CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE
715 P Street, 8th Floor | Sacramento, CA 95814 | P.O. Box 942836 | Sacramento, CA 94236-0001

January 18, 2024

Chris Lee
Solano County Water Agency
801 Vaca Valley Parkway, Suite 203
Vacaville CA 95688
clee@scwa2.com

RE: Sacramento Valley – Solano Subbasin - 2022 Groundwater Sustainability Plan

Dear Chris Lee,

The Department of Water Resources (Department) has evaluated the groundwater sustainability plan (GSP or Plan) submitted for the Sacramento Valley – Solano Subbasin and has determined the GSP is approved. The approval is based on recommendations from the Staff Report, included as an exhibit to the attached Statement of Findings, which describes that the Solano Subbasin GSP satisfies the objectives of the Sustainable Groundwater Management Act (SGMA) and substantially complies with the GSP Regulations. The Staff Report also proposes recommended corrective actions that the Department believes will enhance the GSP and facilitate future evaluation by the Department. The Department strongly encourages the recommended corrective actions be given due consideration and suggests incorporating all resulting changes to the GSP in future updates.

Recognizing SGMA sets a long-term horizon for groundwater sustainability agencies (GSAs) to achieve their basin sustainability goals, monitoring progress is fundamental for successful implementation. GSAs are required to evaluate their GSPs at least every five years and whenever the Plan is amended, and to provide a written assessment to the Department. Accordingly, the Department will evaluate approved GSPs and issue an assessment at least every five years. The Department will initiate the first periodic review of the Solano Subbasin GSP no later than January 27, 2024.

Please contact Sustainable Groundwater Management staff by emailing sgmps@water.ca.gov if you have any questions related to the Department's assessment or implementation of your GSP.

Thank You,

Paul Gosselin

Paul Gosselin
Deputy Director
Sustainable Groundwater Management

Attachment:

1. Statement of Findings Regarding the Approval of the Sacramento Valley – Solano Subbasin Groundwater Sustainability Plan

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

STATEMENT OF FINDINGS REGARDING THE APPROVAL OF THE SACRAMENTO VALLEY – SOLANO SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

The Department of Water Resources (Department) is required to evaluate whether a submitted groundwater sustainability plan (GSP or Plan) conforms to specific requirements of the Sustainable Groundwater Management Act (SGMA or Act), is likely to achieve the sustainability goal for the basin covered by the Plan, and whether the Plan adversely affects the ability of an adjacent basin to implement its GSP or impedes achievement of sustainability goals in an adjacent basin. (Water Code § 10733.) The Department is directed to issue an assessment of the Plan within two years of its submission. (Water Code § 10733.4.) This Statement of Findings explains the Department's decision regarding the Plan submitted by the City of Vacaville GSA, Northern Delta GSA, Sacramento County GSA, Solano Irrigation District GSA, and Solano Subbasin GSA (GSAs or Agencies) for the Sacramento Valley – Solano Subbasin (Basin No. 5-021.66).

Department management has discussed the Plan with staff and has reviewed the Department Staff Report, entitled Sustainable Groundwater Management Program Groundwater Sustainability Plan Assessment Staff Report, attached as Exhibit A, recommending approval of the GSP. Department management is satisfied that staff have conducted a thorough evaluation and assessment of the Plan and concurs with staff's recommendation and all the recommended corrective actions. The Department therefore **APPROVES** the Plan and makes the following findings:

A. The Plan satisfies the required conditions as outlined in § 355.4(a) of the GSP Regulations (23 CCR § 350 et seq.):

    1. The Plan was submitted within the statutory deadline of January 31, 2022. (Water Code § 10720.7(a); 23 CCR § 355.4(a)(1).)

    2. The Plan was complete, meaning it generally appeared to include the information required by the Act and the GSP Regulations sufficient to warrant a thorough evaluation and issuance of an assessment by the Department. (23 CCR § 355.4(a)(2).)

    3. The Plan, either on its own or in coordination with other Plans, covers the entire Subbasin. (23 CCR § 355.4(a)(3).)

B. The general standards the Department applied in its evaluation and assessment of the Plan are: (1) "conformance" with the specified statutory requirements, (2)

"substantial compliance" with the GSP Regulations, (3) whether the Plan is likely to achieve the sustainability goal for the Subbasin within 20 years of the implementation of the Plan, and (4) whether the Plan adversely affects the ability of an adjacent basin to implement its GSP or impedes achievement of sustainability goals in an adjacent basin. (Water Code § 10733.) Application of these standards requires exercise of the Department's expertise, judgment, and discretion when making its determination of whether a Plan should be deemed "approved," "incomplete," or "inadequate."

The statutes and GSP Regulations require Plans to include and address a multitude and wide range of informational and technical components. The Department has observed a diverse array of approaches to addressing these technical and informational components being used by GSAs in different basins throughout the state. The Department does not apply a set formula or criterion that would require a particular outcome based on how a Plan addresses any one of SGMA's numerous informational and technical components. The Department finds that affording flexibility and discretion to local GSAs is consistent with the standards identified above; the state policy that sustainable groundwater management is best achieved locally through the development, implementation, and updating of local plans and programs (Water Code § 113); and the Legislature's express intent under SGMA that groundwater basins be managed through the actions of local governmental agencies to the greatest extent feasible, while minimizing state intervention to only when necessary to ensure that local agencies manage groundwater in a sustainable manner. (Water Code § 10720.1(h)) The Department's final determination is made based on the entirety of the Plan's contents on a case-by-case basis, considering and weighing factors relevant to the particular Plan and Subbasin under review.

B. In making these findings and Plan determination, the Department also recognized that: (1) the Department maintains continuing oversight and jurisdiction to ensure the Plan is adequately implemented; (2) the Legislature intended SGMA to be implemented over many years; (3) SGMA provides Plans 20 years of implementation to achieve the sustainability goal in a Subbasin (with the possibility that the Department may grant GSAs an additional five years upon request if the GSA has made satisfactory progress toward sustainability); and, (4) local agencies acting as GSAs are authorized, but not required, to address undesirable results that occurred prior to enactment of SGMA. (Water Code §§ 10721(r); 10727.2(b); 10733(a); 10733.8.)

C. The Plan conforms with Water Code §§ 10727.2 and 10727.4, substantially complies with 23 CCR § 355.4, and appears likely to achieve the sustainability goal for the Subbasin. It does not appear at this time that the Plan will adversely affect the ability of adjacent basins to implement their GSPs or impede achievement of sustainability goals.

1. The sustainable management criteria, which generally aim to maintain groundwater levels near recent historical averages and limit groundwater level declines to their historic low values, is reasonable. The Plan describes how the Subbasin is already sustainable with no historical undesirable results, and sustainable management criteria were developed to maintain sustainability. By maintaining groundwater levels near historical averages, the potential for basin-wide impacts to other sustainability indicators resulting from groundwater management activities is also unlikely. Overall, sustainable management criteria are sufficiently justified and explained. While some recommended corrective actions related to sustainable management criteria are identified, groundwater level and storage conditions in the Subbasin are generally stable based on the information included in the GSP, so the recommended corrective actions do not preclude plan approval. The Plan relies on credible information and science such as long-term groundwater level data, a reasonable understanding of aquifer properties, and an updated groundwater model to quantify the groundwater conditions that the Plan seeks to avoid and provides an objective way to determine whether the Subbasin is being managed sustainably in accordance with SGMA. (23 CCR § 355.4(b)(1).)

2. The Plan identified and provided reasonable measures to eliminate data gaps, including the evaluation of remote sensing datasets to help identify groundwater dependent ecosystems, and the construction of new monitoring wells to enhance data collection and better characterize Subbasin groundwater conditions. (23 CCR § 355.4(b)(2).)

3. The projects and management actions described by the Plan are designed to help the Subbasin maintain sustainable through adaptive management. The Plan describes that projects and management actions are not currently needed to maintain sustainability because the Subbasin is already sustainable and projected to be sustainable in the future. The projects and management actions are reasonable and commensurate with the level of understanding of the Subbasin setting. The projects and management actions described in the Plan provide a feasible approach to achieving the Subbasin's sustainability goal and should provide the GSAs with greater versatility to adapt and respond to changing conditions and future challenges during GSP implementation. (23 CCR § 355.4(b)(3).)

4. The Plan provides a detailed explanation of how the varied interests of some of the groundwater uses and users in the Subbasin were considered in developing the sustainable management criteria and how those interests, including domestic, municipal, and agricultural well owners

would be impacted by the chosen minimum thresholds. (23 CCR § 355.4(b)(4).)

5. The Plan's projects and management actions appear feasible at this time and appear capable of preventing undesirable results, addressing localized issues, and ensuring that the Subbasin continues to be operated within its sustainable yield during the 20-year implementation period and beyond. The Department will continue to monitor Plan implementation and reserves the right to change its determination if projects and management actions are not implemented or appear unlikely to prevent undesirable results or achieve sustainability within SGMA timeframes. (23 CCR § 355.4(b)(5).)

6. The Plan includes a reasonable assessment of overdraft conditions and includes reasonable means to mitigate overdraft. (23 CCR § 355.4(b)(6).)

7. At this time, it does not appear that the Plan will adversely affect the ability of an adjacent basin to implement its GSP or impede achievement of sustainability goals in an adjacent basin. The Plan states that changes in inflows and outflows between adjacent basins are not expected to adversely affect the ability of the adjacent subbasins to achieve or maintain sustainability compared to historical conditions. The Plan describes how the geology and hydrogeology of the Subbasin limit impacts to adjacent Subbasins to the south, southeast, and west. Additionally, the Plan states that minimum thresholds were developed in cooperation with the adjacent Yolo Subbasin to the north and east. (23 CCR § 355.4(b)(7).)

8. Because a single plan was submitted for the Subbasin, a coordination agreement was not required. (23 CCR § 355.4(b)(8).)

9. The GSAs and their member agencies have a history of groundwater and surface water management in the Subbasin, which provides a reasonable level of confidence that the GSAs have the legal authority and financial resources necessary to implement the Plan. (23 CCR § 355.4(b)(9).)

10. Through review of the Plan and consideration of public comments, the Department determines that the GSAs adequately responded to comments that raised credible technical or policy issues with the Plan, sufficient to warrant approval of the Plan at this time. The Department also notes that the recommended corrective actions included in the Staff Report are important to addressing certain technical or policy issues that were raised and, if not addressed before future, subsequent plan evaluations, may preclude approval of the Plan in those future evaluations. (23 CCR § 355.4(b)(10).)

D. In addition to the grounds listed above, DWR also finds that:

1. The Department developed its GSP Regulations consistent with and intending to further the State's human right to water policy through implementation of SGMA and the Regulations, primarily by achieving sustainable groundwater management in a basin. By ensuring substantial compliance with the GSP Regulations, the Department has considered the state policy regarding the human right to water in its evaluation of the Plan. (Water Code § 106.3; 23 CCR § 350.4(g).)

2. The Plan acknowledges and identifies interconnected surface waters within the Subbasin. The GSAs proposes initial sustainable management criteria to manage this sustainability indicator and measures to improve understanding and management of interconnected surface water. The GSAs acknowledge, and the Department agrees, many data gaps related to interconnected surface water exist. The GSAs should continue filling data gaps, collecting additional monitoring data, and coordinating with resources agencies and interested parties to understand beneficial uses and users that may be impacted by depletions of interconnected surface water caused by groundwater pumping. Future periodic evaluations of the Plan and amendments to the Plan should aim to improve the initial sustainable management criteria as more information and improved methodology becomes available.

3. The basin is not currently in a state of long-term overdraft and projections of future basin extractions are likely to stay within current and historic ranges, at least until the next periodic evaluation by the GSA and the Department. Basin groundwater levels and other SGMA sustainability indicators are unlikely to deteriorate while the GSA implements the Department's recommended corrective actions. State intervention is not necessary at this time to ensure that local agencies manage groundwater in a sustainable manner. (Wat. Code § 10720.1(h).).

4. The California Environmental Quality Act (Public Resources Code § 21000 *et seq*.) does not apply to the Department's evaluation and assessment of the Plan.

Accordingly, the GSP submitted by the Agencies for the Sacramento Valley – Solano Subbasin is hereby **APPROVED.** The recommended corrective actions identified in the Staff Report will assist the Department's future review of the Plan's implementation for consistency with SGMA and the Department therefore recommends the Agencies address them by the time of the Department's periodic review, which is set to begin on January 27, 2027, as required by Water Code § 10733.8. Failure to address the Department's recommended corrective actions before future, subsequent plan evaluations, may lead to a Plan being determined incomplete or inadequate.

