

September 9, 2019

MKGSA Groundwater Sustainability Plan Public Comments
c/o Tulare Irrigation District
P.O. Box 1920
Tulare, CA 93275

Submitted via email at midkaweah@gmail.com

Re: Mid-Kaweah Groundwater Subbasin Groundwater Sustainability Plan

Dear Basin Representatives,

The Nature Conservancy (TNC) appreciates the opportunity to comment on the Mid-Kaweah Subbasin Groundwater Sustainability Plan being prepared under the Sustainable Groundwater Management Act (SGMA).

TNC as a Stakeholder Representative for the Environment

TNC is a global, nonprofit organization dedicated to conserving the lands and waters on which all life depends. We seek to achieve our mission through science-based planning and implementation of conservation strategies. For decades, we have dedicated resources to establishing diverse partnerships and developing foundational science products for achieving positive outcomes for people and nature in California. TNC was part of a stakeholder group formed by the Water Foundation in early 2014 to develop recommendations for groundwater reform and actively worked to shape and pass SGMA.

Our reason for engaging is simple: California's freshwater biodiversity is highly imperiled. We have lost more than 90 percent of our native wetland and river habitats, leading to precipitous declines in native plants and the populations of animals that call these places home. These natural resources are intricately connected to California's economy providing direct benefits through industries such as fisheries, timber and hunting, as well as indirect benefits such as clean water supplies. SGMA must be successful for us to achieve a sustainable future, in which people and nature can thrive within Mid-Kaweah Subbasin region and California.

We believe that the success of SGMA depends on bringing the best available science to the table, engaging all stakeholders in robust dialog, providing strong incentives for beneficial outcomes and rigorous enforcement by the State of California.

Given our mission, we are particularly concerned about the inclusion of nature, as required, in GSPs. The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Addressing Nature's Water Needs in GSPs

SGMA requires that all beneficial uses and users, including environmental users of groundwater, be considered in the development and implementation of GSPs (Water Code § 10723.2).

The GSP Regulations include specific requirements to identify and consider groundwater dependent ecosystems [23 CCR §354.16(g)] when determining whether groundwater conditions are having potential effects on beneficial uses and users. GSAs must also assess whether sustainable management criteria may cause adverse impacts to beneficial uses, which include environmental uses, such as plants and animals. The Nature Conservancy has identified each part of the GSP where consideration of beneficial uses and users are required. That list is available here: <https://groundwaterresourcehub.org/importance-of-gdes/provisions-related-to-groundwater-dependent-ecosystems-in-the-groundwater-s>.

Please ensure that environmental beneficial users are addressed accordingly throughout the GSP. Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decision, and using data collected through monitoring to revise decisions in the future. Over time, GSPs should improve as data gaps are reduced and uncertainties addressed.

To help ensure that GSPs adequately address nature as required under SGMA, The Nature Conservancy has prepared a checklist (**Attachment A**) for GSAs and their consultants to use. The Nature Conservancy believes the following elements are foundational for 2020 GSP submittals. For detailed guidance on how to address the checklist items, please also see our publication, *GDEs under SGMA: Guidance for Preparing GSPs*¹.

1. Environmental Representation

SGMA requires that groundwater sustainability agencies (GSAs) consider the interests of all beneficial uses and users of groundwater. To meet this requirement, we recommend actively engaging environmental stakeholders by including environmental representation on the GSA board, technical advisory group, and/or working groups. This could include local staff from state and federal resource agencies, nonprofit organizations and other environmental interests. By engaging these stakeholders, GSAs will benefit from access to additional data and resources, as well as a more robust and inclusive GSP.

2. Basin GDE and ISW Maps

SGMA requires that groundwater dependent ecosystems (GDEs) and interconnected surface waters (ISWs) be identified in the GSP. We recommend using the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) provided online² by the Department of Water Resources (DWR) as a starting point for the GDE map. The NC Dataset was developed through a collaboration between DWR, the Department of Fish and Wildlife and TNC.

