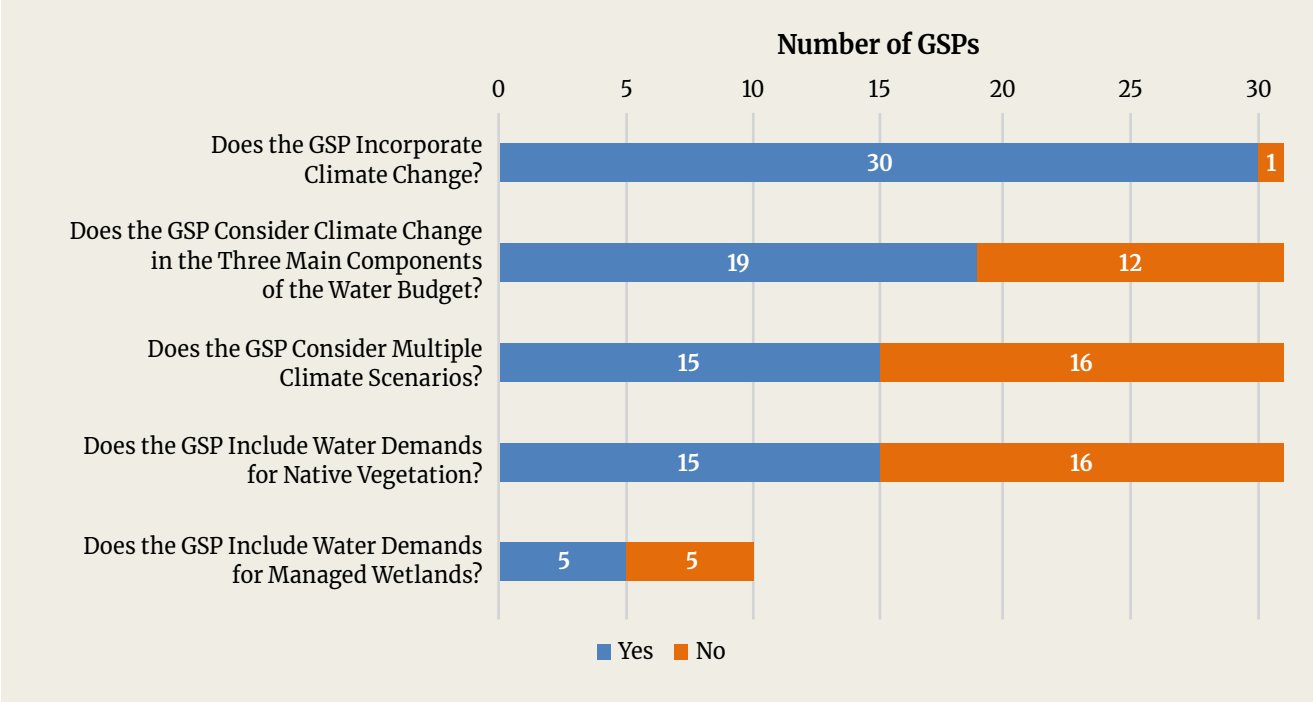
Indirect impacts of minimum thresholds are notably more difficult to quantify than the direct impacts discussed above. A salient example of indirect effects of minimum thresholds are water quality impacts that can result from declining water levels. For example, in some areas of the Central Valley, it has been documented that declining water levels that result in the dewatering of Corcoran Clay can result in increased concentrations of arsenic in groundwater.[14] Similarly, in some areas declining water levels have been associated with increased uranium concentrations in groundwater.[15] Significant changes in groundwater pumping can potentially mobilize naturally occurring constituents or cause migration or expansion of contaminant plumes even when the extracted amount is within the basin's sustainable yield.[16,17]

In order to evaluate a potential relationship between water levels and water quality constituents, GSPs should include an assessment of the change in water quality constituent concentrations relative to water levels over time. The United States Geological Survey recently conducted a study of concentration trends of inorganic water quality constituents in public water supply wells.[18,19] GSAs can utilize this dataset, as well as conduct their own similar analyses (i.e., Mann-Kendall trend analyses) to evaluate the water quality trends observed over periods of recent water level decline to support an assessment of whether water level decline is associated with changes in water quality concentrations.

3. Water Budget

The results of our organizations' assessment of water budgets in reviewed GSPs are summarized in Chart 2 below. Findings are discussed in detail in the following sections.

Chart 2. Water Budget



Total number of GSPs for each question might not add up to 31 because the question is not applicable to some GSPs. For example, for the question "Does the GSP include water demands for managed wetlands," total number of GSPs is 10 because there are no managed wetlands identified in the corresponding basins for the remaining 21 GSPs. Note: URs = undesirable results, MOs = measurable objectives, MTs = minimum thresholds.

3.1 Does the GSP Incorporate Climate Change and Consider Climate Change in the Main Components of the Water Budget?

SGMA regulations require GSAs "…to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow" (23 CCR § 354.18 (e)). The GSAs "shall utilize the following information provided, as available, by DWR pursuant to Section 353.2, or other data of comparable quality, to develop the water budget: … (3) Projected water budget information for population, population growth, climate change, and sea level rise" (23 CCR § 354.18 (d)(3)). In its Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development, DWR provides detailed guidance on how to incorporate climate change into water budgets, and provides precipitation and evapotranspiration change factors to represent climate change under two future climate periods (2030 and 2070).[20] It is important that GSPs integrate climate change into all elements of the projected water budgets to form the basis for development of sustainable management criteria and projects and management actions.