Signed:

Karla Nemeth

Karla Nemeth, Director
Date: January 18, 2024

Exhibit A: Groundwater Sustainability Plan Assessment Staff Report – Sacramento Valley – Solano Subbasin

State of California
Department of Water Resources
Sustainable Groundwater Management Program
Groundwater Sustainability Plan Assessment
Staff Report

Groundwater Basin Name:	Sacramento Valley – Solano Subbasin (No. 5-021.66)
Submitting Agency:	City of Vacaville Groundwater Sustainability Agency, Northern Delta Groundwater Sustainability Agency, Sacramento County Groundwater Sustainability Agency, Solano Subbasin Groundwater Sustainability Agency, and Solano Irrigation District Groundwater Sustainability Agency
Submittal Type:	Initial GSP Submission
Submittal Date:	January 27, 2022
Recommendation:	Approved
Date:	January 18, 2024

The City of Vacaville Groundwater Sustainability Agency (GSA), Northern Delta GSA, Sacramento County GSA, Solano Subbasin GSA, and Solano Irrigation District GSA (collectively referenced to as the GSAs or Agencies) submitted the Solano Subbasin Groundwater Sustainability Plan (GSP or Plan) for the Sacramento Valley – Solano Subbasin (Subbasin) to the Department of Water Resources (Department) for evaluation and assessment as required by the Sustainable Groundwater Management Act (SGMA)[1] and GSP Regulations.[2] The GSP covers the entire Subbasin for the implementation of SGMA.[3]

After evaluation and assessment, Department staff conclude that the Plan includes the required components of a GSP, demonstrates a thorough understanding of the Subbasin based on what appears to be the best available science and information, sets well explained, supported, and reasonable sustainable management criteria to prevent undesirable results as defined in the Plan, and proposes a set of projects and

[1] Water Code § 10720 *et seq*.
[2] 23 CCR § 350 *et seq*.
[3] Evaluations of Groundwater Sustainability Plans by the Department of Water Resources' Sustainable Groundwater Management Office focus solely on the relevant requirements of SGMA and the GSP Regulations. This GSP covers parts of the Sacramento-San Joaquin Rivers Delta, an area with numerous legal and regulatory regimes affecting land use, surface flows, water rights, and water quality. Nothing in this staff report constitutes an express or implied endorsement by the Department of any statements or theories in the GSP involving ownership, obligations, or liabilities regarding land use, surface flows, water rights, or water quality in the Delta, and the Department's GSP assessments and determinations cannot be used in other forums or proceedings to support or oppose arguments or positions regarding these issues. (See Water Code §§ 10720.5(b) and (c); 10738).

management actions that will likely achieve the sustainability goal defined for the Subbasin.[4] Department staff will continue to monitor and evaluate the Subbasin's progress toward achieving the sustainability goal through annual reporting and future periodic evaluations of the GSP and its implementation.

- ***Based on the current evaluation of the Plan, Department staff recommend the GSP be approved with the recommended corrective actions described herein.***

This assessment includes five sections:

- **Section 1 – Summary:** Provides an overview of Department staff's assessment and recommendations.
- **Section 2 – Evaluation Criteria:** Describes the legislative requirements and the Department's evaluation criteria.
- **Section 3 – Required Conditions:** Describes the submission requirements, Plan completeness, and basin coverage required for a GSP to be evaluated by the Department.
- **Section 4 – Plan Evaluation:** Provides an assessment of the contents included in the GSP organized by each Subarticle outlined in the GSP Regulations.
- **Section 5 – Staff Recommendation:** Includes the staff recommendation for the Plan and any recommended or required corrective actions, as applicable.

1 SUMMARY

Department staff recommend approval of the Solano Subbasin GSP. The GSAs have identified areas for improvement of their Plan (such as addressing data gaps in the groundwater level, groundwater quality, and interconnected surface water monitoring networks). Department staff concur that those items are important and recommend the GSAs address them as soon as possible. Department staff have also identified additional recommended corrective actions within this assessment that the GSAs should consider addressing by the first periodic evaluation of the Plan. The recommended corrective actions generally focus on the following:

(1) Revising the definition of undesirable results for degraded water quality so that exceedances of minimum thresholds caused by groundwater extraction, whether the GSAs have implemented pumping regulations or not, is considered in the assessment of undesirable results.

(2) Revising the sustainable management criteria for land subsidence.

(3) Continuing to fill data gaps, collecting additional monitoring data, coordinating with resource agencies and interested parties to understand beneficial uses and users

[4] 23 CCR § 350 *et seq*.

of groundwater that may be impacted by depletions of interconnected surface water caused by groundwater pumping, and potentially refine sustainable management criteria.

Addressing the recommended corrective actions identified in Section 5 of this assessment will be important to demonstrate, on an ongoing basis, that implementation of the Plan is likely to achieve the sustainability goal.

2 EVALUATION CRITERIA

The GSAs submitted a single GSP to the Department to evaluate whether it conforms to specified SGMA requirements[5] and is likely to achieve the sustainability goal for the Solano Subbasin.[6] To achieve the sustainability goal for the Subbasin, the GSP must demonstrate that implementation of the Plan will lead to sustainable groundwater management, which means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.[7] Undesirable results must be defined quantitatively by the GSAs.[8] The Department is also required to evaluate whether the GSP will adversely affect the ability of an adjacent basin to implement its GSP or achieve its sustainability goal.[9]

For the GSP to be evaluated by the Department, it must first be determined that the Plan was submitted by the statutory deadline,[10] and that it is complete and covers the entire basin.[11] If these conditions are satisfied, the Department evaluates the Plan to determine whether it complies with specific SGMA requirements and substantially complies with the GSP Regulations.[12] Substantial compliance means that the supporting information is sufficiently detailed and the analyses sufficiently thorough and reasonable, in the judgment of the Department, to evaluate the Plan, and the Department determines that any discrepancy would not materially affect the ability of the Agency to achieve the sustainability goal for the basin, or the ability of the Department to evaluate the likelihood of the Plan to attain that goal.[13]

When evaluating whether the Plan is likely to achieve the sustainability goal for the Subbasin, Department staff reviewed the information provided and relied upon in the GSP for sufficiency, credibility, and consistency with scientific and engineering professional standards of practice.[14] The Department's review considers whether there is a reasonable relationship between the information provided and the assumptions and conclusions made by the GSA, including whether the interests of the beneficial uses and users of groundwater in the basin have been considered; whether sustainable management criteria and projects and management actions described in the Plan are commensurate with the level of understanding of the basin setting; and whether those projects and management actions are feasible and likely to prevent undesirable results.[15]

[5] Water Code §§ 10727.2, 10727.4.
[6] Water Code § 10733(a).
[7] Water Code § 10721(v).
[8] 23 CCR § 354.26 *et seq.*
[9] Water Code § 10733(c).
[10] 23 CCR § 355.4(a)(1).
[11] 23 CCR §§ 355.4(a)(2), 355.4(a)(3).
[12] 23 CCR § 350 *et seq.*
[13] 23 CCR § 355.4(b).
[14] 23 CCR § 351(h).
[15] 23 CCR §§ 355.4(b)(1), (3), (4), and (5).

The Department also considers whether the GSA has the legal authority and financial resources necessary to implement the Plan.[16]

To the extent overdraft is present in a basin, the Department evaluates whether the Plan provides a reasonable assessment of the overdraft and includes reasonable means to mitigate it.[17] The Department also considers whether the Plan provides reasonable measures and schedules to eliminate identified data gaps.[18] Lastly, the Department's review considers the comments submitted on the Plan and evaluates whether the GSA adequately responded to the comments that raise credible technical or policy issues with the Plan.[19]

The Department is required to evaluate the Plan within two years of its submittal date and issue a written assessment of the Plan.[20] The assessment is required to include a determination of the Plan's status.[21] The GSP Regulations define the three options for determining the status of a Plan: Approved,[22] Incomplete,[23] or Inadequate.[24]

Even when review indicates that the GSP satisfies the requirements of SGMA and is in substantial compliance with the GSP Regulations, the Department may recommend corrective actions.[25] Recommended corrective actions are intended to facilitate progress in achieving the sustainability goal within the basin and the Department's future evaluations, and to allow the Department to better evaluate whether the Plan adversely affects adjacent basins. While the issues addressed by the recommended corrective actions do not, at this time, preclude approval of the Plan, the Department recommends that the issues be addressed to ensure the Plan's implementation continues to be consistent with SGMA and the Department is able to assess progress in achieving the sustainability goal within the basin.[26] Unless otherwise noted, the Department proposes that recommended corrective actions be addressed by the submission date for the first periodic assessment.[27]

The staff assessment of the GSP involves the review of information presented by the GSA, including models and assumptions, and an evaluation of that information based on scientific reasonableness, including standard or accepted professional and scientific methods and practices. The assessment does not require Department staff to recalculate or reevaluate technical information provided in the Plan or to perform their own geologic

[16] 23 CCR § 355.4(b)(9).
[17] 23 CCR § 355.4(b)(6).
[18] 23 CCR § 355.4(b)(2).
[19] 23 CCR § 355.4(b)(10).
[20] Water Code § 10733.4(d); 23 CCR § 355.2(e).
[21] Water Code § 10733.4(d); 23 CCR § 355.2(e).
[22] 23 CCR § 355.2(e)(1).
[23] 23 CCR § 355.2(e)(2).
[24] 23 CCR § 355.2(e)(3).
[25] Water Code § 10733.4(d).
[26] Water Code § 10733.8.
[27] 23 CCR § 356.4 *et seq*.

or engineering analysis of that information. The staff recommendation to approve a Plan does not signify that Department staff, were they to exercise the professional judgment required to develop a GSP for the basin, would make the same assumptions and interpretations as those contained in the Plan, but simply that Department staff have determined that the assumptions and interpretations relied upon by the submitting GSA are supported by adequate, credible evidence, and are scientifically reasonable.

Lastly, the Department's review and approval of the Plan is a continual process. Both SGMA and the GSP Regulations provide the Department with the ongoing authority and duty to review the implementation of the Plan.[28] Also, GSAs have an ongoing duty to provide reports to the Department, periodically reassess their plans, and, when necessary, update or amend their plans.[29] The passage of time or new information may make what is reasonable and feasible at the time of this review to not be so in the future. The emphasis of the Department's periodic reviews will be to assess the progress toward achieving the sustainability goal for the basin and whether Plan implementation adversely affects the ability of adjacent basins to achieve their sustainability goals.

3 REQUIRED CONDITIONS

A GSP, to be evaluated by the Department, must be submitted within the applicable statutory deadline. The GSP must also be complete and must, either on its own or in coordination with other GSPs, cover the entire basin.

3.1 SUBMISSION DEADLINE

SGMA required basins categorized as high- or medium-priority and not subject to critical conditions of overdraft to submit a GSP no later than January 31, 2022.[30]

The GSAs submitted their Plan on January 27, 2022.

3.2 COMPLETENESS

GSP Regulations specify that the Department shall evaluate a GSP if that GSP is complete and includes the information required by SGMA and the GSP Regulations.[31]

The GSAs submitted an adopted GSP for the entire Subbasin. After an initial, preliminary review, Department staff found the GSP to be complete and appearing to include the

[28] Water Code § 10733.8; 23 CCR § 355.6.
[29] Water Code §§ 10728 *et seq.*, 10728.2.
[30] Water Code § 10720.7(a)(2).
[31] 23 CCR § 355.4(a)(2).

required information, sufficient to warrant a thorough evaluation by the Department.[32] The Department posted the GSP to its website on February 7, 2022.[33]

3.3 Basin Coverage

A GSP, either on its own or in coordination with other GSPs, must cover the entire basin.[34] A GSP that is intended to cover the entire basin may be presumed to do so if the basin is fully contained within the jurisdictional boundaries of the submitting GSAs.

The GSP intends to manage the entire Solano Subbasin and the jurisdictional boundary of the submitting GSAs fully contains the Subbasin.[35]

4 Plan Evaluation

As stated in Section 355.4 of the GSP Regulations, a basin "shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act." The Department's assessment is based on a number of related factors including whether the elements of a GSP were developed in the manner required by the GSP Regulations, whether the GSP was developed using appropriate data and methodologies and whether its conclusions are scientifically reasonable, and whether the GSP, through the implementation of clearly defined and technically feasible projects and management actions, is likely to achieve a tenable sustainability goal for the basin. The Department staff's evaluation of the likelihood of the Plan to attain the sustainability goal for the Subbasin is provided below.

4.1 Administrative Information

The GSP Regulations require each Plan to include administrative information identifying the submitting Agency, its decision-making process, and its legal authority;[36] a description of the Plan area and identification of beneficial uses and users in the Plan area;[37] and a description of the ability of the submitting Agency to develop and implement a Plan for that area.[38]

The GSP was developed by the Solano Collaborative, described in the Plan as "a group of GSAs, each having authority for portions of the Solano Subbasin, working through a

[32] The Department undertakes a preliminary completeness review of a submitted Plan under section 355.4(a) of the GSP Regulations to determine whether the elements of a Plan required by SGMA and the Regulations have been provided, which is different from a determination, upon review, that a Plan is "incomplete" for purposes of section 355.2(e)(2) of the Regulations.
[33] https://sgma.water.ca.gov/portal/gsp/preview/117.
[34] Water Code § 10727(b); 23 CCR § 355.4(a)(3).
[35] Solano Subbasin GSP, Section 1.3, pp. 104-109.
[36] 23 CCR § 354.6 *et seq*.
[37] 23 CCR § 354.8 *et seq*.
[38] 23 CCR § 354.6(e).

Collaboration Agreement in order to develop a GSP for the entire Solano Subbasin."[39] The GSAs that make up the Solano Collaborative include: the Solano Subbasin GSA, City of Vacaville GSA, Northern Delta GSA, Sacramento County GSA, and Solano Irrigation District GSA. The GSP identifies six other GSAs that "were at one time a part of the Northern Delta GSA and were contacted by the Solano Collaborative regarding their involvement in GSP development."[40] These GSAs include Reclamation District (RD) 3, RD 317, RD 407, RD 554, RD 556, and RD 2111. Department staff note that the GSP does not provide details on the level of involvement of these six GSAs or describe whether areas covered by these GSAs will be managed (with regard to GSP implementation) by agencies in the Solano Collaborative, or the GSAs themselves. Additionally, the GSP indicates that both RD 317 and RD 407 "resigned GSA status and joined Sacramento County GSA;"[41] however, Department staff cannot find confirmation that RD 317 has withdrawn its exclusive GSA notice.