3. Potential Effects on Environmental Beneficial Users

¹GDEs under SGMA: Guidance for Preparing GSPs is available at: https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_GDE_Guidance_Doc_2-1-18.pdf

² The Department of Water Resources' Natural Communities Commonly Associated with Groundwater dataset is available at: <https://gis.water.ca.gov/app/NCDatasetViewer/>

SGMA requires that potential effects on GDEs and environmental surface water users be described when defining undesirable results. In addition to identifying GDEs in the basin, The Nature Conservancy recommends identifying beneficial users of surface water, which include environmental users. This is a critical step, as it is impossible to define “significant and unreasonable adverse impacts” without knowing *what* is being impacted. For your convenience, we’ve provided a list of freshwater species within the boundary of the Kaweah Subbasin in **Attachment C**. Our hope is that this information will help your GSA better evaluate the impacts of groundwater management on environmental beneficial users of surface water. We recommend that after identifying which freshwater species exist in your basin, especially federal and state listed species, that you contact staff at the Department of Fish and Wildlife (DFW), United States Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Services (NMFS) to obtain their input on the groundwater and surface water needs of the organisms on the GSA’s freshwater species list. We also refer you to The Critical Species LookBook³ prepared by The Nature Conservancy and partner organizations for additional background information on the water needs and groundwater reliance of critical species. Because effects to plants and animals are difficult and sometimes impossible to reverse, we recommend erring on the side of caution to preserve sufficient groundwater conditions to sustain GDEs and ISWs.

4. Biological and Hydrological Monitoring

If sufficient hydrological and biological data in and around GDEs is not available in time for the 2020/2022 plan, data gaps should be identified along with actions to reconcile the gaps in the monitoring network.

The Nature Conservancy has thoroughly reviewed the Mid-Kaweah Subbasin Draft GSP. We appreciate the work that has gone into the preparation of various elements of this plan. However, we consider it to be **inadequate** under SGMA since key environmental beneficial uses and users are not adequately identified and considered. In particular, GDEs are not adequately evaluated through existing data or modeling, and no plans are presented for future monitoring to address current data gaps. We recognize that acreage of potential GDEs (220 acres) in the mid-Kaweah subbasin is small compared to acreage of potential GDEs in the entire Kaweah Basin (3488 acres). However, since the Basin Setting section (Appendix 2A) covers the *entire* Kaweah Basin, presenting a complete analysis of the identification of GDEs in the full Kaweah Basin is a necessary first step. Only then can the GDEs in the Mid-Kaweah subbasin be identified and evaluated for ecological importance, noting any data gaps that can be addressed in the future, and considered in the basin’s sustainable management criteria. **Please present a thorough analysis of the identification and evaluation of GDEs in subsequent drafts of the GSP. Once GDEs are identified, they must be considered when defining undesirable results and for further monitoring.**

Our specific comments related to the Mid-Kaweah Subbasin Draft GSP are provided in detail in **Attachment B** and are in reference to the numbered items in **Attachment A**. **Attachment C** provides a list of the freshwater species located in the Kaweah Subbasin. **Attachment D** describes six best practices that GSAs and their consultants can apply when using local groundwater data to confirm a connection to groundwater for DWR’s Natural Communities Commonly Associated with Groundwater Dataset². **Attachment E** provides an overview of a new, free online tool that allows GSAs to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data.

Thank you for fully considering our comments as you develop your GSP.

³ The Critical Species LookBook is available at: <https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/>

Best Regards,

A handwritten signature in black ink, appearing to read "Sandi Matsumoto". The signature is fluid and cursive, with the first name "Sandi" being more prominent.

Sandi Matsumoto
Associate Director, California Water Program
The Nature Conservancy

Attachment A

Environmental User Checklist

The Nature Conservancy is neither dispensing legal advice nor warranting any outcome that could result from the use of this checklist. Following this checklist does not guarantee approval of a GSP or compliance with SGMA, both of which will be determined by DWR and the State Water Resources Control Board.