Likely owing to the detailed guidance from DWR, virtually all of the GSPs (30 out of 31 GSPs, 97%) incorporated climate change into the water budget in some capacity. However, only 61% of them (19 out of 31 GSPs) clearly and transparently identified the effects of climate change in the three main components of the water budget

(as shown on Chart 2, above). That is, many of these GSPs broadly stated that climate change was incorporated into the water budgets, but did not specifically identify how climate change is anticipated to affect each major water budget component or domain, and/or did not clearly describe in the text that climate change was applied to those water budget components. One way to demonstrate the effect of climate change is to present the detailed water budget components under various scenarios (e.g., baseline [historical conditions projected out], 2030 climate change, and 2070 climate change) so that the reader can compare the magnitude and direction of climate change effects on all water inflows, outflows, and uses.

Model GSP Elements

An example of incorporation of climate change is available in Section 5.4 of the GSP for the Northern and Central Delta-Mendota Regions.[21] This GSP very transparently details the assumptions used in each projected water budget scenario, identifies the differences in assumptions between scenarios, and presents the water budget for each projected scenario (baseline, climate change, and climate change with implementation of projects and management actions) in both tabular and graphical format in a series of tables and figures.

3.2 Does the GSP Consider Wet and Dry Scenarios Per DWR Guidance?

The projected hydrology information shall be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise (23 CCR § 354.18 (c) (3)). DWR provides two future climate periods for GSAs to use in the Guidance for Climate Change Data Using During Groundwater Sustainability Plan Development, including one scenario for 2030 and three scenarios for 2070.[22] The climate projections provided include a 2030 central tendency, a 2070 central tendency, and what DWR considers as two 2070 extreme scenarios (i.e., one drier with extreme warming and one wetter with moderate warming). As shown on Chart 2 above, 15 out of 31 reviewed GSPs (approximately 48%) presented water budgets summarized by different water year types (i.e., normal, wet and dry years) within a single central tendency climate scenario, but did not document following DWR guidance for evaluating extremely wet and dry climate change scenarios. Along with clearly presenting average, wet and dry year summary conditions within projected water budgets for a climate change scenario, GSPs should also clearly and transparently incorporate the proposed extremely wet and dry scenarios provided by DWR into projected water budgets, or select more appropriate extreme scenarios for their basins.

Model GSP Elements

The North Fork Kings GSP is an example that presents historical, current, and projected water budgets for 2040 and 2070 climate change scenarios by normal, dry, and wet year conditions in Tables 3-8, 3-11, 3-13 and 3-14.[23] However, it is noted that, as the GSP states, “only the central tendency simulations were used for preparing water budgets for the Kings Subbasin.” Thus, the water budget can and should be further improved by considering the extremely wet and dry scenarios provided by DWR.

3.3 Does the GSP Include Water Demands for Native Vegetation and Managed Wetlands?

GSP water budgets shall quantify "Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow" (23 CCR § 354.18 (b)(3)). Based on 23 CCR § 351 (al), "Water use sector" refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

As shown in Chart 2 above, 15 of the 31 GSPs collectively reviewed by our organizations (approximately 47%) clearly and transparently included water demands for native vegetation; and 5 out of 10 GSPs (50%) include water demands for managed wetlands when present in the basin. GSAs are required to quantify and present the water use sector demands in their historical, current, and projected water budgets, in tabular and graphical format, with individual line items for each water use sector in the tabular form, including managed wetlands and native vegetation. Based on our organizations' review, many GSPs did not clearly identify water demands for native vegetation in the water budget, often not identifying native vegetation in the description of water budget component calculations and including broad undefined water budget sectors such as "plant evapotranspiration," which could be interpreted as referring only to water use by agricultural crops or "riparian vegetation," which does not identify if non-riparian native vegetation is accounted for. Similarly, managed wetlands were not identified as a distinct water use sector in GSP water budgets, even where managed wetlands were described as a land use and/or beneficial user of groundwater. Additional clarity can be accomplished by clearly identifying demand by native vegetation and managed wetlands as a component in water budgets, and describing how water demand by vegetation was quantified.