The GSP provides the contact information for the five GSAs in the Solano Collaborative.[42] The Collaboration Agreement is included in Appendix 1B of the GSP.[43] The Collaboration Agreement defines and describes the organization, management structure, and legal authorities of the Solano Collaborative, including procedures and policies for decision making, meetings, voting, allocating costs, and other activities related to GSP development and GSP implementation in the Subbasin. The GSP also describes that a Community Advisory Committee, made up of non-GSA community members, and a Groundwater Sustainability Advisory Group, made up of GSA representatives, provide input and technical recommendations related to GSP development and implementation.[44]

The GSP includes a written description of the plan area, noting the Subbasin, located in the southern portion of the greater Sacramento Valley Groundwater Basin, is "adjacent to the Yolo Subbasin to the north and the east, the South American Subbasin to the east, the Eastern San Joaquin Subbasin to the southeast, the East Contra Costa Subbasin to the south, and the Suisun-Fairfield Groundwater Basin to the west."[45] The plan area covers the entire area within the Solano Subbasin boundary. The GSP states the Subbasin is 354,600 acres, with 79 percent in Solano County, 20 percent in Sacramento County and 1 percent in Yolo County.[46] The GSP's land use by area shows the Subbasin is dominated by agriculture and riparian or native, followed by urban.[47] Figure 1 displays a map of the plan area and the adjacent subbasins.

[39] Solano Subbasin GSP, Section 1.3.1, p 104.
[40] Solano Subbasin GSP, Section 1.3.1, p. 104.
[41] Solano Subbasin GSP, Appendix 2A, pp. 628-629.
[42] Solano Subbasin GSP, Section 1.3.2, p. 105.
[43] Solano Subbasin GSP, Appendix 1B, pp. 553-569.
[44] Solano Subbasin GSP, Section 1.2, pp. 103-104.
[45] Solano Subbasin GSP, Executive Summary, p. 47.
[46] Solano Subbasin GSP, Executive Summary, p. 47.
[47] Solano Subbasin GSP, Executive Summary, p. 47.

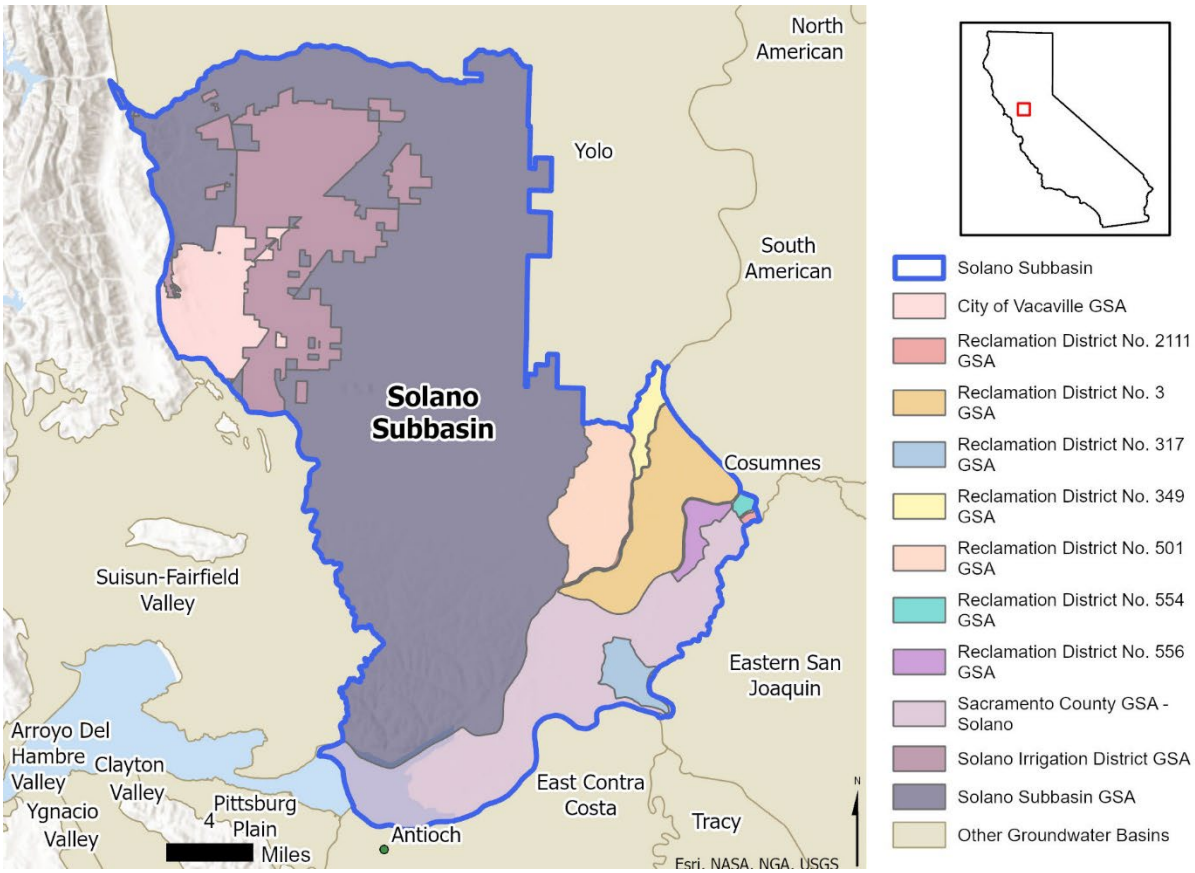

Figure 1: Solano Subbasin Location Map.

The GSP contains a Community Engagement Plan (CEP).[48] The GSP identifies beneficial uses and users of groundwater as: the Tribal Government of the Yocha Dehe Wintun Nation, community members, public water systems (including municipal water systems, small community water systems, state small water systems, non-transient/non-community water systems such as schools, transient non-community water systems, cal code water systems), commercial and industrial use, agricultural groundwater use, surface water users, environmental and ecosystems, drinking water well use, state land use, integrated regional water management, land use, and economic development.[49] The GSP states the purpose of the CEP is to positively contribute to the development of a GSP that incorporates the understanding, knowledge, and support of the Subbasin's diverse population and interests.[50]

Regarding GSP implementation costs the GSP states "[n]ot including the costs of [project and management action] implementation, the estimated annual Plan Implementation cost ranges from $405,500 to $553,000, with a five-year total of $2.58 million. The GSAs implementation cost is estimated to be $332,000 to $477,000, with a five-year total of

[48] Solano Subbasin GSP, Appendix 2a, pp. 648-662.
[49] Solano Subbasin GSP, Section 2.5.3, p. 165.
[50] Solano Subbasin GSP, Section 2.5.3, p. 164.

$1.8 million. The combined costs of GSP implementation and individual GSA costs will be a combined average of nearly $880,000 annually over the next five years. The GSA Collaborative, as well as individual GSAs, will continue to evaluate the assumptions used to estimate GSP activities and costs."[51] The Plan describes that funding sources for GSAs and other projects and management actions may include grants and loans, issuing bonds, and private funding or borrowing (including environmental easements).[52]

The administrative information included in the Plan substantially complies with the requirements outlined in the GSP Regulations. The GSP's discussion and presentation of administrative information covers the specific items listed in the GSP Regulations in an understandable format using appropriate detail. Department staff are aware of no significant inconsistencies or contrary information to that presented in the GSP and, therefore, have no significant concerns regarding the quality, data, and discussion of this subject in the GSP.

4.2 Basin Setting

GSP Regulations require information about the physical setting and characteristics of the basin and current conditions of the basin, including a hydrogeologic conceptual model; a description of historical and current groundwater conditions; and a water budget accounting for total annual volume of groundwater and surface water entering and leaving the basin, including historical, current, and projected water budget conditions.[53]

4.2.1 Hydrogeologic Conceptual Model

The hydrogeologic conceptual model is a non-numerical model of the physical setting, characteristics, and processes that govern groundwater occurrence within a basin, and represents a local agency's understanding of the geology and hydrology of the basin that support the geologic assumptions used in developing mathematical models, such as those that allow for quantification of the water budget.[54] The GSP Regulations require a descriptive hydrogeologic conceptual model that includes a written description of geologic conditions, supported by cross sections and maps,[55] and includes a description of basin boundaries and the bottom of the basin,[56] principal aquifers and aquitards,[57] and data gaps.[58]

[51] Solano Subbasin GSP, Executive Summary, p. 68.
[52] Solano Subbasin GSP, Acknowledgements, p. 2; Executive Summary, p. 69.
[53] 23 CCR § 354.12.
[54] DWR Best Management Practices for the Sustainable Management of Groundwater: Hydrogeologic Conceptual Model, December 2016: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-3-Hydrogeologic-Conceptual-Model_ay_19.pdf.
[55] 23 CCR §§ 354.14 (a), 354.14 (c).
[56] 23 CCR §§ 354.14 (b)(2-3).
[57] 23 CCR § 354.14 (b)(4) *et seq.*
[58] 23 CCR § 354.14 (b)(5).

The GSP describes that the Subbasin is within the southern Sacramento Valley portion of the larger Great Valley geologic province of California that is bounded by the Coast Range geologic province to the west and the Sierra Nevada geologic province to the east. The Subbasin's topography is described as relatively flat, with elevations ranging from 700 feet above sea level in the more northern and western areas of the Subbasin abutting the Coast Range to 20 feet below sea level in the southern part of the Subbasin near the Delta.[59]

The GSP describes that there are a series of faults and fault zones mapped in and around the Subbasin, the most notable being the north-southbound oriented Midland Fault Zone. The GSP states that the role of these faults as barriers or conduits for groundwater flow within the Subbasin is not clearly understood, although groundwater conditions in the interior of the Subbasin do not exhibit indications of faults exerting strong controls on groundwater occurrence or movement.[60] The Plan describes that freshwater-bearing sedimentary deposits in the Subbasin extend to depths of up to 3,000 feet, with the Cenozoic Tehama formation and overlying Quaternary sands and gravels providing much of the fresh groundwater available.[61] The GSP includes a map and figure depicting the geologic units and a generalized stratigraphic column of geologic formations.[62]

The GSP describes the Subbasin's physical and administrative boundaries, which are defined by Putah Creek on the north, the Yolo County line on the east, the North Mokelumne River on the southeast (from Walnut Grove to the San Joaquin River), and the San Joaquin River on the south (from the North Mokelumne River to the Sacramento River).[63] The western Subbasin boundary, which extends through a portion of Vacaville, is partly defined by the groundwater divide between the San Francisco Bay and Sacramento River Hydrologic Regions, roughly delineated by the English Hills and the Montezuma Hills.[64]

The GSP states the vertical extent of the Subbasin is considered to be the bottom of the fresh groundwater system, where freshwater is defined by a total dissolved solids (TDS) concentration threshold of 2,000 milligrams per liter (mg/L). The Plan provides a contour map displaying the estimated elevation of the base of freshwater across the Subbasin.[65] The Plan notes that, depending on the local hydrogeologic and geochemical conditions and the intended use for the water, higher salinity groundwater occurring below the freshwater interface can also be used for beneficial purposes.[66] Additionally, the Plan describes that the bottom of continental deposits located below the Tehama formation is considered the bottom of the potential groundwater resource (including higher salinity

[59] Solano Subbasin GSP, Section 3.1.1, p. 171; Figure 3-2, p.173; Appendix 3A, p. 1122.
[60] Solano Subbasin GSP, Section 3.1.2.1, p. 178; Appendix 3A, Figure 2-8, p. 1214.
[61] Solano Subbasin GSP, Section 3.1, p. 171.
[62] Solano Subbasin GSP, Figure 3.5A, p. 179; Figure 3.5B, p. 180.
[63] Solano Subbasin GSP, Section 3.1.2, p. 178.
[64] Solano Subbasin GSP, Section 3.2.1, p. 181.
[65] Solano Subbasin GSP, Figure 3-6, p. 182.
[66] Solano Subbasin GSP, Section 3.2.1, p. 181; Figure 3-6, p. 182.

water), although no known groundwater wells have penetrated below the Tehama formation and the water-yielding characteristics of the deepest continental deposits have not been evaluated.[67]

The GSP describes that the Subbasin consists of two primary aquifer zones: the upper zone, referred to as the Alluvial Aquifer and Upper Tehama zone, which consists of the Quaternary alluvium, Montezuma formation and Upper Tehama; and the lower zone, which is referred to as the Basal Tehama zone and consists solely of the Basal Tehama formation. The GSP describes that the geologic formations in the upper primary aquifer have similar hydrogeologic characteristics and behave as a hydraulically connected aquifer zone.[68] The middle zone of the Tehama formation, or Middle Tehama, is described as generally fine grained with only relatively thin sandy intervals of limited lateral extent. The GSP describes that the Middle Tehama does not serve as a major water-yielding unit and thereby functions as an aquitard throughout much of the Subbasin, confining the underlying Basal Tehama zone and limiting vertical movement of water between the shallower Alluvial Aquifer and Upper Tehama zone and the deeper Basal Tehama zone.[69] The Plan describes that the Basal Tehama zone is not utilized throughout the entire Subbasin, but is generally found at great depth and under confined conditions.[70] The Plan provides estimates of various aquifer properties, such as hydraulic conductivity, transmissivity, specific yield, and specific storage for the different geologic units. The GSP describes that the Alluvial Aquifer and Upper Tehama zone generally supplies groundwater for all beneficial uses and users and is where most of the groundwater production in the Subbasin occurs. The Basal Tehama zone is described as supplying groundwater mainly to municipal wells and is only utilized in some portions of the Subbasin.[71]

The GSP discusses data gaps related to the hydrogeologic conceptual model for the Subbasin. The GSP states that an improved understanding of some of the more complex hydrogeology along the northwestern edge of the Subbasin is needed as it relates to recharge sources and rates, aquifer storage and conductivity characteristics, and influences from groundwater development within the Subbasin and outside of the Subbasin.[72] The Plan also identifies the Montezuma Hills and southwestern portion of the Subbasin as areas where additional studies or monitoring could be beneficial to the understanding of the Subbasin's hydrogeology. Additionally, the Plan indicates that if considerable expansion of groundwater production from the Basal Tehama zone occurs, the need for additional characterization of this zone, especially as it relates to storage

[67] Solano Subbasin GSP, Section 3.2.2, p. 183; Figure 3-7, p. 184.
[68] Solano Subbasin GSP, Figure 3.5A, p. 179; Figure 3.5B, p. 180.
[69] Solano Subbasin GSP, Figure 3.5A, p. 179; Figure 3.5B, p. 180.
[70] Solano Subbasin GSP, Figure 3.5A, p. 179; Figure 3.5B, p. 180.
[71] Solano Subbasin GSP, Appendix 3A, Section 2.6, pp. 1127-1132.
[72] Solano Subbasin GSP, Section 3.2.4, p. 187.

characteristics and recharge source areas and rates, should be evaluated as a project management action.[73]

The information provided in the GSP that comprises the hydrogeologic conceptual model substantially complies with the requirements outlined in the GSP Regulations. In general, the Plan's descriptions of the regional geologic setting, the Subbasin's physical characteristics, the principal aquifer, and hydrogeologic conceptual model appear to utilize the best available science.