GSP Plan Element*		GDE Inclusion in GSPs: Identification and Consideration Elements	Check Box
Admin Info	2.1.5 Notice & Communication <i>23 CCR §354.10</i>	Description of the types of environmental beneficial uses of groundwater that exist within GDEs and a description of how environmental stakeholders were engaged throughout the development of the GSP.	1
Planning Framework	2.1.2 to 2.1.4 Description of Plan Area <i>23 CCR §354.8</i>	Description of jurisdictional boundaries, existing land use designations, water use management and monitoring programs; general plans and other land use plans relevant to GDEs and their relationship to the GSP.	2
		Description of instream flow requirements, threatened and endangered species habitat, critical habitat, and protected areas.	3
		Summary of process for permitting new or replacement wells for the basin, and how the process incorporates any protection of GDEs	4
Basin Setting	2.2.1 Hydrogeologic Conceptual Model <i>23 CCR §354.14</i>	Basin Bottom Boundary: Is the bottom of the basin defined as at least as deep as the deepest groundwater extractions?	5
		Principal aquifers and aquitards: Are shallow aquifers adequately described, so that interconnections with surface water and vertical groundwater gradients with other aquifers can be characterized?	6
		Basin cross sections: Do cross-sections illustrate the relationships between GDEs, surface waters and principal aquifers?	7
	2.2.2 Current & Historical Groundwater Conditions <i>23 CCR §354.16</i>	Interconnected surface waters:	8
		Interconnected surface water maps for the basin with gaining and losing reaches defined (included as a figure in GSP & submitted as a shapefile on SGMA portal).	9
		Estimates of current and historical surface water depletions for interconnected surface waters quantified and described by reach, season, and water year type.	10
	Basin GDE map included (as figure in text & submitted as a shapefile on SGMA Portal).	11	

		If NC Dataset was used:	Basin GDE map denotes which polygons were kept, removed, and added from NC Dataset (Worksheet 1, can be attached in GSP section 6.0).	12	
			The basin's GDE shapefile, which is submitted via the SGMA Portal, includes two new fields in its attribute table denoting: 1) which polygons were kept/removed/added, and 2) the change reason (e.g., why polygons were removed).	13	
			GDEs polygons are consolidated into larger units and named for easier identification throughout GSP.	14	
		If NC Dataset was <i>not</i> used:	Description of why NC dataset was not used, and how an alternative dataset and/or mapping approach used is best available information.	15	
		Description of GDEs included:			16
		Historical and current groundwater conditions and variability are described in each GDE unit.			17
		Historical and current ecological conditions and variability are described in each GDE unit.			18
		Each GDE unit has been characterized as having high, moderate, or low ecological value.			19
		Inventory of species, habitats, and protected lands for each GDE unit with ecological importance (Worksheet 2, can be attached in GSP section 6.0).			20
		2.2.3 Water Budget 23 CCR §354.18	Groundwater inputs and outputs (e.g., evapotranspiration) of native vegetation and managed wetlands are included in the basin's historical and current water budget.		21
Potential impacts to groundwater conditions due to land use changes, climate change, and population growth to GDEs and aquatic ecosystems are considered in the projected water budget.			22		
Sustainable Management Criteria	3.1 Sustainability Goal 23 CCR §354.24	Environmental stakeholders/representatives were consulted.		23	
		Sustainability goal mentions GDEs or species and habitats that are of particular concern or interest.		24	
		Sustainability goal mentions whether the intention is to address pre-SGMA impacts, maintain or improve conditions within GDEs or species and habitats that are of particular concern or interest.		25	
	3.2 Measurable Objectives 23 CCR §354.30	Description of how GDEs were considered and whether the measurable objectives and interim milestones will help achieve the sustainability goal as it pertains to the environment.		26	
	3.3 Minimum Thresholds 23 CCR §354.28	Description of how GDEs and environmental uses of surface water were considered when setting minimum thresholds for relevant sustainability indicators:		27	
		Will adverse impacts to GDEs and/or aquatic ecosystems dependent on interconnected surface waters (beneficial user of surface water) be avoided with the selected minimum thresholds?		28	
		Are there any differences between the selected minimum threshold and state, federal, or local standards relevant to the species or habitats residing in GDEs or aquatic ecosystems dependent on interconnected surface waters?		29	
	3.4 Undesirable Results 23 CCR §354.26	For GDEs, hydrological data are compiled and synthesized for each GDE unit:		30	
		If hydrological data <i>are available</i> within/nearby the GDE	Hydrological datasets are plotted and provided for each GDE unit (Worksheet 3, can be attached in GSP Section 6.0).	31	
			Baseline period in the hydrologic data is defined.	32	