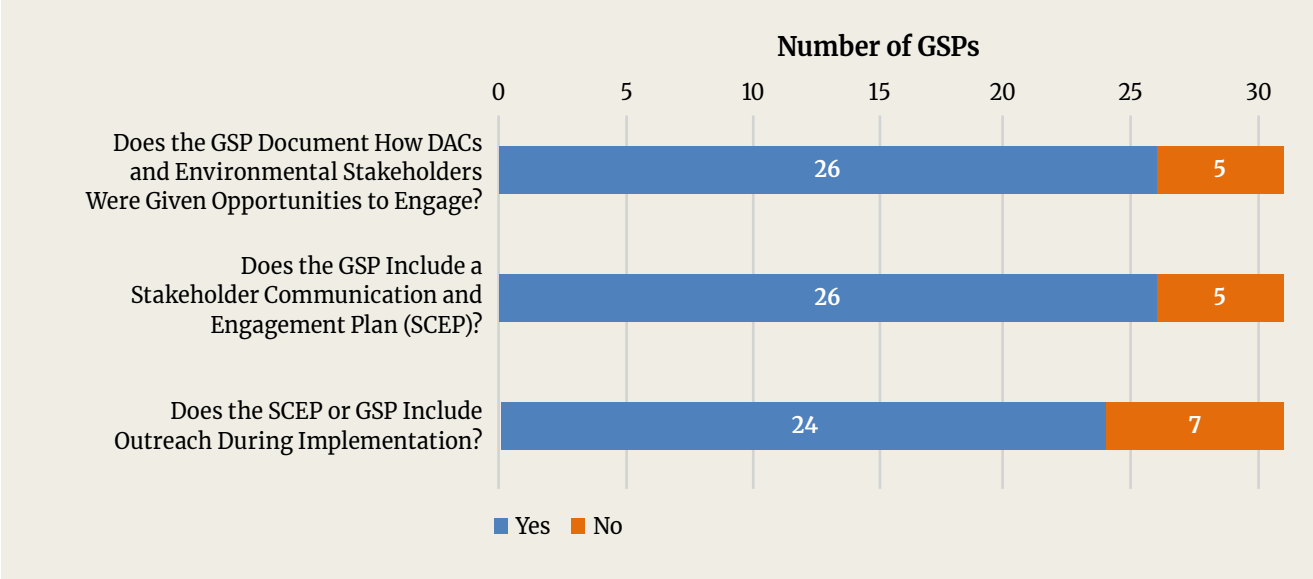
Model GSP Elements

Grassland GSP included managed wetlands in the historical, current, and future water budgets (Tables 3-4, 3-6, and 3-8), although managed wetlands are not identified as a separate domain in the presentation of these water budgets, but rather grouped with evapotranspiration for agricultural and native vegetation. It is advised to include the groundwater demands specifically of native and wetland vegetation. Managed wetlands make up 95% of the land use in the Grassland GSA area, and thus represent a substantial portion of the evapotranspiration in the water budget.

4. Notice and Communication

The results of our organizations' assessment of notice and communication in reviewed GSPs are summarized in Chart 3 below. Findings are discussed in detail in the following sections.

Chart 3. Notice and Communication



It is noted that our organizations' review of stakeholder notice and communication was necessarily limited to the information documented and presented in the GSPs. For a complete list of all additional elements that must be present in order to ensure adequate public participation, particularly by disadvantaged communities, please refer to the Human Right to Water Scorecard.[24]

4.1 Does the GSP Document How DACs and Environmental Stakeholders Were Given Opportunities to Engage?

Each GSP shall include a communication section that includes "Identification of opportunities for public engagement and a discussion of how public input and response will be used" (23 CCR § 354.10 (d)(2)) and "A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin" (23 CCR § 354.10 (d)(3)). In order to support GSAs with effective stakeholder engagement through GSP development and implementation, both DWR and several non-governmental organizations developed guidance documents.[25] DWR also made available a toolkit of digital documents and templates to support this effort.[26] As shown on Chart 3, approximately 84% of the 31 GSPs reviewed by our organizations document how DACs and environmental stakeholders were given opportunities to engage in the SGMA process.

Effective engagement of beneficial users, particularly DACs, has been difficult to assess. With few exceptions DACs and environmental stakeholders do not qualify for membership on GSA boards.[27] Further, when DACs were asked to serve on GSAs or Advisory Committees, technical assistance to ensure that DAC members were able to fully participate was lacking, and where it existed, was not provided or funded by the GSAs.

Model GSP Elements

The Chowchilla Subbasin GSP is an example of a GSP that clearly documents how beneficial users, including DACs and environmental stakeholders, were provided opportunities to engage in the SGMA process.[28] Section 2.1.5.3 details that the public was given the opportunity to engage during the GSP development process, including at public meetings such as GSA meetings, joint subbasin meetings, subbasin-wide technical meetings, and county advisory committee meetings. The advisory committee for this basin includes two seats reserved for DAC community representatives, and the GSA expanded the stakeholder list associated with the Environmental and Ecosystem Uses category in response to comments on their draft GSP. The GSP also documents activities related to encouraging involvement and building capacity for engagement. Specifically, Madera County worked with Self-Help Enterprises and the Leadership Counsel for Justice and Accountability, organizations that represent DAC communities, to inform DAC members about the plan and encourage their involvement.[29] Activities organized in coordination with these groups included: (a) capacity-building workshops, (b) educational tours for the public, and (c) presentations held in communities around the Subbasin.

4.2 Does the GSP Include a Stakeholder Communication and Engagement Plan?

Per the DWR Guidance Document for GSP Stakeholder Communication and Engagement, a Stakeholder Communication and Engagement Plan (SCEP) is "a tool for GSAs to create common understanding and transparency throughout the GSP preparation and submission process. This process should be tailored to the basins and stakeholder needs. Documentation of the engagement and outreach by GSAs is important for Phase 3 (GSP review and evaluation). GSAs could evaluate the successes and learn from the stakeholder feedback to make necessary adjustments in order to achieve their goals." As shown on Chart 3, approximately 84% of the reviewed GSPs include a SCEP. In order to be most effective, a SCEP should be developed as a standalone document at the beginning of the GSP development process and made easily accessible to the public. A SCEP should be treated as a living document and updated periodically throughout the development of a GSP and through SGMA implementation.

Model GSP Elements

The SCEP included in the Eastern Tule Subbasin GSP is an example of a robust plan, which was prepared early in the GSP development process. This SCEP includes key elements such as: (1) identifying plans for stakeholder outreach through GSP implementation, (2) holding public meetings in different locations across the GSA to increase accessibility, (3) posting notices in public locations and local newspapers to reach community members that do not have access to internet, (4) translation of outreach materials into multiple languages, (5) formation and inclusion of a stakeholder committee to provide input in the GSP development process, which includes both drinking water and environmental user representatives, and (6) a timeline for development of the various GSP components outlined up front. It is noted however, that this SCEP was not updated prior to inclusion in the GSP to document the stakeholder outreach that occurred or to include updated plans for future engagement.