4.2.2 Groundwater Conditions

The GSP Regulations require a written description of historical and current groundwater conditions for each of the applicable sustainability indicators and groundwater dependent ecosystems that includes the following: groundwater elevation contour maps and hydrographs,[74] a graph depicting change in groundwater storage,[75] maps and cross-sections of the seawater intrusion front,[76] maps of groundwater contamination sites and plumes,[77] maps depicting total subsidence,[78] identification of interconnected surface water systems and an estimate of the quantity and timing of depletions of those systems,[79] and an identification of groundwater dependent ecosystems.[80]

The GSP provided a total of 62 hydrographs that depict short- and long-term groundwater elevations within the principal aquifer.[81] The period of record for hydrographs provided in the GSP vary, with some beginning as early as the 1930s and extend through 2020. The GSP explains that due to surface water being the main supply used in the southern area of the Subbasin, there is less groundwater level data for that region than there is for the central and northern regions.[82] Hydrographs representing groundwater conditions indicate relatively stable conditions throughout the Subbasin with some wells showing groundwater elevation declines in the northwestern portion of the Subbasin during recent drought periods. In most hydrographs, groundwater elevations recover or stabilize following periods of wetter conditions.

The GSP includes a narrative description of the change in groundwater storage, as well as a graph depicting the change in storage demonstrating the annual and cumulative change in groundwater storage volume.[83] The GSP states that the estimated changes in groundwater storage within the Alluvial Aquifer and Upper Tehama zone from 1988 to

[73] Solano Subbasin GSP, Section 3.2.4, p. 187.
[74] 23 CCR §§ 354.16 (a)(1-2).
[75] 23 CCR § 354.16 (b).
[76] 23 CCR § 354.16 (c).
[77] 23 CCR § 354.16 (d).
[78] 23 CCR § 354.16 (e).
[79] 23 CCR § 354.16 (f).
[80] 23 CCR § 354.16 (g).
[81] Solano Subbasin GSP, Appendix 3A, Figures 3-15a to 3-17c, pp. 1294-1301.
[82] Solano Subbasin GSP, Section 3.3.1, p. 188.
[83] Solano Subbasin GSP, Section 3.3.3, p. 200; Figure 5-8, p. 261.

2018 equals 55,000 to 89,000 acre feet, or 1,800 to 3,000 acre-feet per year.[84] The GSP also states, due to the limited groundwater elevation data and limited extent of the aquifer zone, the Basal Tehama zone has a very small annual rate of increase of approximately five acre-feet per year from 2015 to 2018.[85]

The GSP states that the southern portion of the Subbasin is adjacent to the San Francisco Bay Delta and that delta waters in the southern portion of the Subbasin are characterized as "tidal fresh" and "mixing."[86] The GSP describes how, prior to the construction of large reservoirs in the 1940s and 1950s, high salinity conditions in the summer extended much farther into the delta than they do presently. The historic maximum salinity intrusion into the delta is measure each year and a figure depicting this is provided in the GSP.[87] Chloride concentrations in the Subbasin are less than 50 mg/L, which the GSP explains are well below the secondary MCL of 250 mg/L.[88]

The GSP includes a description and maps of groundwater quality issues in the Subbasin and has identified TDS, chloride, nitrate, arsenic, hexavalent chromium, and boron as constituents of concern.[89] The GSP states that these constituents have the largest potential of creating regional water quality concerns in the Subbasin that extend beyond site-specific conditions.[90] The GSP also states that areas of known contamination exist that have the potential to impact groundwater, but these areas are under the oversight of the appropriate regulatory agencies.[91]

The GSP includes a description of current and historical land subsidence conditions in the Subbasin, including maps with elevation data charts.[92] The maps of current land subsidence cover the extent, cumulative total, and annual rate of subsidence in the Subbasin. The graphs provided in the GSP show that subsidence is causing vertical displacement of up to approximately -0.2 feet over the period of record from 2005 to 2021, which the GSP states has not resulted in any reported adverse impacts.[93]

The GSP identifies Putah Creek, Sweeney Creek, Ulatis Creek, Cache Slough, Steamboat Slough, Sacramento River, Mokelumne River, and the San Joaquin River as major surface water features in the Subbasin. The GSP evaluates the historical interconnection between surface water and groundwater by using minimum depth to groundwater values from measurements collected between 2000 and 2018. In general, surface water features overlying a groundwater table with historical minimum depths less than 20 feet below ground surface were considered likely connected; whereas surface

[84] Solano Subbasin GSP, Section 3.3.3, p. 200.
[85] Solano Subbasin GSP, Section 3.3.3, p. 200.
[86] Solano Subbasin GSP, Appendix 3B, Figure 407a, p. 2647.
[87] Solano Subbasin GSP, Appendix 3B, Figure 4-7b, p. 2648.
[88] Solano Subbasin GSP, Section 3.3.5, p. 203.
[89] Solano Subbasin GSP, Section 3.3.4, p. 200.
[90] Solano Subbasin GSP, Section 3.3.4, p. 200.
[91] Solano Subbasin GSP, Section 3.3.4, p. 203.
[92] Solano Subbasin GSP, Section 3.3.6, pp. 203-205; Appendix 3A, Figures 3-30 to 3-34d, pp. 1314-1322.
[93] Solano Subbasin GSP, Section 3.3.6, p. 205.

water features overlying a groundwater table with historical minimum depths greater than 20 feet below ground surface were considered likely or probably disconnected.[94] The GSP provides a map displaying the results of the analysis, which generally shows that surface water features in the northeast, northwest, and southwest are generally disconnected from the groundwater table, while the central and southeast portions of the Subbasin are generally connected.[95] The GSP does not provide estimates of historical or projected depletion volumes.

The GSP evaluates groundwater dependent ecosystems using the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset in combination with groundwater level data. Areas of the Subbasin that show an intersection of NCCAG area with a groundwater table having a minimum depth of up to 30 feet below ground surface (based on historical measurements between 2000 and 2018) were considered likely groundwater dependent ecosystems, while those areas that have a groundwater table more than 30 feet below ground surface were not. The GSP provides a map displaying these potential groundwater dependent ecosystems, but indicates that additional studies and input from stakeholders will be needed to confirm their actual presence.[96]

The Plan sufficiently describes the historical and current groundwater conditions throughout the Subbasin, and the information included in the Plan substantially complies with the requirements outlined in the GSP Regulations.

4.2.3 Water Budget

GSP Regulations require a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical; current; and projected water budget conditions,[97] and the sustainable yield.[98]

Water budgets presented in the GSP were developed through application of the Solano Integrated Hydrologic Model (Solano IHM).[99] The model uses historical climate, hydrology, land use, and water supply data from the period of 1985 through 2018. The model was built upon foundational elements of the Department's SVSim regional model for the Sacramento Valley and was refined for improved application in the Subbasin area.[100]

[94] Solano Subbasin GSP, Section 3.3.7, pp. 205-209.
[95] Solano Subbasin GSP, Figure 3-17, p. 208.
[96] Solano Subbasin GSP, Section 3.2.8, p. 209; Figure 3-18, p. 210.
[97] 23 CCR §§ 354.18 (a), 354.18 (c) *et seq*.
[98] 23 CCR § 354.18 (b)(7).
[99] Solano Subbasin GSP, Appendix 5B, p. 3083.
[100] Solano Subbasin GSP, Section 5, p. 234.

The historical water budget represents water years 1991 to 2018 and is presented in both graphical[101] and tabular[102] form for both the surface water and groundwater systems. The GSP describes that the period used for the historical water budget was selected "to represent long-term average hydrologic conditions following evaluation of precipitation records and DWR Sacramento Valley water year type classification."[103] Annual changes in groundwater storage during the historical water budget period ranged from a deficit of 88,000 acre-feet to a surplus of 120,000 acre-feet. An average annual increase in groundwater storage of 2,900 acre-feet was estimated over the historical modeling scenario, indicating the Subbasin has not historically been in overdraft.[104]

In developing the current water budget, the GSP evaluated different water budgets based on five different time periods: recent ten years (2009-2018), recent five years (2014-2018), recent three years (2016-2018), recent one year (2017), and a second recent one year (2018). The GSP describes that available hydrologic, climate, water supply, and land use data were utilized for each recent scenario.[105] Based on this evaluation, the GSP describes that the recent five-year water budget, representing water years 2014 to 2018, was determined to be the most suitable to represent the current water budget conditions and is representative of current hydrologic and land use conditions.[106] The recent five year water budget estimated an average annual decrease in groundwater storage of 1,000 acre-feet over water years 2014 to 2018.[107]

The GSP includes six projected water budgets based on different modeling scenarios that were developed using the Solano IHM. The GSP describes that historical hydrologic conditions from the years 1968 to 2018 were used to develop 50 years of future hydrologic conditions for these projected water budgets. The differences between the projected water budgets included adjustments to land use changes and considerations due to climate change using the Department's guidance for the 2030 and 2070 central tendencies.[108] The projected water budgets include scenarios for:

1. Projected (Current Land Use)
2. Projected (Current Land Use) with Climate Change (2030)
3. Projected (Current Land Use) with Climate Change (2070)
4. Projected (Future Land Use)
5. Projected (Future Land Use) with Climate Change (2030)
6. Projected (Future Land Use) with Climate Change (2070)

[101] Solano Subbasin GSP, Figure 5-6, p. 256; Figure 5-8, p. 261.
[102] Solano Subbasin GSP, Table 5-11, pp. 257-258; Table 5-12, p. 262.
[103] Solano Subbasin GSP, Section 5.2.1, p. 239.
[104] Solano Subbasin GSP, Table 5-12, p. 262.
[105] Solano Subbasin GSP, Section 5.2.1, p. 239.
[106] Solano Subbasin GSP, Section 5.6, p. 263.
[107] Solano Subbasin GSP, Table 5-14, p. 265.
[108] Solano Subbasin GSP, Section 5.7, pp. 266-296.

The GSP provides summary tables of the water budget results for the surface water and groundwater systems for the projected water budgets.[109] Additionally, the projected groundwater system water budget scenarios provide separate estimates for both the Alluvial Aquifer / Upper Tehama zone, and Basal Tehama zone. The projected water budgets for the overall groundwater system indicate that the Subbasin should have an average annual surplus of groundwater in storage no matter the scenario. Average annual change in groundwater storage estimates for the projected water budgets range between increases of 800 acre-feet in the Projected (Future Land Use) with Climate Change (2070) scenario to 1,400 acre-feet in the Projected (Current Land Use) and Projected (Current Land Use) with Climate Change (2030) scenarios.[110]

The Subbasin's sustainable yield was derived from modeling scenarios for the historical and projected water budgets, including effects from climate change. The historical scenario average annual groundwater extractions were estimated to be 180,000 acre-feet per year. The GSP states undesirable results, such as streamflow depletions and effects on neighboring subbasins, were considered when analyzing the estimated sustainable yield, which is stated to be 190,000 acre-feet per year. This volume is equivalent to the estimated groundwater recharge due to deep percolation from the projected model scenario that includes future land use and the 2070 climate change conditions. An assumption is made in the GSP for having a 20 percent uncertainty with this number, so the associated range of the sustainable yield is between 150,000 acre-feet and 230,000 acre-feet per year.[111]

The historical, current, and projected water budgets included in the Plan substantially comply with the requirements outlined in the GSP Regulations. The GSP provides the required historical, current, and future accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the Subbasin including an estimate of the sustainable yield of the Subbasin and projected future water demands.

4.2.4 Management Areas

The GSP Regulations provide the option for one or more management areas to be defined within a basin if the GSA has determined that the creation of the management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives, provided that undesirable results are defined consistently throughout the basin.[112]

The GSP does not define management areas.

[109] Solano Subbasin GSP, Table 5-21, p. 292; Table 5-23, p. 293; Table 5-25, p. 296.
[110] Solano Subbasin GSP, Table 5-25, p. 296.
[111] Solano Subbasin GSP, Section 5.10.4, p. 353.
[112] 23 CCR § 354.20.