		GDE unit is classified as having high, moderate, or low susceptibility to changes in groundwater.	33	
		Cause-and-effect relationships between groundwater changes and GDEs are explored.	34	
		If hydrological data <i>are not available</i> within/nearby the GDE	Data gaps/insufficiencies are described.	35
			Plans to reconcile data gaps in the monitoring network are stated.	36
		For GDEs, biological data are compiled and synthesized for each GDE unit:		37
		Biological datasets are plotted and provided for each GDE unit, and when possible provide baseline conditions for assessment of trends and variability.		38
		Data gaps/insufficiencies are described.		39
		Plans to reconcile data gaps in the monitoring network are stated.		40
		Description of potential effects on GDEs, land uses and property interests:		41
		Cause-and-effect relationships between GDE and groundwater conditions are described.		42
		Impacts to GDEs that are considered to be "significant and unreasonable" are described.		43
		Known hydrological thresholds or triggers (e.g., instream flow criteria, groundwater depths, water quality parameters) for significant impacts to relevant species or ecological communities are reported.		44
		Land uses include and consider recreational uses (e.g., fishing/hunting, hiking, boating).		45
		Property interests include and consider privately and publicly protected conservation lands and opens spaces, including wildlife refuges, parks, and natural preserves.		46
Sustainable Management Criteria	3.5 Monitoring Network 23 CCR §354.34	Description of whether hydrological data are spatially and temporally sufficient to monitor groundwater conditions for each GDE unit.	47	
		Description of how hydrological data gaps and insufficiencies will be reconciled in the monitoring network.	48	
		Description of how impacts to GDEs and environmental surface water users, as detected by biological responses, will be monitored and which GDE monitoring methods will be used in conjunction with hydrologic data to evaluate cause-and-effect relationships with groundwater conditions.	49	
Projects & Mgmt Actions	4.0. Projects & Mgmt Actions to Achieve Sustainability Goal 23 CCR §354.44	Description of how GDEs will benefit from relevant project or management actions.	50	
		Description of how projects and management actions will be evaluated to assess whether adverse impacts to the GDE will be mitigated or prevented.	51	

* In reference to DWR's GSP annotated outline guidance document, available at:
https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GD_GSP_Outline_Final_2016-12-23.pdf

Attachment B

TNC Evaluation of the Mid-Kaweah Groundwater Sustainability Plan, Public Review Draft

A complete draft of the Mid-Kaweah Groundwater Sustainability Plan (GSP) was provided for public review on July 31, 2019. This attachment summarizes our comments on the complete public draft GSP, which includes the main GSP file and several separate appendix files. Comments are provided in the order of the checklist items included as Attachment A.

Checklist Item 1 - Notice & Communication (23 CCR §354.10)

- [Section 1.5.2 Beneficial Uses and Users (p. 1-23 to 1-25)]
 - Surface water users and the following groups were listed as Beneficial Users: “Environmental and ecosystem interests in MKGSA include representatives of the Tulare Basin Wildlife Partners, Sierra Club Mineral King Group, and Sequoia Riverlands Trust (p. 1-25).” **Please identify whether or not the following beneficial uses and users of groundwater in the subbasin are present: Protected Lands, including preserves, refuges, conservation areas, recreational areas; and other protected lands; and Public Trust Uses, including wildlife, aquatic habitat, fisheries, and recreation.**
 - The types and locations of environmental uses, species and habitats supported, and the designated beneficial environmental uses of surface waters that may be affected by groundwater extraction in the Subbasin should be specified. **To identify environmental users, please refer to the following:**
 - Natural Communities Commonly Associated with Groundwater dataset (NC Dataset) - <https://gis.water.ca.gov/app/NCDatasetViewer/>
 - The list of freshwater species located in the Kaweah Subbasin in Attachment C of this letter. Please take particular note of the species with protected status.

Checklist Items 2 to 4 - Description of general plans and other land use plans relevant to GDEs and their relationship to the GSP (23 CCR §354.8).