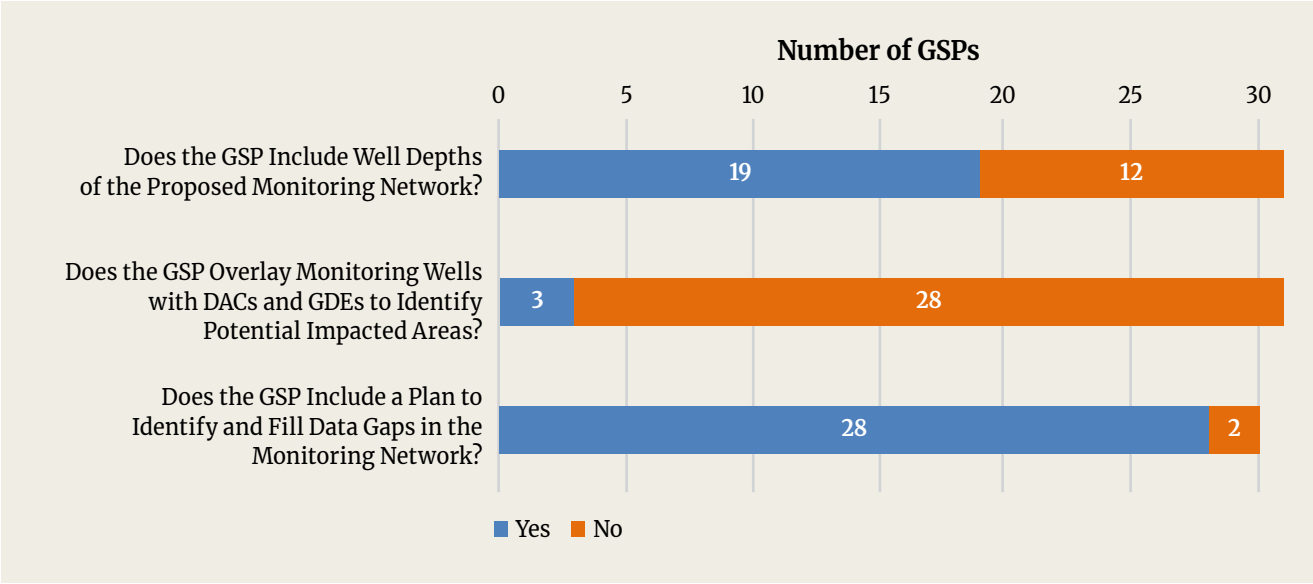
4.3 Does the SCEP or GSP Include Outreach During Implementation?

In addition to conducting stakeholder outreach and engagement during development of GSPs, it is also important that stakeholders be given continual opportunities for engagement through the implementation phase of the GSP. This includes opportunities to learn about and engage on: (1) projects and management actions at all planning and implementation phases, (2) GSAs' annual reporting, and (3) five-year GSP assessments and re-evaluations. The DWR Guidance Document for GSP Stakeholder Communication and Engagement,[31] specifies that encouraging active stakeholder involvement is required during the implementation and reporting phase under CWC § 10727.8 and that public notices and meetings are specifically required under CWC § 10730 during the before amending a GSP and prior to imposing or increasing a fee. However, as shown on Chart 3, approximately 23% of the SCEPs do not include plans to conduct outreach during implementation. Most GSPs included a commitment to outreach during implementation as part of their SCEP, but few included detailed plans. Continued engagement of beneficial users and interested parties will need to be a focus of annual reports and five-year updates submitted as part of plan implementation.

5. Monitoring Network

Results of our organizations' assessment of monitoring networks in reviewed GSPs are summarized in Chart 4 below. Findings are discussed in detail in the following sections.

Chart 4. Monitoring Network



Total number of GSPs for each question might not add up to 31 because the question is not applicable to some GSPs. For example, for the question "Does the GSP include a plan to identify and fill data gaps in the monitoring network," total number of GSPs is 30 because the remaining one GSP did not identify data gaps in the monitoring network.

5.1 Does the GSP Include Well Depths of the Proposed Monitoring Network?

Wells used to monitor groundwater conditions shall be constructed according to applicable construction standards and shall provide the information in both tabular and geodatabase-compatible shapefile form, including casing perforations, borehole depth, and total well depth (23 CCR § 352.4 (c)(1)). If a GSA relies on monitoring wells that lack casing perforations, borehole depth, or total well depth information to monitor groundwater conditions as part of a GSP, the GSA shall describe a schedule for acquiring monitoring wells with the necessary information or demonstrate to the DWR that such information is not necessary to understand and manage groundwater in the basin (23 CCR § 352.4 (c)(2)). As shown on Chart 4, approximately 61% of the reviewed GSPs include well depths of the proposed monitoring network.

Model GSP Elements

As an example, the Madera Subbasin Joint GSP includes detailed well construction information for all monitoring wells.[32] Average well depths of the monitoring wells are included in Table 3-4 in Section 3 of the GSP, together with well type, top and bottom well screen interval, and aquifer designation for each monitoring well.

5.2 Does the GSP Overlay Monitoring Wells with DACs and GDEs to Identify Potential Impacted Areas?

Based on 23 CCR § 354.34 (b)(2), the monitoring network objectives shall be implemented to "Monitor impacts to the beneficial uses or users of groundwater." GSAs shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon "Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal" (23 CCR § 354.34 (f)(3)).

As shown on Chart 4, only approximately 10% of GSPs reviewed provide maps that overlay monitoring well locations with the locations of DACs and GDEs to clearly identify potentially impacted areas. Mapping this information is necessary for the public and DWR to be able to assess whether the monitoring network is adequate to monitor potential impacts to the beneficial users of groundwater per 23 CCR § 354.34 (b)(2). Because these users are not explicitly considered in developing the monitoring network, the concern is that impacts will continue to be unreported or under-reported.