4.3 SUSTAINABLE MANAGEMENT CRITERIA

GSP Regulations require each Plan to include a sustainability goal for the basin and to characterize and establish undesirable results, minimum thresholds, and measurable objectives for each applicable sustainability indicator, as appropriate. The GSP Regulations require each Plan to define conditions that constitute sustainable groundwater management for the basin including the process by which the GSA characterizes undesirable results and establishes minimum thresholds and measurable objectives for each applicable sustainability indicator.[113]

4.3.1 Sustainability Goal

GSP Regulations require that GSAs establish a sustainability goal for the basin. The sustainability goal should be based on information provided in the GSP's basin setting and should include an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation.[114]

The sustainability goal for the Solano Subbasin is "to continue to operate the Subbasin in a sustainable manner to: protect and maintain safe and reliable sources of groundwater for all beneficial uses and users; ensure current and future groundwater demands account for changing groundwater conditions due to climate change; establish and protect sustainable yield for the Subbasin by achieving measurable objectives set forth in this GSP; and avoid undesirable results for the sustainability indicators identified under SGMA."[115]

The GSP describes that the Subbasin is "currently sustainable and is anticipated to remain sustainable of the 50-year planning and implementation horizon."[116] Additionally, the GSP states that "undesirable results have not occurred historically and are not [currently] present throughout the Subbasin" and "projected conditions do not indicate the occurrence of undesirable results for the 20-year GSP implementation period."[117] Due to these factors, the GSP generally presents an adaptive management approach, describing how projects and management actions may be implemented to strengthen overall water supply reliability if needed to maintain sustainability in the Subbasin.[118] Projects and management actions described by the GSP generally consist of water use efficiency, water conservation, recycled water, and groundwater recharge projects; however, demand management is also identified by the GSP as a "backstop" if other projects and management actions are insufficient to maintain sustainability.[119]

[113] 23 CCR § 354.22 *et seq*.
[114] 23 CCR § 354.24.
[115] Solano Subbasin GSP, Section 6.1.1, p. 357.
[116] Solano Subbasin GSP, Section 6.1.2, p. 357.
[117] Solano Subbasin GSP, Section 6.1.3, p. 357.
[118] Solano Subbasin GSP, Section 6.1, pp. 357-358.
[119] Solano Subbasin GSP, Section 8.2, Table 8-1, p. 480; Section 8.2.2, p. 482.

The GSP's discussion and presentation of information related to the Subbasin's sustainability goal substantially complies with the requirements outlined in the GSP Regulations in an understandable format using appropriate data.

4.3.2 Sustainability Indicators

Sustainability indicators are defined as any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results.[120] Sustainability indicators thus correspond with the six undesirable results – chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon, significant and unreasonable reduction of groundwater storage, significant and unreasonable seawater intrusion, significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies, land subsidence that substantially interferes with surface land uses, and depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water[121] – but refer to groundwater conditions that are not, in and of themselves, significant and unreasonable. Rather, sustainability indicators refer to the effects caused by changing groundwater conditions that are monitored, and for which criteria in the form of minimum thresholds are established by the agency to define when the effect becomes significant and unreasonable, producing an undesirable result.

GSP Regulations require that GSAs provide descriptions of undesirable results including defining what are significant and unreasonable potential effects to beneficial uses and users for each sustainability indicator.[122] GSP Regulations also require GSPs provide 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.[123]

GSP Regulations require that the description of minimum thresholds include the information and criteria relied upon to establish and justify the minimum threshold for each sustainability indicator.[124] GSAs are required to describe how conditions at minimum thresholds may affect beneficial uses and users,[125] and the relationship between the minimum thresholds for each sustainability indicator, including an explanation for how the GSA has determined conditions at each minimum threshold will avoid causing undesirable results for other sustainability indicators.[126]

[120] 23 CCR § 351(ah).
[121] Water Code § 10721(x).
[122] 23 CCR §§ 354.26 (a), 354.26 (b)(c).
[123] 23 CCR § 354.26 (b)(2).
[124] 23 CCR § 354.28 (b)(1).
[125] 23 CCR § 354.28 (b)(4).
[126] 23 CCR § 354.28 (b)(2).

GSP Regulations require that GSPs include a description of the criteria used to select measurable objectives, including interim milestones, to achieve the sustainability goal within 20 years.[127] GSP Regulations also require that the measurable objectives be established based on the same metrics and monitoring sites as those used to define minimum thresholds.[128]

The following subsections thus consolidate three facets of sustainable management criteria: undesirable results, minimum thresholds, and measurable objectives. Information, as presented in the Plan, pertaining to the processes and criteria relied upon to define undesirable results applicable to the Subbasin, as quantified through the establishment of minimum thresholds, are addressed for each applicable sustainability indicator. A submitting agency is not required to establish criteria for undesirable results that the agency can demonstrate are not present and are not likely to occur in a basin.[129]

4.3.2.1 Chronic Lowering of Groundwater Levels

In addition to components identified in 23 CCR §§ 354.28 (a-b), for the chronic lowering of groundwater, the GSP Regulations require the minimum threshold for chronic lowering of groundwater levels to be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results that is supported by information about groundwater elevation conditions and potential effects on other sustainability indicators.[130]

The GSP describes that undesirable results "were defined to prevent the occurrence of conditions outside the range of those experienced in the historical base period, thereby avoiding significant and unreasonable adverse impacts on beneficial users."[131] Undesirable results for the chronic lowering of groundwater levels are described as "excessive regional groundwater pumping that causes a significant and unreasonable decline in groundwater levels over an extended period of time that results in existing water supply wells (drinking water, industrial, and irrigation wells) not being viable for intended beneficial uses due to reduction in pumping capacity, or groundwater levels exhibit lowering that significantly affects other beneficial uses (e.g., [groundwater dependent ecosystems (GDEs)])."[132]

The GSP defines a quantitative identification of undesirable results as "when 30 percent [i.e. 13 of 41] or more of representative monitoring site (RMS) wells exceed their respective groundwater level [minimum threshold] for two consecutive years."[133] The GSP describes that these criteria were selected because "the use of a two-year

[127] 23 CCR § 354.30 (a).
[128] 23 CCR § 354.30 (b).
[129] 23 CCR § 354.26 (d).
[130] 23 CCR § 354.28(c)(1) *et seq*.
[131] Solano Subbasin GSP, Section 6.2, p. 358.
[132] Solano Subbasin GSP, Section 6.2.1.1, p. 361.
[133] Solano Subbasin GSP, Section 6.2.1.1, p. 361.

consecutive exceedance provides a good balance between providing tolerance for some short-term extreme groundwater demands while not allowing for long-term excessive pumping of groundwater" and "use of a 30 percent criterion for RMS [minimum threshold] exceedances constituting an undesirable result provides an appropriate balance between recognizing the potential occurrence of localized conditions versus conditions representative of a more significant fraction of the Subbasin."[134] The GSP also describes that any individual minimum threshold exceedance would trigger an "evaluation of factors related to groundwater level declines."[135]

The GSP describes various factors that were considered in the development of the minimum thresholds for the chronic lowering of groundwater levels and presents a summary of selected minimum thresholds in Table 6-3.[136] For RMS wells screened in the Alluvial Aquifer and Upper Tehama zone, the minimum recorded groundwater elevations from the historical base period (1991 to 2014) were first considered. The GSP then describes that "where the historical low groundwater level over the base period does not provide sufficient operational flexibility to accommodate drought conditions and intermittent periods of higher pumping, [minimum thresholds] were lowered through consideration of longer-term historical conditions (prior to and after the base period)."[137] The GSP also describes that consideration was given to nearby domestic well depths and nearby groundwater dependent ecosystems when developing minimum thresholds for wells in the Alluvial Aquifer and Upper Tehama zone.[138] Based on review of the minimum thresholds and provided hydrographs, only six wells screened in the Alluvial Aquifer / Upper Tehama zone have minimum thresholds set below historic lows.[139] Minimum threshold depths in these six wells are generally within five feet of historic lows and range from 11.9 to 38.6 feet below ground surface.

For RMS wells screened in the Basal Tehama zone, the GSP describes that the minimum thresholds "were generally set at a level 50 feet below the recent five-year average (prior to January 2015)."[140] Based on review of the hydrographs, the minimum thresholds for RMS wells in the Basal Tehama zone are all set below historic lows. The GSP describes that groundwater levels in this confined aquifer zone represent potentiometric heads, which generally display higher levels of fluctuations in relation to pumping. The GSP states that only municipal wells are screened in the Basal Tehama zone, and the zone generally occurs at depths of 1,000 feet or greater. Declines in potentiometric head in the Basal Tehama zone to minimum threshold levels are only estimated to result in a decrease of groundwater in storage of 500 acre-feet, which the GSP indicates would not

[134] Solano Subbasin GSP, Section 6.2.1.1, p. 361.
[135] Solano Subbasin GSP, Section 6.2.1.1, p. 361.
[136] Solano Subbasin GSP, Table 6-3, pp. 372-374.
[137] Solano Subbasin GSP, Section 6.3.1, p. 371.
[138] Solano Subbasin GSP, Section 6.3.1, p. 371.
[139] Solano Subbasin GSP, Appendix 6A, pp. 5931-5972.
[140] Solano Subbasin GSP, Section 6.3.1, p. 371.

cause significant or unreasonable impacts to beneficial users of this aquifer.[141] Overall, the GSP describes that the general approach for developing minimum thresholds was to allow for sufficient operational flexibility, while avoiding significant and unreasonable adverse impacts to beneficial users.[142]

The GSP describes how selected minimum thresholds were evaluated with consideration for beneficial uses and users of groundwater. The GSP indicates that an interpolated water surface elevation, based on minimum threshold depths, was compared to well completion report data for domestic wells constructed since 1970. Based on this analysis, it was estimated only two domestic wells (0.17% of all domestic wells constructed since 1970 with available well construction information) would potentially go dry if groundwater levels for RMS wells across the Subbasin declined to their minimum thresholds.[143] Additionally, the GSP describes that agricultural wells are typically deeper than domestic wells, and thus also protected by the minimum thresholds. For municipal wells, the GSP states that "the chronic lowering of groundwater level [minimum thresholds] are set so that municipal groundwater pumpers can meet existing and projected water demands by protecting their ability to meet existing and projected demands through typical well and pumping configurations (e.g., depths, perforation intervals, pumping lifts)."[144] The GSP does not describe how environmental users, such as groundwater dependent ecosystems, were considered when developing minimum thresholds; however, this topic is identified as a data gap, which the GSAs intend to address in the future.[145]

The GSP describes that measurable objectives for the chronic lowering of groundwater levels screened in the Alluvial Aquifer and Upper Tehama zones "were determined based on average static groundwater elevations in the base period prior to 2015."[146] For RMS wells screened in the Basal Tehama zone, the GSP states that "in select cases, such as the Basal Tehama groundwater levels that took several years to equilibrate following new groundwater development in the northern part of the Subbasin, the [measurable objective] was set as the average groundwater level post equilibrium."[147] The GSP states that interim milestones are set equal to measurable objectives. The GSP describes that the selection of measurable objectives and interim milestones "reflects how the Solano Subbasin anticipates maintaining sustainability with continued use of existing groundwater extraction amounts."[148]

Overall, Department staff find the sustainable management criteria for the chronic lowering of groundwater levels presented in the GSP, with minimum thresholds generally being associated with recent historical lows and measurable objectives based on average

[141] Solano Subbasin GSP, Section 6.3.1, p. 371.
[142] Solano Subbasin GSP, Section 6.3.1, p. 371.
[143] Solano Subbasin GSP, Section 6.3.1.4, p. 383.
[144] Solano Subbasin GSP, Section 6.3.1.4, p. 383.
[145] Solano Subbasin GSP, Section 6.3.1.4, p. 383.
[146] Solano Subbasin GSP, Section 6.4.1.1, p. 408.
[147] Solano Subbasin GSP, Section 6.4.1.1, p. 408.
[148] Solano Subbasin GSP, Section 6.4.1.2, p. 408.

historical groundwater levels, to be reasonable and sufficiently protective of significant and unreasonable impacts related to the chronic lowering of groundwater levels. While minimum thresholds for wells in the Basal Tehama zone are set below historic lows, the GSP describes how municipal wells are the only beneficial users of this zone, and the selection of minimum thresholds considered the potential impacts to these users and sufficiently supported the GSAs' determination that those impacts would not be significant or unreasonable. The GSP indicates that the Subbasin is currently sustainable and is projected to be sustainable in the future; thus, defining interim milestones as equal to measurable objectives seems appropriate based on the Subbasin's management strategy to maintain the average historic groundwater levels throughout the 20-year implementation period and beyond.

4.3.2.2 Reduction of Groundwater Storage

In addition to components identified in 23 CCR §§ 354.28 (a-b), for the reduction of groundwater storage, the GSP Regulations require the minimum threshold for the reduction of groundwater storage to be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.[149]

The GSP describes that the Subbasin will use sustainable management criteria developed for the chronic lowering of groundwater levels as a proxy for reduction in groundwater storage. The GSP states "the total volume of groundwater in storage in the Subbasin is considerable and a reduced volume of groundwater storage is not a meaningful metric for detecting significant and unreasonable impacts from reduction of storage," and "potential [undesirable results] related to reduction in groundwater storage in the Solano Subbasin occur as potential impacts resulting from lowered groundwater levels that are directly related to the reduction of groundwater storage."[150] The GSP describes the potential causes of undesirable results and effects of undesirable results related to reduction in groundwater storage as similar to those described for the chronic lowering of groundwater levels.[151] The GSP quantitatively defines an undesirable result for reduction in groundwater storage as occurring when "there is an exceedance of the water level [minimum thresholds] for two consecutive years at 30 percent of water level RMS locations," which is the same metric used for identifying undesirable results due to chronic lowering of groundwater levels.[152]

The GSP defines minimum thresholds, measurable objectives, and interim milestones for reduction in groundwater storage as the same values at the identified RMS well locations

[149] 23 CCR § 354.28(c)(2).
[150] Solano Subbasin GSP, Section 6.2.2, pp. 362-363.
[151] Solano Subbasin GSP, Section 6.2.2.2, p. 364; Section 6.2.2.3, p. 364.
[152] Solano Subbasin GSP, Section 6.2.2.1, p. 363.

as those defined for the chronic lowering of groundwater levels.[153] As described above in Department staff's evaluation of chronic lowering of groundwater level sustainable management criteria, the minimum thresholds are generally defined near the historic low groundwater levels and the measurable objectives and interim milestones are generally defined near the historic average groundwater levels.