- [Section 1.4.3 General Plans in Plan Area (p. 1-12 to 1-16)]
 - This section should include a discussion of General Plan goals and policies related to the protection and management of GDEs and aquatic resources that could be affected by groundwater withdrawals, rather than being limited to goals and policies directly related to groundwater resources as the Tulare General Plan does. **Please include a discussion of how implementation of the GSP may affect and be coordinated with General Plan policies**

and procedures regarding the protection of wetlands, aquatic resources and other GDEs and ISWs.

- This section should identify Habitat Conservation Plans (HCPs) or Natural Community Conservation Plans (NCCPs) within the Subbasin and if they are associated with critical, GDE or ISW habitats. **Please identify all relevant HCPs and NCCPs within the Subbasin, and address how GSP implementation will coordinate with the goals of these HCPs or NCCPs.**
 - The Open Space and Conservation Element of the City of Visalia’s General Plan includes (p. 1-14 to 1-15):
 - “1. Protect, restore and enhance a continuous corridor of native riparian vegetation along Planning Area waterways, including the St. Johns River; Mill, Packwood, and Cameron Creeks; and segments of other creeks and ditches where feasible, in conformance with the Parks and Open Space diagram of this General Plan.
 - 2. Establish design and development standards for new projects in waterway corridors to preserve and enhance irrigation capabilities, if provided, and the natural riparian environment along these corridors. In certain locations or where conditions require it, alternative designs may be appropriate (e.g., terraced seating or a planted wall system)
 - 3. Place special emphasis on the protection and enhancement of the St. Johns River Corridor by establishing extensive open space land along both sides
 - 4. Where no urban development exists, maintain a minimum riparian habitat development setback from the discernible top of the bank: 50 feet for both sides of the Mill, Packwood, and Cameron Creek corridors and 25 feet for both sides of Modoc, Persian, and Mill Creek ditches. Where riparian trees are located within 100 feet of the discernible top of the banks of the creek corridors and 50 feet from the banks for the ditches, the setback shall be wide enough to include five feet outside the drip line of such trees. Restore and enhance the area within the setback with native vegetation as follows:
 - a. Where existing development or land committed to development prohibits the 50-foot setback on Mill, Packwood, and Cameron Creek corridors, provide the maximum amount of land available for a development setback
 - b. Where existing development or land committed to development prohibits the 25-foot setback along Modoc, Persian, and Mill Creek ditches, provide the maximum amount of land available for a development setback.”
- Please specify if any of these areas are potential GDEs and describe how they are managed.**
- Please refer to The Critical Species LookBook⁴ to review and discuss the potential groundwater reliance of critical species in the basin. **Please include a discussion regarding the management of critical habitat for these aquatic species and its relationship to the GSP.**

⁴The Critical Species LookBook is available at: <https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/>

- [Appendix 2A Section 2.3.1 Existing Groundwater Level Monitoring (p. 37-38)] The monitoring programs are described, but there is no mention of how GDEs are monitored and protected. **Once GDEs are identified, please describe how existing groundwater monitoring programs are protective of GDEs, or propose additional monitoring that specifically targets GDEs.**
- [Appendix 2A Section 2.3.4 Existing Stream Flow Monitoring (p. 50)] This section describes the programs of USACOE, Kaweah and St. Johns Rivers Association (KSJRA), and the ditch companies. Surface water sources are listed along with the group monitoring them. Small surface streams which pass through TID's service area are noted as used, but the names are not listed. There is no mention of ISWs or GDEs and how they are monitored. **Please explain how existing stream flow monitoring is protective of ISWs and GDEs.**
- [Section 1.4.4 Well Permitting Process (p. 1-17)] **This section should include a discussion of the following:**
 - Future well permitting must be coordinated with the GSP to assure achievement of the Plan's sustainability goals. The County of Tulare is currently revising their well permitting program. The City of Visalia also has a well permitting program for wells within their jurisdiction.
 - The State Third Appellate District recently found that Counties have a responsibility to consider the potential impacts of groundwater withdrawals on public trust resources when permitting new wells near streams with public trust uses (ELF v. SWRCB and Siskiyou County, No. C083239). The need for well permitting programs to comply with this requirement should be stated in the text.