Model GSP Elements

The Madera Subbasin Joint GSP provides maps that clearly overlay the locations of proposed monitoring wells with DACs and GDEs (Figures 3-1 and 3-2).[33] DACs are identified on maps of monitoring wells in the basin, and average well depths of the monitoring wells are included in Table 3-4 in Section 3 of the GSP, which can be cross-referenced with information regarding DAC wells. According to the GSP, two of the monitoring wells were moved closer to the communities of Fairmead and La Vina (both DACs) in response to feedback from stakeholders. Along with existing monitoring wells, the two proposed monitoring wells that were relocated will provide information regarding the effects of GSP implementation on DACs and allow the GSA to proactively monitor and respond to potential Undesirable Results affecting these vulnerable beneficial users.

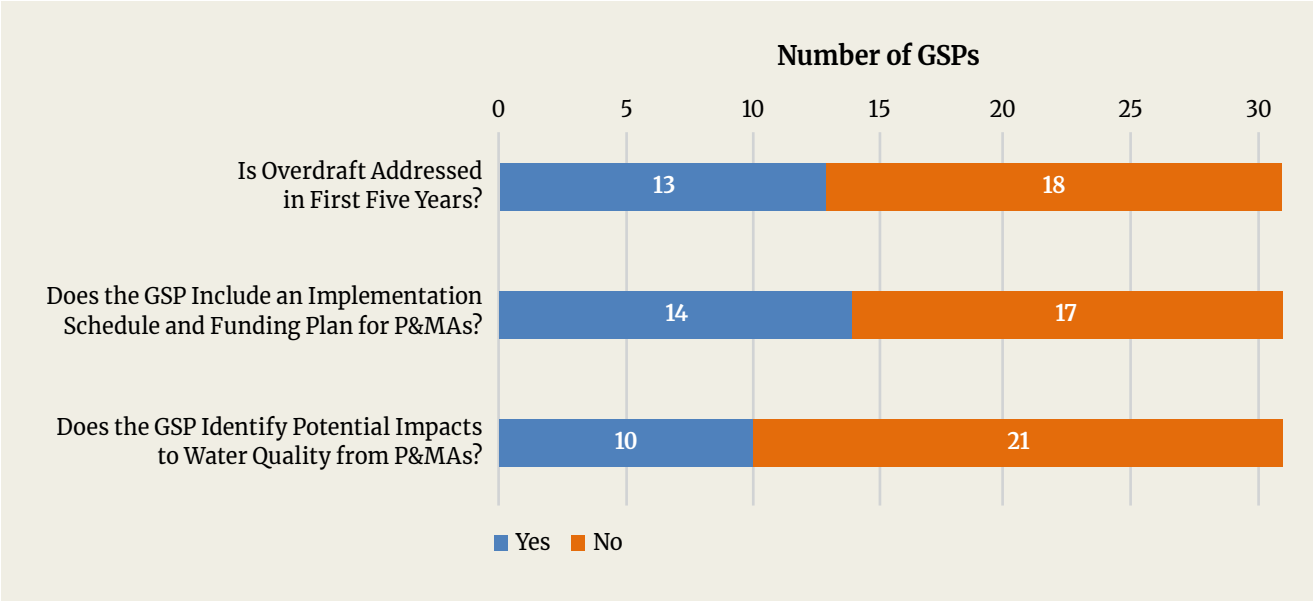
5.3 Does the GSP Include a Plan to Identify and Fill Data Gaps in the Monitoring Network?

"Each GSA shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency" (23 CCR § 354.34 (b)). "If the monitoring network contains data gaps, the Plan shall include a description of the following: (1) The location and reason for data gaps in the monitoring network. (2) Local issues and circumstances that limit or prevent monitoring" (23 CCR § 354.34 (C)). As shown on Chart 4, approximately 90% of the GSPs reviewed include a plan to identify and fill data gaps in the monitoring network. However, it is noted that the proposed plans to fill data gaps identified in the GSPs were often: (1) not very specific as to the locations of proposed new monitoring wells or points, and (2) often did not specifically address data gaps affecting the ability to monitor conditions for DACs and/or GDEs. As noted above, the Madera Subbasin Joint GSP does include a clear plan to fill monitoring data gaps specific to DACs.

6. Projects and Management Actions

Results of our organizations' assessment of projects and management actions in reviewed GSPs are summarized in Chart 5 below. Findings are discussed in detail in the following sections.

Chart 5. Projects and Management Actions



6.1 Is Overdraft Addressed in First Five Years?

23 CCR § 354.44 (b)(2) requires that "If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft."

In order to evaluate a GSP's plan to address overdraft in the first five years of GSP implementation, we reviewed the projects identified in the GSP, including the estimated yield and funding source for each project, but did not review the feasibility of the projects or question the yield assumptions or issues of water rights. If funding sources were not yet identified, we assumed that the project was unlikely to occur in the first five years of plan implementation; if funding was secured or a funding source identified, we assumed that the project would be implemented by 2025. If the quantified benefits of projects with identified funding sources would address at least approximately 25% of the identified overdraft of the basins, the GSP was considered to adequately address overdraft in the first five years of GSP implementation. As shown on Chart 5, based on this assessment, 13 GSPs (approximately 42% of those reviewed) include a plan to address overdraft in the first five years.