Regarding the sustainable yield and the reduction in groundwater storage sustainable management criteria, the GSP states that "[undesirable results] are protective of the sustainable yield of the Subbasin"[154] and "the [minimum threshold] for reduction in groundwater storage is based on the sustainable yield of Solano Subbasin."[155] Other than these statements, the GSP does not describe how the sustainable yield was considered when developing undesirable results or minimum thresholds; however, regardless of this omission, the GSP states that "groundwater levels are the fundamental underlying field data required to implement any method of quantifying groundwater storage."[156]

Department staff find the use of water level sustainable management criteria as a proxy for reduction in groundwater storage to be reasonable considering the Subbasin's approach to maintain groundwater levels at historical averages throughout implementation and beyond. By maintaining groundwater levels at historical averages, groundwater in storage would generally not be depleted in the long-term.

4.3.2.3 Seawater Intrusion

In addition to components identified in 23 CCR §§ 354.28 (a-b), for seawater intrusion, the GSP Regulations require the minimum threshold for seawater intrusion to be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results.[157]

The GSP describes that seawater intrusion "is not directly applicable to the Solano Subbasin" because the Subbasin is not adjacent to the Pacific Ocean.[158] The GSP acknowledges that the Subbasin is adjacent to the San Francisco Bay Delta but describes that the area of the Subbasin near the delta accounts for very little current or future-planned groundwater pumping. The GSP states "potential impacts could conceivably occur on limited occasion as a result of intrusion of higher-salinity surface water from San Pablo Bay"; however, the GSP does not establish sustainable management criteria for seawater intrusion.[159] Rather, the GSP describes that "potential impacts [due to higher salinity water from the delta] are addressed through SMCs for groundwater quality." The

[153] Solano Subbasin GSP, Section 6.2.3, p. 364; Section 6.4.2.1, p. 413; Section 6.4.2.2, p. 413.
[154] Solano Subbasin GSP, Section 6.2.2.1, p. 363.
[155] Solano Subbasin GSP, Section 6.3.1.2, p. 378.
[156] [156] Solano Subbasin GSP, Section 6.3.2.1, p. 385.
[157] 23 CCR § 354.28(c)(3).
[158] Solano Subbasin GSP, Section 6.2.3, p. 364.
[159] Solano Subbasin GSP, Section 6.2.3, pp. 364-365.

GSP also describes the impacts to groundwater conditions due to changing conditions in the delta and/or sea level rise that will be evaluated as part of the periodic GSP updates.

Department staff feel that the presented approach is reasonable considering the current minimal amount of groundwater pumping near the delta and the relatively low chloride concentrations observed in groundwater quality sampling throughout the Subbasin, as described in the Groundwater Conditions section of the GSP. Furthermore, the GSP's commitment to continue to evaluate this issue for any material changes in circumstances in periodic GSP updates provides further assurance that groundwater extraction and management in the Subbasin is unlikely to cause an undesirable result related to seawater intrusion.

4.3.2.4 Degraded Water Quality

In addition to components identified in 23 CCR §§ 354.28 (a-b), for degraded water quality, the GSP Regulations require the minimum threshold for degraded water quality to be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.[160]

The GSP describes that groundwater quality conditions in the Subbasin are "satisfactory for the different beneficial uses and users."[161] The GSP identifies nitrate, arsenic, total dissolved solids (TDS), chloride, and hexavalent chromium as the constituents of interest in the Subbasin regarding groundwater quality.[162] The GSP states that "an [undesirable result] for groundwater quality degradation would be limited to water quality conditions caused by implementation of GSP [projects and management actions] because management of groundwater quality issues has historically been and is currently under the purview of other agencies or programs."[163] The GSP further describes that "significant and unreasonable degradation of water quality occurs when beneficial uses and users for groundwater are adversely impacted by constituent concentrations increasing to levels above the drinking water [maximum contaminant limits (MCLs)] for one of the key constituents of interest at wells in the RMS water quality monitoring network due to implementation of a GSP project or management action."[164] Department staff note that the GSP indicates that projects and management actions are not required to maintain

[160] 23 CCR § 354.28(c)(4).
[161] Solano Subbasin GSP, Section 6.2.4, p. 365.
[162] Solano Subbasin GSP, Section 6.2.4.1, p. 365.
[163] Solano Subbasin GSP, Section 6.2.4.1, p. 365.
[164] Solano Subbasin GSP, Section 6.2.4.1, p. 366.

sustainability in the Subbasin, and it is unclear whether any projects or management actions will be implemented.

The GSP identifies potential causes and related effects of undesirable results related to degradation of groundwater quality.[165] One potential cause identified by the GSP is described as "substantial and long-term changes to the location or rates of pumping, beyond the range of distribution and rate historically occurring in the Subbasin, could result in mobilization and migration of certain constituents including anthropogenic sources of contamination or natural constituents of concern, including connate groundwater."[166] Based on the GSP's description of undesirable results and potential causes, Department staff find the GSP's narrow definition of what conditions can cause an undesirable result to be inconsistent with the intent of SGMA.

The GSP describes that an undesirable result could only occur "due to implementation of a GSP project or management action";[167] however, no projects or management actions are proposed that limit potential changes in the location or rates of pumping, which the GSP identifies as a potential cause of degraded groundwater quality. Additionally, SGMA specifies that the significant and unreasonable effects are those "caused by groundwater conditions occurring throughout the basin," which does not limit them to only impacts directly caused by a GSA's implementation of projects or management actions. SGMA also includes in its definition of undesirable results "significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies."[168] Therefore, potential groundwater quality degradation due to groundwater level changes, changes in the direction of groundwater flow, or changes in horizontal or vertical movement of groundwater within the Subbasin should be evaluated and addressed by the GSP, whether or not these factors are the direct results of a project or management action (see Recommended Corrective Action 1).

The GSP defines a quantitative identification of undesirable results for degraded groundwater quality as occurring when "the average concentrations of a key constituent(s) is greater than the [minimum threshold] at more than 25 percent of RMS wells [at least 7 of 27 wells] over a three-year period."[169] The GSP describes that the 25 percent criteria was considered "a reasonable balance between not letting a very localized problem drive the definition of URs and not allowing most of the Subbasin to be impacted before declaring an [undesirable result] has occurred."[170] Minimum thresholds for degraded groundwater quality are defined as either "exceeding drinking water MCLs or the existing constituent concentration plus 20 percent, whichever is greater for each of

[165] Solano Subbasin GSP, Section 6.2.4.2, p. 366; Section 6.2.4.3, pp. 366-367.
[166] Solano Subbasin GSP, Section 6.2.4.2, p. 366.
[167] Solano Subbasin GSP, Section 6.2.4.1, p. 366.
[168] Water Code § 10721(x)
[169] Solano Subbasin GSP, Section 6.2.4.1, p. 366.
[170] Solano Subbasin GSP, Section 6.2.4.1, p. 366.

the constituent[s] of concern."[171] The GSP includes a table summarizing the selected minimum threshold values.[172] For some RMS wells, some constituents do not have minimum thresholds developed; however, the GSP describes that sustainable management criteria for these constituents will be developed for the GSP's periodic update. The GSP also describes that "for constituents with Primary MCL [minimum thresholds], Trigger Levels are set at 75% of the MCL. Trigger initiates evaluation of factors related to increasing constituent concentrations."[173]

The GSP describes that measurable objectives were "established to not exacerbate adverse impacts on all beneficial uses of groundwater resulting from implementation of GSP projects or management actions."[174] Measurable objectives for degraded groundwater quality are defined as "the average of the recent concentrations from baseline sampling for each of the key constituents."[175] The GSP states that interim milestones are set equal to measurable objectives.[176] The GSP describes that measurable objectives and interim milestones were developed to maintain existing groundwater quality conditions in the Subbasin (i.e. to limit further degradation of groundwater quality), even in wells with constituent concentrations currently above maximum contaminant limits.

Despite the identified recommended corrective action to expand the GSP's current, overly-narrow definition of undesirable results as those tied solely to GSA projects or management actions rather than also including effects of groundwater extractions in the Subbasin, Department staff consider the GSP's water quality sustainable management criteria to be generally reasonable and consistent with the GSP Regulations. Additionally, staff conclude that the GSP's discussion and presentation of information on degradation of water quality substantially covers the specific items listed in the GSP Regulations in an understandable format. Addressing the recommended corrective actions by the next periodic update to the GSP is sufficient at this time because the minimum thresholds and measurable objectives are generally defined to maintain existing water quality, and limit degradation to MCLs. Additionally, based on the minimum thresholds established for groundwater levels, the GSAs do not intend to significantly lower groundwater levels below the lowest levels historically observed in the Subbasin, which makes it unlikely the Subbasin will experience undesirable results related to the migration of contaminant plumes, changes in concentrations of contaminants due to reduction in volume of groundwater in the Subbasin, or appreciable releases of naturally occurring constituents.

[171] Solano Subbasin GSP, Section 6.3.3, p. 387.
[172] Solano Subbasin GSP, Table 6-4, pp. 389-391.
[173] Solano Subbasin GSP, Section 6.2.4.1, p. 366.
[174] Solano Subbasin GSP, Section 6.4.3.1, p. 414.
[175] Solano Subbasin GSP, Section 6.4.3.1, p. 414.
[176] Solano Subbasin GSP, Section 6.4.3.2, p. 415.

4.3.2.5 Land Subsidence

In addition to components identified in 23 CCR §§ 354.28 (a-b), the GSP Regulations require the minimum threshold for land subsidence to be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results.[177] Minimum thresholds for land subsidence shall be supported by identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects and maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum thresholds and measurable objectives.[178]

The GSP describes undesirable results for land subsidence as "excessive regional groundwater pumping that leads to inelastic subsidence that results in significant and unreasonable damage to public infrastructure critical for public health and safety (i.e., levees, flood control channels, roadways, railways, water supply canals or pipelines)."[179] The GSP states that "inelastic subsidence [due to excessive groundwater pumping] has not historically occurred in the Subbasin."[180] The GSP describes that subsidence related to the oxidation of peat has historically occurred in the San Francisco Bay Delta due to farming practices; however, the GSP does not address this type of land subsidence.[181] The GSP describes the potential causes of undesirable results due to land subsidence as "increased pumping in susceptible areas," such as areas with compressible clays.[182] Potential effects of undesirable results generally include damage to public infrastructure, lowering property values, and related economic burdens.[183] The GSP does not identify specific infrastructure that may be susceptible to land subsidence or describe a rate or extent of land subsidence considered tolerable to infrastructure in the Subbasin (see Recommended Corrective Action 2a).

The GSP defines a quantitative identification of undesirable results due to land subsidence as occurring "if subsidence at a subsidence RMS exceeds the [minimum threshold] for three consecutive years, indicating a persistent trend in subsidence at a rate above the [minimum threshold]."[184] The GSP proposes to use four existing continuous global positioning system (cGPS) stations as the only representative monitoring sites for land subsidence in the Subbasin, with locations shown on Figure 6-8.[185] In addition to the four cGPS stations, the GSP describes that Interferometric

[177] 23 CCR § 354.28(c)(5).
[178] 23 CCR §§ 354.28(c)(5)(A-B).
[179] Solano Subbasin GSP, Section 6.2.5.1, pp. 367-368.
[180] Solano Subbasin GSP, Section 6.2.5, p. 367.
[181] Solano Subbasin GSP, Section 6.2.5, p. 367.
[182] Solano Subbasin GSP, Section 6.2.5.2, p. 368.
[183] Solano Subbasin GSP, Section 6.2.5.3, p. 368.
[184] Solano Subbasin GSP, Section 6.2.5.1, p. 368.
[185] Solano Subbasin GSP, Figure 6-8, p. 397.

Synthetic Aperture Radar (InSAR) data and groundwater level data "will be used for supplemental monitoring of land subsidence and evaluation of the relationship of land subsidence to groundwater pumping and management in the Subbasin."[186]

Minimum thresholds for these sites are defined as "the annual subsidence rate exceeding the historical average range of the yearly fluctuation in vertical displacement."[187] The GSP describes that "deviations from this [minimum threshold] over several years may indicate the onset of an inelastic component of subsidence."[188] The GSP summarizes the minimum thresholds in Table 6-5.[189] Minimum thresholds presented in the GSP range from -0.0651 to -0.0957 feet per year (or approximately -2 to -3 centimeters per year). Department staff note that the GSP does not describe how the defined minimum thresholds and the identification of undesirable results are protective against significant and unreasonable impacts related to land subsidence (see Recommended Corrective Action 2b).

Measurable objectives are defined as the "rate of vertical displacement equal to average historical rate of vertical displacement at the four CPGS stations."[190] Interim milestones are set equal to measurable objectives. The GSP summarizes the measurable objectives in Table 6-10.[191] Measurable objectives range from -0.0043 to -0.0108 feet per year (or approximately -0.1 to -0.3 centimeters). The GSP also provides charts displaying the cGPS station annual vertical displacement along with the minimum thresholds and measurable objectives.[192]

While land subsidence due to groundwater pumping may be improbable in the Subbasin, based on lack of historical subsidence and the GSP's management approach of generally keeping groundwater levels above historic lows, Department staff feel that the GSP's proposed sustainable management criteria and associated monitoring network limit the ability of the GSP to identify and prevent significant and unreasonable impacts. While the sustainable management criteria (i.e. minimum thresholds, measurable objectives, and interim milestones) defined for the four cGPS stations appears to be reasonable, land subsidence due to groundwater pumping can be very localized. Thus, Department staff find that the use of only four cGPS stations would not be able to detect potential impacts due to land subsidence outside of the immediate vicinity of each station. Additionally, while the GSP plans to generally keep groundwater levels above historic lows, groundwater level minimum threshold exceedances are still allowed to occur in the Subbasin under the proposed management regime (i.e. up to 30 percent of RMS wells), which could result in land subsidence if groundwater levels decline below historic lows.