Checklist Items 5, 6, and 7 – Hydrogeologic Conceptual Model (23 CCR §354.14); The Hydrogeologic Conceptual Model should illustrate the relationship between GDEs, surface waters, and principal aquifers.

- [Appendix 2A Section 2.2.4 Bottom of the Subbasin (p. 22)] The base of the Subbasin corresponds with the base of freshwater. "This is generally defined as the elevation below which total dissolved solids are greater than 2,000 milligrams per liter (mg/l) (Bertoldi et al, 1991)" (p. 22 of Appendix 2A). As noted on page 9 of DWR's Hydrogeologic Conceptual Model BMP (https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_HCM_Final_2016-12-23.pdf) "the definable bottom of the basin should be at least as deep as the deepest groundwater extractions". **Thus, groundwater extraction well depth data should also be included in the determination of the basin bottom.** Properly defining the bottom of the basin will prevent the possibility of extractors with wells deeper than the basin boundary from claiming exemption from SGMA due to their well residing outside the vertical extent of the basin boundary.
- [Appendix 2A Section 2.2.1.3 Kaweah Subbasin Geology (p. 17-21)] Basin-wide cross sections provided in Figures 4 through 13 are regional, and do not include a graphical representation of the manner in which shallow groundwater may interact with ISWs or GDEs that would allow the reader to understand this topic. **Please consider including an example near-surface cross section that depicts the**

conceptual understanding of shallow groundwater and stream interactions at different locations, including the Upper Aquifer, as well as any potential GDEs.

Checklist Items 8, 9, and 10 – Interconnected Surface Waters (ISW) (23 CCR §354.16); Identification of ISWs is a required element of Current and Historical Groundwater Conditions (23 CCR §354.16).

- [Appendix 2A Section 2.9 Interconnected Surface Water (p. 145)] The discussion of interconnected surface waters should first be introduced in Appendix 2A Section 2.4 (Groundwater Elevation and Flow Conditions §354.16), since the identification of interconnected surface water systems is a required element of Current and Historical Groundwater Conditions (23 CCR §354.16). In Appendix 2A Section 2.4 (Groundwater Elevation and Flow Conditions §354.16), please expand this discussion, in particular:
 - The regulations [23 CCR §351(o)] define interconnected surface waters (ISW) as “surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted”. “At any point” has both a spatial and temporal component. Even short durations of interconnections of groundwater and surface water can be crucial for surface water flow and supporting environmental users of groundwater and surface water. **Please identify interconnected surface waters in the Basin by relying on groundwater elevation and stream gauge data, specifying any data gaps that exist so that they can be resolved in the monitoring network.**
 - ISWs are best estimated by first determining which reaches are completely disconnected from groundwater. This approach would involve comparing groundwater elevations with a land surface Digital Elevation Model that could identify which surface waters have groundwater consistently below surface water features, such that an unsaturated zone would separate surface water from groundwater. Groundwater elevations that are always deeper than 50 feet below the land surface can be used to identify the aboveground reaches as disconnected surface waters. **Please reconcile data gaps (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP to improve ISW mapping.**
- [Section 3.2.1.5 Interconnected Surface Water Systems (p. 3-4)] “Depletions of interconnected surface waters are minimal and, to the extent they occur, impact only vegetation along the banks of unlined channels within the forebay regions of the aquifer system where natural channels exhibit gaining reaches from time to time. Undesirable results may occur should any such groundwater-dependent vegetation disappear from locations of known historic existence.” This discussion is inadequate and is not supported by data. **Please expand the discussion of ISWs to include the above referenced recommendations on identifying and mapping ISWs and provide discussion of the depletions on specific rivers or creeks.**

Checklist Items 11 to 15, Identifying and Mapping GDEs (23 CCR §354.16); Identification of GDEs is a required element of Current and Historical Groundwater Conditions (23 CCR §354.16).