Model GSP Elements

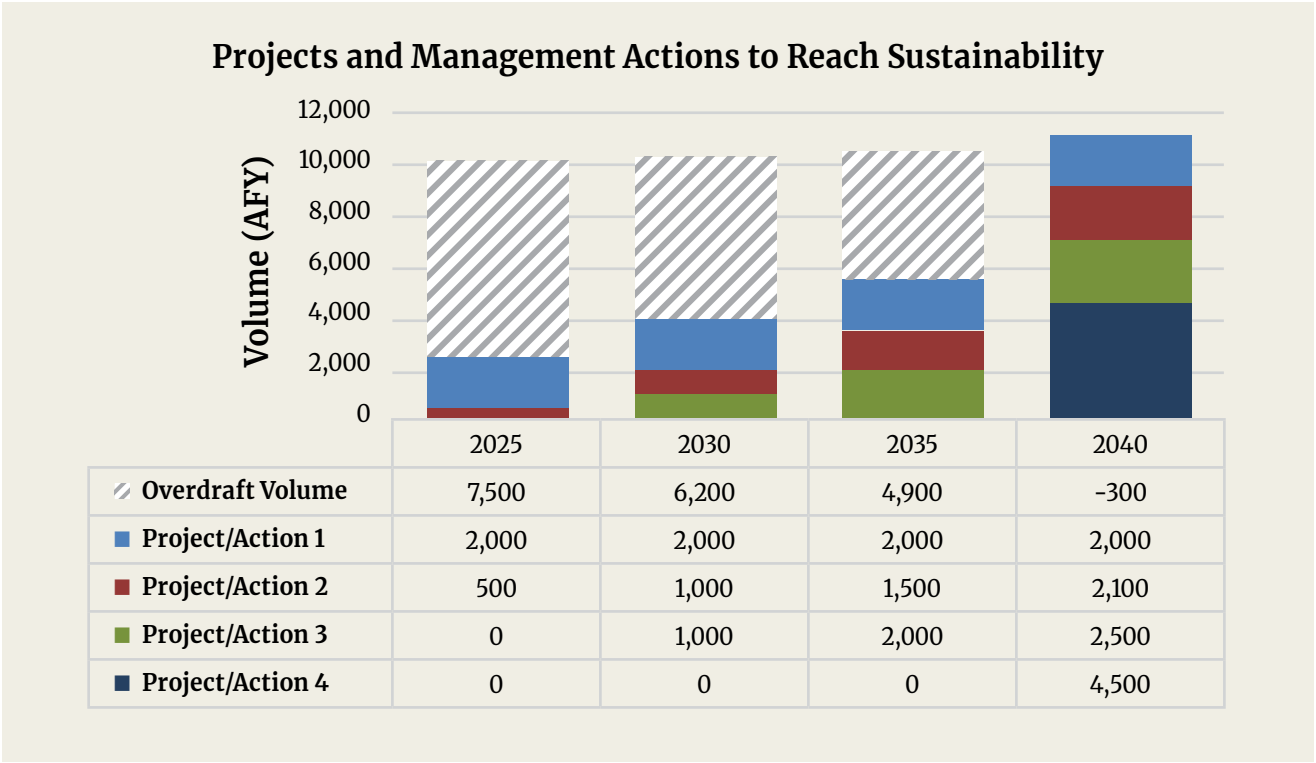
The Greater Kaweah GSP includes sixteen projects and management actions with identified funding sources, which total an estimated benefit of 15,860 acre-feet per year (AFY), or 46% of the estimated 34,600 AFY overdraft.[34]

6.2 Does the GSP Include an Implementation Schedule and Funding Plan for Projects and Management Actions?

The GSP shall include status of each project and management action, including a timetable for expected initiation and completion, the accrual of expected benefits (23 CCR § 354.44 (b)(4)), a description of the estimated cost for each project and management action, and a description of how the Agency plans to meet those costs (23 CCR § 354.44 (b)(8)).

Based on our review, proposed projects and management actions are often ill-defined in GSPs, and do not clearly identify: (1) a quantification of the anticipated benefits, (2) a clear timeframe for project implementation and realization of benefits, (3) a clear funding source, and/or (4) a description of benefits specific to sensitive beneficial users including drinking water users and GDEs. For GSPs that include numerical models, it is particularly helpful to model the implementation of the proposed projects and management actions and to evaluate and present the effects (ability to reduce overdraft conditions) on the basin over time. As shown on Chart 5, 14 GSPs (approximately 45%) include an implementation schedule and funding plan for projects and management actions.

Ideally, GSPs should quantify the anticipated reduction in overdraft volume in five-year increments through the implementation period as a result of the implementation of projects and management actions, and other conditions. However, during our review we did not identify any GSPs that presented this information clearly and transparently. The actual overdraft reduction benefit for many projects and management actions were not quantified and/or the anticipated timeline for realization of these benefits were not articulated. Below is an example of a simple illustration that could be used to effectively illustrate how a GSA's suite of projects and management actions is anticipated to reduce overdraft overtime and reach sustainability by 2040.



	2025	2030	2035	2040
Overdraft Volume	7,500	6,200	4,900	-300
Project/Action 1	2,000	2,000	2,000	2,000
Project/Action 2	500	1,000	1,500	2,100
Project/Action 3	0	1,000	2,000	2,500
Project/Action 4	0	0	0	4,500

6.3 Does the GSP Identify Potential Impacts to Water Quality from Projects and Management Actions?

Based on our review, the most commonly identified supply augmentation projects are recharge projects. While groundwater recharge projects will be an essential part of groundwater sustainability, recharge projects have the potential to mobilize contaminants, including by mobilizing surface and shallow soil contaminants through percolation, spreading existing contaminant plumes by altering the groundwater flow gradient, and mobilizing naturally occurring compounds through changes in geochemistry due to the introduction of a different water type, among other mechanisms. As recommended in the 2019 Stanford *A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act*, "In addition to complying with any regulatory requirements, GSAs undertaking recharge or other active management actions should consider developing a sufficient understanding of the interactions between subsurface geology, geochemistry and GSP projects in their basin. The development of sufficient monitoring networks, capable of detecting changes in groundwater quality conditions related to active management, will be critical to understanding these interactions."[35,36]