[186] Solano Subbasin GSP, Section 6.3.4, p. 396.
[187] Solano Subbasin GSP, Section 6.3.4, p. 398.
[188] Solano Subbasin GSP, Section 6.3.4, p. 398.
[189] Solano Subbasin GSP, Table 6-5, p. 398.
[190] Solano Subbasin GSP, Section 6.4.4.1, p. 419.
[191] Solano Subbasin GSP, Table 6-10, p. 419.
[192] Solano Subbasin GSP, Figure 6-9, p. 399; Appendix 6C, pp. 5999-6000.

The GSP mentions that InSAR and other land subsidence data will be reviewed; however, there are no related actions defined if significant and unreasonable land subsidence is detected through these other data sources. As such, Department staff recommend that the land subsidence monitoring network used to comply with sustainable management criteria be expanded to provide Subbasin-wide coverage (see Recommended Corrective Action 2c).

4.3.2.6 Depletions of Interconnected Surface Water

SGMA defines undesirable results for the depletion of interconnected surface water as those that have significant and unreasonable adverse impacts on beneficial uses of surface water and are caused by groundwater conditions occurring throughout the basin.[193] The GSP Regulations require that a Plan identify the presence of interconnected surface water systems in the basin and estimate the quantity and timing of depletions of those systems.[194] The GSP Regulations further require that minimum thresholds be set based on the rate or volume of surface water depletions caused by groundwater use, supported by information including the location, quantity, and timing of depletions, that adversely impact beneficial uses of the surface water and may lead to undesirable results.[195]

The Plan acknowledges the presence of interconnected surface waters in the Subbasin and identifies their location by evaluating minimum historical depth to groundwater near surface water features throughout the Subbasin. Department staff are satisfied that the GSAs have adopted a reasonable approach to identify the location of interconnected surface waters in the Subbasin. However, the GSP does not quantify the rate or volume of surface water depletions due to groundwater pumping as required by the GSP Regulations.[196] Instead, the GSP proposes a combination of flow requirements along Putah Creek (defined in the Putah Creek Accord) and the use of groundwater elevations as a proxy metric to manage depletions of interconnected surface water, as described in more detail below.

The GSP describes undesirable results due to depletions of interconnected surface water as "excessive regional groundwater pumping that results in reductions in flow or stage of major surface water features that are hydrologically connected to groundwater in the Subbasin, and which cause significant and unreasonable impacts to beneficial uses and users of surface water (e.g., surface water rights holders, environmental users/[groundwater dependent ecosystems])."[197] The GSP describes the potential causes of undesirable results and potential impacts associated with undesirable results;[198] however, the GSP does not describe the rate or volume of depletions that

[193] Water Code § 10721(x)(6).
[194] 23 CCR § 354.16 (f).
[195] 23 CCR § 354.28 (c)(6).
[196] 23 CCR § 354.28 (c)(6).
[197] Solano Subbasin GSP, Section 6.2.6.1, p. 369.
[198] Solano Subbasin GSP, Section 6.2.6.2, pp. 369-370; Section 6.2.6.3, p. 370.

would cause significant and unreasonable impacts to beneficial uses and users of groundwater. The GSP defines the conditions used to identify undesirable results related to depletions of interconnected surface water as either when "the flow requirements and other conditions stipulated in the Putah Creek Accord are not met or maintained" or when "30 percent [i.e. 2 of 6] of RMS wells associated with monitoring of interconnected surface water experience water levels below the [minimum threshold] for two consecutive years as a result of excessive pumping occurring within the Subbasin."[199]

The GSP describes that minimum thresholds for depletions of interconnected surface water from Putah Creek will be based on the flow requirements defined in the Putah Creek Accord. The GSP provides a table of these flow requirements and identifies flow monitoring stations on a map.[200] The GSP states that "Putah Creek is regulated to ensure that there is adequate water to serve the various [groundwater dependent ecosystems] found along the Creek."[201] Minimum thresholds for the remainder of the Subbasin will use groundwater levels as a proxy and be the same minimum thresholds as those defined for the chronic lowering of groundwater levels. The depletions of interconnected surface water monitoring network consists of a subset of six RMS wells selected from the chronic lowering of groundwater levels monitoring network in areas of the Subbasin where the surface water system is considered likely connected to the groundwater system, with the exclusion of the San Francisco Bay Delta area of the Subbasin.[202] The GSP states "it was determined that flows in the Delta are so large, and groundwater in that area is so shallow, that depletions are insignificant and no [minimum threshold] is needed at this time."[203] Minimum thresholds for the wells are generally set at historic lows or within five feet of historic lows, with depths ranging from 11.9 to 32.1 feet below ground surface.[204] The GSP does not describe a correlation between the selected minimum thresholds and rates or volumes of depletions that would potentially cause significant and unreasonable impacts. In addition to the six RMS wells, the GSP also identifies six additional shallow groundwater level monitoring wells (five along Putah Creek and one near the delta), proposed to be included in the monitoring network for depletions of interconnected surface water in the future. The GSP states that minimum thresholds for these proposed monitoring wells will be "the minimum observed static groundwater elevation in the base period prior to 2015."[205]

The GSP describes that measurable objectives for depletions of interconnected surface water are "based on the compliance with the Putah Creek Accord for Putah Creek and the average static groundwater elevation in the base period for selected RMS

[199] Solano Subbasin GSP, Section 6.2.6.1, p. 369.
[200] Solano Subbasin GSP, Figure 6-10, p. 402; Table 6-6, pp. 403-404.
[201] Solano Subbasin GSP, Section 6.3.5, p. 401.
[202] Solano Subbasin GSP, Figure 6-10, p. 402.
[203] Solano Subbasin GSP, Section 6.3.5.1, p. 401.
[204] Solano Subbasin GSP, Table 6-7, p. 405.
[205] Solano Subbasin GSP, Section 6.3.5, p. 401.

locations."[206] Interim milestones for depletions of interconnected surface water are set equal to measurable objectives. The GSP provides a table summarizing measurable objectives and interim milestones for the six RMS wells.[207]

Overall, Department staff find the GSP's sustainable management criteria for the depletions of interconnected surface water to be reasonable considering the Subbasin's approach to maintain groundwater levels near historical averages; however, the GSP does not describe the rates or volumes of depletions that would be considered significant and unreasonable, as required by the GSP Regulations. The GSP also fails to describe the correlation between estimated depletion rates and selected minimum thresholds and the conditions used to identify undesirable results. The GSP is unclear whether the use of modeling tools was, or could be, utilized in the development of sustainable management criteria. While the GSP describes that the Subbasin is not in overdraft, and not projected to be in overdraft in the future, sustainable management criteria allow for some minimum threshold exceedances (potentially below historic low groundwater levels) before identifying an undesirable result. As such, Department staff recommend the GSAs begin to fill data gaps and work toward establishing the necessary information and methodologies to estimate the location, quantity, and timing of depletion of interconnected surface waters as required by the GSP Regulations and, if reasonable, provide an estimate of the projected future depletions based on the Subbasin's management regime.

Department staff understand that quantifying depletions of surface water from groundwater extractions is a complex task that likely requires developing new, specialized tools, models, and methods to understand local hydrogeologic conditions, interactions, and responses. During the initial review of GSPs, Department staff have observed that most GSAs have struggled with this new requirement of SGMA. However, staff believe that most GSAs will more fully comply with regulatory requirements after several years of Plan implementation that includes projects and management actions to address the data gaps and other issues necessary to understand, quantify, and manage depletions of interconnected surface waters. Accordingly, Department staff believe that affording GSAs adequate time to refine their Plans to address interconnected surface waters is appropriate and remains consistent with SGMA's timelines and local control preferences.

The Department will continue to support GSAs in this regard by providing, as appropriate, financial and technical assistance to GSAs, including the development of guidance describing appropriate methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water caused by groundwater extractions. Once the Department's guidance related to depletions of interconnected surface water is publicly available, the GSA, where applicable, should consider incorporating appropriate guidance approaches into their future periodic updates to the GSP (See Recommended Corrective Action 3a). GSAs should consider availing themselves of the Department's

[206] Solano Subbasin GSP, Section 6.4.5, p. 420.
[207] Solano Subbasin GSP, Table 6-11, p. 420.

financial or technical assistance, but in any event must continue to fill data gaps, collect additional monitoring data, and implement strategies to better understand and manage depletions of interconnected surface water caused by groundwater extractions and define segments of interconnectivity and timing within their jurisdictional area (See Recommended Corrective Action 3b). Furthermore, GSAs should coordinate with local, state, and federal resources agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion (See Recommended Corrective Action 3c).

4.4 MONITORING NETWORK

The GSP Regulations describe the monitoring network that must be developed for each sustainability indicator including monitoring objectives, monitoring protocols, and data reporting requirements. Collecting monitoring data of sufficient quality and quantity is necessary for the successful implementation of a groundwater sustainability plan. The GSP Regulations require a monitoring network of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.[208] Specifically, a monitoring network must be able to monitor impacts to beneficial uses and users,[209] monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds,[210] capture seasonal low and high conditions,[211] include required information such as location and well construction and include maps and tables clearly showing the monitoring site type, location, and frequency.[212] Department staff encourage GSAs to collect monitoring data as specified in the GSP, follow SGMA data and reporting standards,[213] fill data gaps identified in the GSP prior to the first periodic evaluation,[214] update monitoring network information as needed, follow monitoring best management practices,[215] and submit all monitoring data to the Department's Monitoring Network Module immediately after collection including any additional groundwater monitoring data that is collected within the Plan area that is used for groundwater management decisions. Department staff note that if GSAs do not fill their identified data gaps, the GSA's basin understanding may not represent the best available science for use to monitor basin conditions.

The GSP has identified 178 monitoring wells within the Subbasin's principal aquifer as part of the groundwater level monitoring network.[216] Of these 178 wells, 41 will be used

[208] 23 CCR § 354.32.
[209] 23 CCR § 354.34(b)(2).
[210] 23 CCR § 354.34(b)(3).
[211] 23 CCR § 354.34(c)(1)(B).
[212] 23 CCR §§ 354.34(g-h).
[213] 23 CCR § 352.4 *et seq*.
[214] 23 CCR § 354.38(d).
[215] Department of Water Resources, 2016, Best Management Practices and Guidance Documents.
[216] Solano Subbasin GSP, Table 6-12, p. 422; Table 6-13, pp. 426-434.

as representative monitoring points in the Subbasin.[217] However, there are a total of only 41 wells uploaded to the Department's SGMA Portal Monitoring Network Module (MNM). The MNM is consistent with the GSP regarding the 41 representative monitoring points in the monitoring network; however, the MNM is missing the remaining 137 wells used in the GSP. The Department's review of the groundwater level monitoring network is based on information provided in the MNM rather than the information provided in the GSP.

The GSP proposes to use the groundwater level monitoring network as a proxy for the groundwater storage monitoring network because changes in groundwater storage are directly dependent on changes in groundwater levels in the unconfined Alluvial/Upper Tehama primary aquifer, and indirectly dependent on changes in the potentiometric head of the confined Basal Tehama primary aquifer.[218]

The GSP identifies 251 wells in the Subbasin to include in the degraded water quality monitoring network.[219] Of these 251 wells, 27 will be used as representative monitoring points in the Subbasin.[220] The GSP incorporates data from as many wells as possible in its assessment of degraded water quality using various programs and agencies including the Department, United States Geological Survey, State Water Resources Control Board's (SWRCB) Groundwater Ambient Monitoring Assessment (GAMA) Priority Basin Project, SWRCB Division of Drinking Water, SWRCB GeoTracker, and Groundwater Quality Trend Monitoring Program courtesy of the Sacramento Valley Water Quality Coalition.[221] The GSP defines five "constituents of interest" to measure groundwater quality degradation: nitrate, arsenic, TDS, chloride, and hexavalent chromium.[222]

The GSP proposes to establish a dedicated land subsidence monitoring network that is comprised of four cGPS stations within the Subbasin in conjunction with groundwater level data collected by the GSAs, InSAR data provided by the Department, and Conaway Extensometer data from the neighboring Yolo Subbasin.[223] The Plan also mentions using data from nine supplementary cGPS stations located outside of the Subbasin.[224] Only the four cGPS stations within the Subbasin are defined as representative monitoring points that will be used to evaluate sustainable management criteria. As described previously in the land subsidence sustainable management criteria evaluation and Recommended Corrective Action 2c, the land subsidence monitoring network used to comply with sustainable management criteria may need to be supplemented to provide Subbasin-wide coverage.

[217] Solano Subbasin GSP, Table 6-12, p. 422; Table 6-13, pp. 426-434.
[218] Solano Subbasin GSP, Table 6-2, p. 359; Section 6.2.2, pp. 362-363; Section 6.3.2, p. 385; Section 6.6.2.1, p. 442.
[219] Solano Subbasin GSP, Table 6-12, p. 422; Table 6-13, pp. 426-434.
[220] Solano Subbasin GSP, Table 6-12, p. 422; Table 6-13, pp. 426-434.
[221] Solano Subbasin GSP, Section 6.3.3, p. 443.
[222] Solano Subbasin GSP, Section 6.2.4, p. 365.
[223] Solano Subbasin GSP, Section 3.3.6, p. 205; Section 3.4.1, p. 213; Section 6.3.4, p. 396; Section 6.6.4, p. 457.
[224] Solano Subbasin GSP, Figure 6-8, p. 397.