- [Section 5.3.5 Minimum Thresholds – Interconnected Surface Waters (p. 5-17)], [Appendix 2A Section 2.2.7.3 Delineation of recharge areas, potential recharge areas, and discharge areas, including springs, seeps, and wetlands (p. 33)], and [Appendix 2A Section 2.10 Groundwater Dependent Ecosystems (p. 146)] All three of the above referenced sections refer to or include discussion of the identification of groundwater dependent ecosystems (GDEs). **Please consolidate and expand these sections of the document in GSP Appendix 2A Section 2.4 (Groundwater Elevation and Flow Conditions §354.16), since the identification of groundwater dependent ecosystems (GDEs) is a required element of Current and Historical Groundwater Conditions (23 CCR §354.16).** This is a more appropriate place for the identification of GDEs, since groundwater conditions (e.g., depth to groundwater, interconnected surface water maps, groundwater quality) are necessary local information and data from the GSP in assessing whether polygons in the NC dataset are connected to groundwater in a principal aquifer. For detailed guidance on how to address GDEs, please see our publication, *GDEs under SGMA: Guidance for Preparing GSPs*⁵. In particular, note the following:
 - **Please provide a comprehensive discussion and figure(s) for the identification of GDEs.** Figure 19 of Appendix 2A is titled “Potential Groundwater Dependent Ecosystems”, however the figure does not actually present this. The NC dataset is a starting point for GSAs to identify GDEs in their basin. The NC dataset comprises 3,488 acres of potential GDEs for the entire Kaweah basin, representing a significant amount of GDEs to be considered. **Please map the original NC dataset on Figure 19 or another figure, and document which polygons were added (and what local sources were used to identify them), removed (and the removal reason), and kept (from the original NC dataset).** The basin’s GDE shapefile, which is submitted via the SGMA Portal, should also include two new fields in its attribute table denoting: 1) which polygons were kept/removed/added, and 2) the change reason (e.g., why polygons were added or removed).
 - **Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC dataset are supported by groundwater in an aquifer. If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network.** Specifically, please note:

⁵GDEs under SGMA: Guidance for Preparing GSPs is available at:
https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_GDE_Guidance_Doc_2-1-18.pdf

- **Please provide depth to groundwater contour maps. See Attachment D for best practices for completing this step. Specifically, ensure that the first step is contouring groundwater elevations, and the subtracting this layer from land surface elevations from a Digital Elevation Model (DEM) to estimate depth to groundwater contours across the landscape.** This will provide much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found. Depth to groundwater contours developed from depth to groundwater measurements at wells assumes that the land surface is constant, which is a poor assumption to make.
- Figure 19 presents areas marked as ‘Spring 2015 Groundwater Surface within 50 feet of Ground Surface’. Spring 2015 is after the SGMA benchmark date of January 1, 2015. **Please rely on groundwater condition data prior to the SGMA benchmark date.**
- It is highly advised that seasonal and interannual groundwater fluctuations in the groundwater regime are taken into consideration. Utilizing groundwater data from one point in time (e.g., Spring 2015) can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. **We highly recommend using depth to groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network.**
- **Please specify which data were used to determine the elevation of the stream or river bottom and the Valley Oak root zone in the basin.** Page 5-18 states “The water table lies some 60 to 150 feet below the invert of all three of these channel reaches, which is generally 40 to 130 feet below the root zone of the Valley Oak”, however no information is provided on the data used to determine the elevation of the stream or river bottom and these calculations. These depths suggest a root zone of approximately 20 feet, but this is not stated explicitly. There is a citation to data (Lewis and Burgy, 1964⁶) which indicates root zones deeper than 70 feet for this species in a fractured rock aquifer. Rooting depths for the Valley Oak in this region have not been reported, and are a data gap. Furthermore, care must be taken when considering rooting depths of vegetation. Rooting depths are likely to spatially vary based on the local hydrologic