The State Water Resources Control Board clarified a GSA's responsibility with regard to water quality, stating that "Water Code Section 10727.2 and the GSP regulations require GSAs to characterize the groundwater quality and identify undesirable results associated with groundwater quality in the GSPs for their basin. In addition, any projects or management actions adopted by a GSA within their GSPs should not cause degradation of water quality that could lead to an undesirable result" and that "It is the responsibility of a GSA to ensure that its management of groundwater conditions in the basin and any other action taken by the GSA will not significantly and unreasonably degrade water quality."[37]

However, despite the fact that groundwater recharge projects can have potential negative impacts to water quality which could cause Undesirable Results particularly to drinking water beneficial users, as shown on Chart 5, only 10 of the GSPs (approximately 32%) identify potential impacts to water quality from projects and management actions. Including an analysis of potential water quality impacts is important for both DWR and public stakeholders to be able to understand the potential effects on beneficial users (particularly DAC drinking water users relying on domestic wells or small water systems with limited water treatment facilities); and for the GSAs to be able include appropriate monitoring and mitigation aspects in their project development plans; and to be sure that GSAs are including total project costs in their funding plans.

Model GSP Elements

One example of a GSP that addressed potential water quality impacts associated with recharge projects is the Mid-Kaweah GSP.[38] Specifically, this GSP includes two projects (Cordeniz Recharge Basin, Section 7.3.1; Okieville Recharge Basin, Section 7.3.2) that include installation of monitoring wells to evaluate changes to water quality resulting from project implementation. The GSP notes that both projects are expected to result in water quality benefits; however, such monitoring will also be able to identify further water quality degradation, if any.

7. Conclusion

Our organizations' collective review of 31 GSPs for critically overdrafted basins has identified areas where GSPs frequently did not adequately meet the regulatory requirements to consider drinking water (particularly for DACs) and environmental beneficial users. This document summarizes our findings and recommendations for how to ensure adequacy in future GSPs, and examples of where some GSPs addressed aspects of these issues well. It is our hope that this analysis will serve to inform and improve the development of GSPs for non-critically overdrafted basins, as well as to inform opportunities for improvement in five-year assessments of the GSPs in critically overdrafted basins.

In addition to the ways the GSPs can be improved, discussed above, we have identified a list of elements related to drinking water and environmental users that GSAs should focus on in their five-year assessments, and, to the extent appropriate, annual reports.

Disadvantaged Communities and Drinking Water

- Conduct thorough and ongoing engagement of disadvantaged communities in plan update and implementation.
- Include an update summarizing the stakeholder engagement conducted over the reporting period, as well as a thorough identification of all stakeholders.
- Improve data on drinking water users, including well surveys, to improve available information on active well locations and screening levels.
- Include analysis of potential impacts of projects and management actions on water quality and drinking water users, especially DACs and small water systems.
- Detail demand management strategies, including funding, and evaluate impacts to drinking water wells.

The Environment and Groundwater

- Conduct thorough and ongoing engagement of environmental stakeholders in plan update and implementation.
- Include an update summarizing the stakeholder engagement conducted over the reporting period, as well as a thorough identification of all stakeholders.
- Monitor potential GDEs, interconnected surface waters, and managed wetlands to improve data on environmental beneficial users.
- Evaluate the potential impacts of projects and management actions on interconnected surface waters, GDEs and managed wetlands.
- Re-evaluate sustainable management criteria based on analysis of interconnected surface waters, GDEs, and managed wetlands.
- Detail demand management strategies, including funding, and evaluate impacts to interconnected surface waters, GDEs, and managed wetlands.

Climate Change

- Incorporate climate change projections into all elements of the future water budget, including both the DWR-provided 2030 and 2070 climate scenarios and extremely wet and dry conditions.
- Incorporate climate change projections into plans for projects and management actions and adjust implementation of these actions accordingly.

7.1 GSAs would Benefit from Clear DWR Data and Guidance

In cases where clear DWR guidance has been available, such as development of stakeholder outreach documents (SCEPs) and incorporation of climate change into water budgets, GSAs generally follow these guidance documents well. Guidance documents prepared by third party non-governmental organizations (such as The Nature Conservancy's *Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act* guidance and Stanford's *A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act* guidance) are helpful, but generally not followed as closely as those from DWR. We therefore believe that GSAs would benefit from clear DWR data and guidance on how to address drinking water users (particularly DACs) and environmental users throughout the GSP development process, in particular with the development of data and guidance ensuring the full consideration of the interests of these beneficial users in the development of sustainable management criteria and undesirable results. Guidance could include details on how to document and analyze historical and current groundwater quality conditions, particularly with respect to drinking water users, clarification on the design of monitoring networks that can monitor impacts to these beneficial users of groundwater, and expectations of information and analyses to be included in annual reports and five-year assessments.