The GSP proposes to establish a dedicated depletions of interconnected surface water monitoring network for monitoring shallow groundwater levels, in addition to regulating surface water flows in accordance with the Putah Creek Accord (established to maintain flows and groundwater dependent ecosystems along the creek).[225] The monitoring network is comprised of seven flow and stream gage stations, six shallow representative monitoring wells screened in the Alluvial/Upper Tehama primary aquifer, and five supplemental monitoring wells.[226] The flow and stream gage stations are situated along Putah Creek, and the monitoring wells are dispersed within the vicinities of various stream reaches designated to exhibit some degree of interconnectivity with groundwater, including Putah Creek, Alamo Creek, Sweeny Creek, Ulatis Creek, and other canals.

Apart from the recommended corrective action related to the land subsidence monitoring network (see Recommended Corrective Action 2c), Department staff find that the description of the monitoring network included in the Plan substantially complies with the requirements outlined in the GSP Regulations at this time. Overall, the monitoring network is supported by the best available information and data and is designed to ensure adequate coverage of sustainability indicators.

4.5 Projects and Management Actions

The GSP Regulations require a description of the projects and management actions the submitting Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.[227] Each Plan's description of projects and management actions must include details such as: how projects and management actions in the GSP will achieve sustainability, the implementation process and expected benefits, and prioritization and criteria used to initiate projects and management actions.[228]

The GSP states that the Subbasin is already sustainable and is likely to be sustainable and avoid undesirable results in the future based on current and projected future conditions. Current and projected water budget estimates presented in the GSP indicate that the Subbasin is not currently experiencing overdraft, and overdraft conditions are not expected in the future even when considering climate change. The GSP describes that projects and management actions (PMAs) are not needed for the Subbasin [as a whole] to achieve sustainability; however, the GSP acknowledges that there are areas of the Subbasin, such as the "Northwest Focus Area" which has historically experienced declining groundwater levels, where PMAs could be utilized to avoid localized impacts.[229]

[225] Solano Subbasin GSP, Section 6.3.5, p. 401; Table 6-6, pp. 403-404.
[226] Solano Subbasin GSP, Figure 6-10, p. 402; Table 6-7, p. 405; Table 6-12, p. 422; Table 6-16, pp. 461-462.
[227] 23 CCR § 354.44 (a).
[228] 23 CCR § 354.44 (b) *et seq.*
[229] Solano Subbasin GSP, Section 8.1, pp. 476-477.

Overall, the GSP presents an adaptive management approach relating to the implementation of projects and management actions in the Subbasin.

The GSP presents 11 PMAs categorized into three subgroups: "Ongoing PMAs", "PMAs Developed for Implementation", and "Potential PMAs". The GSP generally describes that "projects" consist of structural features and "management actions" refer to non-structural programs or policies;[230] however, the GSP does not label each PMA as one or the other. Based on this described distinction, the 11 PMAs presented in the GSP would be categorized into four projects (P) and seven management actions (MA) as follows:

Ongoing PMAs

- Municipal & Industrial Water Use Efficiency Outreach & Implementation (MA)

PMAs Developed for Implementation

- City of Vacaville Recycled Water (P)
- Westside Streams Stormwater Capture Project (P)
- Rainfall Managed Aquifer Recharge Demonstration Project (P)

Potential PMAs

- Other Groundwater Recharge Opportunities (P)
- Grower Education Related to On-Farm Practices for Sustainable Groundwater Management (MA)
- Demand Management (MA)
- Groundwater Trading Institution (MA)
- Education and Collaboration (MA)
- Well Owner Outreach and Education (MA)
- Participation in Other Water Resources Management Programs (MA)

Ongoing PMAs are described as projects or management actions that are already being implemented. While the GSP only lists one Ongoing PMA (i.e. Municipal & Industrial Water Use Efficiency Outreach & Implementation), this management action comprises the current various efforts in the Subbasin related to water use efficiency and water conservation. In general, these efforts include education, outreach, incentives, and other forms of support to encourage water use efficiency and conservation.[231] The GSP does not provide a quantification of the benefits of these programs (i.e. estimated volume of groundwater conserved); however, as these programs are already being implemented, it is possible their benefits have already been considered in the current and projected water budgets.

PMAs Developed for Implementation are described as projects or management actions that are considered feasible for implementation but may only be implemented if necessary

[230] Solano Subbasin GSP, Section 8.1, p. 476.
[231] Solano Subbasin GSP, Section 8.3.1, p. 484.

to maintain sustainability.[232] Three projects are identified under this category, as noted above. The project types include one recycled water project and two managed aquifer recharge projects. The two recharge projects are located in the Northwest Focus Area, the portion of the Subbasin identified in the GSP as having historical groundwater level declines. In general, the GSP provides detailed descriptions of these projects that include the expected benefit, relation to sustainability indicators, estimated groundwater offset or recharge, projected costs, and other details consistent with the GSP Regulations, though the GSP states that none of these projects currently have a funding source.[233] If all three projects are implemented as described, the GSP estimates they could result in approximately 5,000 acre-feet of additional annual recharge (in-lieu or managed aquifer recharge), on average.[234]

Potential PMAs are described as projects or management actions that are only conceptual and will require additional development to be implemented but are not required to maintain sustainability in the Subbasin.[235] PMAs in this category are described more broadly and could potentially include numerous, as-yet-to-be-determined projects or management actions within each category. These PMAs generally consist of potential groundwater recharge projects, agricultural education and outreach related to water conservation and water quality, other public education and outreach programs which promote water conservation, and domestic well owner outreach. Demand management is also identified as a potential management action; however, the GSP indicates that demand management would only be considered as a "backstop", should other PMAs not be sufficient to maintain sustainability.[236]

In addition to the PMAs (listed above), the GSP also describes that Solano County and Sacramento County, which are member agencies of the Solano Collaborative, have the authority to enact ordinances or policies related to well permitting, aquifer protection, the regulation of groundwater use, and the export of surface water supplies. The GSP describes that policies or ordinances such as these may be reviewed during GSP implementation, if necessary, to achieve sustainability.[237]

Based on the GSP's overall discussion of PMAs, it appears that no new projects or management actions are guaranteed to be implemented in the Subbasin, and the general approach for the Subbasin is to maintain sustainability through adaptive management. For example, the "Ongoing PMAs" category generally describes preexisting water conservation efforts, while the descriptions of "PMAs Developed for Implementation" and "Potential PMAs" indicate that the identified projects or management actions under these categories may only be implemented if needed to maintain sustainability in the Subbasin.

[232] Solano Subbasin GSP, Section 8.4, p. 484.
[233] Solano Subbasin GSP, Section 8.4, pp. 484-505.
[234] Solano Subbasin GSP, Section 8.4.1.5, p. 487; Section 8.4.2.6, p. 492; Table 8-8, p. 501.
[235] Solano Subbasin GSP, Section 8.2, p. 479.
[236] Solano Subbasin GSP, Section 8.5.3, p. 512.
[237] Solano Subbasin GSP, Section 8.1.2, p. 478.

Department staff find this adaptive management approach reasonable considering vigilant, ongoing monitoring by the GSAs for changing conditions and because the Subbasin is projected to be sustainable in the future based on the projected water budgets. The Plan adequately describes proposed PMAs in a manner that is generally consistent with and substantially compliant with the GSP Regulations. Department staff recommends that the GSAs include and update any need to implement PMAs, or the addition or removal of PMAs, and all implementation efforts in annual reports and in periodic updates.

4.6 Consideration of Adjacent Basins/Subbasins

SGMA requires the Department to "…evaluate whether a groundwater sustainability plan adversely affects the ability of an adjacent basin to implement their groundwater sustainability plan or impedes achievement of sustainability goals in an adjacent basin."[238] Furthermore, the GSP Regulations state that minimum thresholds defined in each GSP be designed to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.[239]

The Solano Subbasin has five adjacent subbasins - the Yolo Subbasin to the north and the east, the South American Subbasin to the east, the Eastern San Joaquin Subbasin to the southeast, the East Contra Costa Subbasin to the south, and the Suisun-Fairfield Valley Groundwater Basin to the west. The East Contra Costa, Eastern San Joaquin, South American, and Yolo subbasins are each required to be managed under a GSP. The Suisun-Fairfield Valley Groundwater Basin is a low priority basin not required to comply with SGMA.

The GSP describes that implementation of the GSP is not expected to impact neighboring Subbasins. The GSP states that projected changes in subsurface inflows and outflows between adjacent subbasins (compared to historical conditions) are not expected to adversely affect the ability of the adjacent subbasins to achieve or maintain sustainability compared to historical conditions.[240] Additionally, the GSP describes that minimum thresholds for the chronic lowering of groundwater levels in the northern portion of the Subbasin were developed in cooperation with the Yolo Subbasin. Regarding the East Contra Costa, Eastern San Joaquin, and South American subbasins, the GSP describes that the San Francisco Bay Delta area of the Subbasin acts as a buffer preventing undesirable results across subbasin boundaries due to the high groundwater levels and minimal groundwater pumping. Finally, the GSP suggests that the western boundary of the Subbasin, where adjacent to the Suisun-Fairfield Valley Groundwater Basin, likely has minimal inter-basin subsurface flows due to the principal aquifer being relatively

[238] Water Code § 10733(c).
[239] 23 CCR § 354.28(b)(3).
[240] Solano Subbasin GSP, Section 5.10.2, p. 344.

shallow and thin along this boundary; thus, potential adverse impacts are likely also limited.[241]

Based on information available, Department staff have no reason to believe that groundwater management under the Plan in the Solano Subbasin will adversely affect the ability of local agencies in the adjacent basins to achieve or maintain sustainability at this time. Department staff will review this issue during periodic updates to the Plan.

4.7 Consideration of Climate Change and Future Conditions

The GSP Regulations require a GSA to consider future conditions and project how future water use may change due to multiple factors including climate change.[242]

Since the GSP was adopted and submitted, climate change conditions have advanced faster and more dramatically. It is anticipated that the hotter, drier conditions will result in a loss of 10 percent of California's water supply. As California adapts to a hotter, drier climate, GSAs should be preparing for these changing conditions as they work to sustainably manage groundwater within their jurisdictional areas. Specifically, the Department encourages GSAs to:

1. Explore how their proposed groundwater level thresholds have been established in consideration of groundwater level conditions in the basin based on current and future drought conditions.
2. Explore how groundwater level data from the existing monitoring network will be used to make progress towards sustainable management of the basin given increasing aridification and effects of climate change, such as prolonged drought.
3. Take into consideration changes to surface water reliability and that impact on groundwater conditions.
4. Evaluate updated watershed studies that may modify assumed frequency and magnitude of recharge projects, if applicable, and
5. Continually coordinate with the appropriate groundwater users, including but not limited to domestic well owners and state small water systems, and the appropriate overlying county jurisdictions developing drought plans and establishing local drought task forces to evaluate how their Plan's groundwater management strategy aligns with drought planning, response, and mitigation efforts within the basin.

[241] Solano Subbasin GSP, Section 6.3.1.3, p. 382.
[242] 23 CCR § 354.18.

5 STAFF RECOMMENDATION

Department staff recommend approval of the GSP with the recommended corrective actions listed below. The Solano Subbasin GSP conforms with Water Code Sections 10727.2 and 10727.4 of SGMA and substantially complies with the GSP Regulations. Implementation of the GSP will likely achieve the sustainability goal for the Solano Subbasin. The GSAs have identified several areas for Plan improvement and Department staff concur that those items are important and should be addressed as soon as possible. Department staff have also identified additional recommended corrective actions that should be considered by the GSAs for the first periodic assessment of the GSP. Addressing these recommended corrective actions will be important to demonstrate that implementation of the Plan is likely to achieve the sustainability goal.

The recommended corrective actions include:

5.1 RECOMMENDED CORRECTIVE ACTION 1

Revise the definition of undesirable results for degraded groundwater quality so that exceedances of minimum thresholds caused by groundwater extraction, whether the GSAs have implemented pumping regulations or not, are considered in the assessment of undesirable results in the Subbasin. Under SGMA, GSAs are responsible for monitoring and managing potential water quality degradation caused by groundwater extractions in the Basin.

5.2 RECOMMENDED CORRECTIVE ACTION 2

Revise the proposed sustainable management criteria for land subsidence as follows:

a. Identify critical infrastructure susceptible to land subsidence and describe what constitutes significant and unreasonable effects. Define the rate (vertical displacement over time) and extent (lateral extent and total vertical displacement) of land subsidence considered to cause these significant and unreasonable impacts.

b. Describe how minimum thresholds and the quantitative identification of undesirable results defined for the land subsidence monitoring network are protective of the rate and extent of land subsidence considered significant and unreasonable.

c. Revise or expand the land subsidence monitoring network to be able to sufficiently detect land subsidence throughout the Subbasin. Department staff understand that portions of the Subbasin near the Delta may experience land subsidence due to the decomposition of peat, which is unrelated to groundwater extractions. The GSP may develop an evaluation process where groundwater level data is used in

conjunction with land subsidence data to disregard this type of land subsidence, if detected.

5.3 Recommended Corrective Action 3

Department staff understand that estimating the location, quantity, and timing of stream depletion due to ongoing, Subbasin-wide pumping is a complex task and that developing suitable tools may take additional time; however, it is critical for the Department's ongoing and future evaluations of whether GSP implementation is on track to achieve sustainable groundwater management. The Department plans to provide guidance on methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water and support for establishing specific sustainable management criteria in the near future. This guidance is intended to assist GSAs to sustainably manage depletions of interconnected surface water.

In addition, the GSA should work to address the following items by the first periodic update:

a. Continue to fill data gaps, collect additional monitoring data, and implement the current strategy to manage depletions of interconnected surface water and define segments of interconnectivity and timing.

b. Prioritize collaborating and coordinating with local, state, and federal regulatory agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion within the GSA's jurisdictional area.

c. Consider utilizing the interconnected surface water guidance, as appropriate, when issued by the Department to establish quantifiable minimum thresholds, measurable objectives, and management actions.