Notes

1 Comment letters can be found on the DWR SGMA Portal: All Submitted GSPs: https://sgma.water.ca.gov/portal/gsp/all

2 Leadership Counsel, Self-Help Enterprises, Community Water Center, Re: Reviewing Groundwater Sustainability Plans In Accordance With State Agency Obligations to Consider the Human Right to Drinking Water, February 10th, 2020, found at https://leadershipcounsel.org/wp-content/uploads/2020/05/HR2W-Letter-Scorecard.pdf

3 The Nature Conservancy. SGMA Signals: Managing Groundwater for Nature. https://groundwaterresourcehub.org

4 DWR Guidance Document for Groundwater Sustainability Plan: Stakeholder Communication and Engagement: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Assistance-and-Engagement/Files/Guidance-Doc-for-GSP---Stakeholder-Communication-and-Engagement.pdf

5 Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation: https://static1.squarespace.com/static/5e83c5f78f0db40cb837cfb5/t/5f3ca8c136dbe60157dd5664/1597810892937/SGMA_Stakeholder_Engagement_White_Paper.pdf

6 DWR DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/

7 Eastern San Joaquin: https://sgma.water.ca.gov/portal/gsp/preview/47

8 East Kaweah: https://sgma.water.ca.gov/portal/gsp/preview/58

9 Natural Communities Dataset Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/

10 The Nature Conservancy GDE Pulse: https://gde.codefornature.org/#/map

11 Domestic Well Vulnerability to Drought Duration and Unsustainable Groundwater Management in California's Central Valley: https://iopscience.iop.org/article/10.1088/1748-9326/ab6f10/pdf

12 Kings River East GSP: https://sgma.water.ca.gov/portal/gsp/preview/23

13 While this analysis was performed, it is noted that we believe some of the assumptions used in the analysis would significantly underestimate the number of impacted wells. In particular, this analysis excludes all wells constructed prior to 1990 on the basis that these wells would be 50 years old or more in 2040. Therefore, this analysis does not (1) consider impacts to wells less than 50 years old that would occur prior to 2040, or (2) provide evidence to substantiate the assumption that a well over 50 years would not be used.

14 Overpumping Leads to California Groundwater Arsenic Threat, Smith, Ryan et al.: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5988660/

15 Effects of Groundwater Development on Uranium: Central Valley, California, USA. B.C. Jurgens, et al.,: https://ca.water.usgs.gov/pubs/2010/JurgensEtAl2010.pdf

16 A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act: https://stacks.stanford.edu/file/druid:dw122nb4780/A%20Guide%20to%20Water%20Quality%20Requirements%20under%20SGMA.pdf

17 Protecting Groundwater Quality in California: Management Considerations for Avoiding Naturally Occurring and Emerging Contaminants, Fakhreddine et al., 2019: https://www.edf.org/sites/default/files/documents/groundwater-contaminants-report.pdf

18 California GAMA Priority Basin Project: Trends in water-quality for inorganic constituents in California public-supply wells (1st ed.), D.I. Dupuy, Nguyen, D.H., and Jurgens, B.C.: https://ca.water.usgs.gov/projects/gama/public-well-water-quality-trends/

19 Identifying areas of degrading and improving groundwater-quality conditions in the State of California, USA, 1974–2014. Environ Monit Assess 192, 250: https://doi.org/10.1007/s10661-020-8180-y

20 DWR Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Climate-Change-Guidance_Final_ay_19.pdf

21 The Northern and Central Delta-Mendota Regions GSP: https://sgma.water.ca.gov/portal/gsp/preview/13

22 DWR Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Climate-Change-Guidance_Final_ay_19.pdf

23 Grassland GSA GSP: https://sgma.water.ca.gov/portal/gsp/preview/38

24 Leadership Counsel, Self-Help Enterprises, Community Water Center, Re: Reviewing Groundwater Sustainability Plans In Accordance With State Agency Obligations to Consider the Human Right to Drinking Water, February 10th, 2020, found at https://leadershipcounsel.org/wp-content/uploads/2020/05/HR2W-Letter-Scorecard.pdf

25 DWR Guidance Document for Groundwater Sustainability Plan: Stakeholder Communication and Engagement: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Assistance-and-Engagement/Files/Guidance-Doc-for-GSP---Stakeholder-Communication-and-Engagement.pdf Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation: https://static1.squarespace.com/static/5e83c5f78f0db40cb837cfb5/t/5f3ca8c136dbe60157dd5664/1597810892937/SGMA_Stakeholder_Engagement_White_Paper.pdf

26 Communication & Engagement Digital Toolkit: https://water.ca.gov/Programs/Groundwater-Management/Assistance-and-Engagement

27 DACs that are also public water systems have standing to participate in GSA governance

28 Chowchilla Subbasin GSP: https://sgma.water.ca.gov/portal/gsp/preview/12

29 Leadership Counsel for Justice and Accountability and Self-Help Enterprises received funding through a technical assistance grant from DWR to provide the described outreach.

30 Eastern Tule GSP: https://sgma.water.ca.gov/portal/gsp/preview/43

31 DWR Guidance Document for Groundwater Sustainability Plan: Stakeholder Communication and Engagement: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Assistance-and-Engagement/Files/Guidance-Doc-for-GSP---Stakeholder-Communication-and-Engagement.pdf

32 Madera Subbasin Joint GSP: https://sgma.water.ca.gov/portal/gsp/preview/21

33 Madera Subbasin Joint GSP: https://sgma.water.ca.gov/portal/gsp/preview/21

34 Greater Kaweah GSP: https://sgma.water.ca.gov/portal/gsp/preview/30

35 A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act: https://stacks.stanford.edu/file/druid:dw122nb4780/A%20Guide%20to%20Water%20Quality%20Requirements%20under%20SGMA.pdf

36 Protecting Groundwater Quality in California: Management Considerations for Avoiding Naturally Occurring and Emerging Contaminants, Fakhreddine et al., 2019: https://www.edf.org/sites/default/files/documents/groundwater-contaminants-report.pdf

37 SWRCB Sustainable Groundwater Management Act Water Quality Frequently Asked Questions: https://www.waterboards.ca.gov/water_issues/programs/gmp/docs/sgma/sgma_wtr_qual.pdf

38 Mid-Kaweah GSP: https://sgma.water.ca.gov/portal/gsp/preview/50