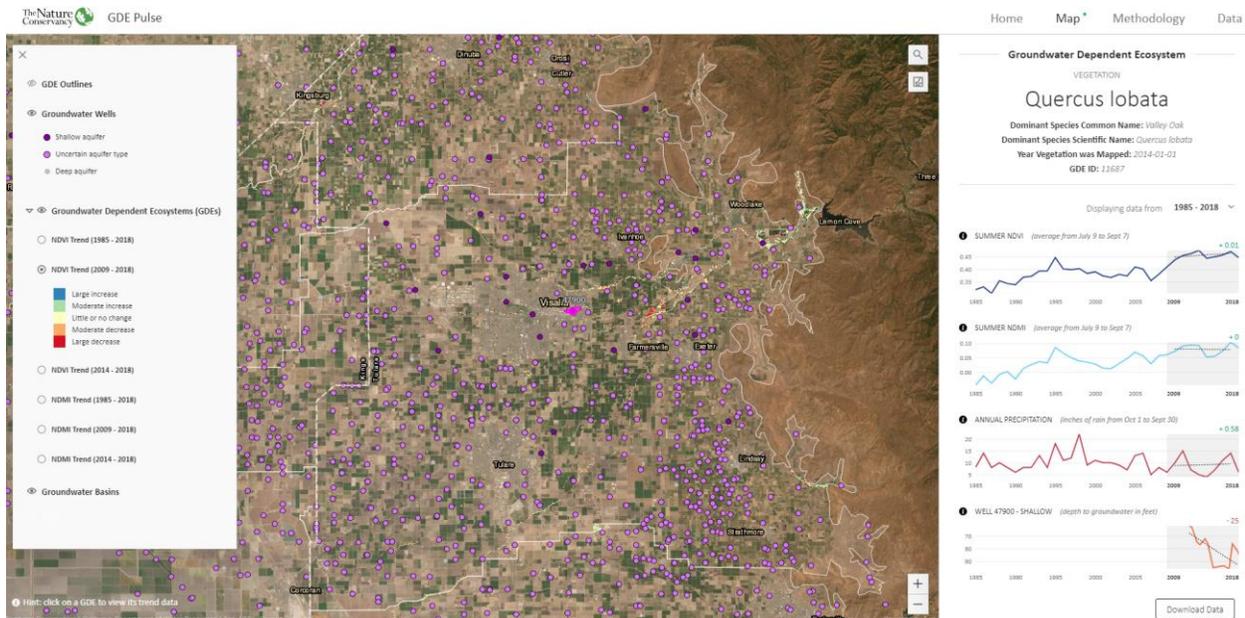
⁶ Lewis, D.C. and Burgy, R.H., 1964. The relationship between oak tree roots and groundwater in fractured rock as determined by tritium tracing. *Journal of Geophysical Research*, 69(12), pp.2579-2588.

conditions available to the plant. Maximum rooting depths do not take capillary action into consideration, which will vary with soil type and is an important consideration since woody phreatophytes generally do not like to have their roots submerged in groundwater for extended periods of time, and hence can access groundwater at deeper depths. In addition, while it is likely to be true that shallow water availability is necessary to support the recruitment of saplings, hydraulic lift of groundwater to shallow depths has been observed in *Quercus* spp.

- Page 33 of Appendix 2A states “The locations of these potential GDEs and hydrographs for the Subbasin indicate that the vegetation of these areas are dependent surface water flows, rather than shallow groundwater.” We disagree with this statement dismissing all potential GDEs from further consideration. There are 3,488 acres of potential GDEs within the Kaweah subbasin as per the NC dataset, and the location is, as to be expected, at the interconnection between groundwater and surface water. Adverse impacts can occur to GDEs due to pumping that further separates groundwater from surface water. **Please provide the rationale for this statement, including the discussion of the type of river reach (i.e., gaining or losing).** Riparian vegetation may still be accessing groundwater, and hence be identified as a GDE. We highly recommend that depth to groundwater levels under the NC polygons be used as the evaluation criteria, since access to groundwater could be occurring in/near losing reaches. **Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. Specifically, it is highly advised that fluctuations in the groundwater regime be characterized in space and time to understand the seasonal and interannual groundwater variability in GDEs.**

Checklist Items 16 to 20, Describing GDEs (23 CCR §354.16)

- **Once potential GDEs are identified, please provide information on the historical or current groundwater conditions in the GDEs or the ecological conditions present.** Refer to GDE Pulse (<https://gde.codefornature.org>; See Attachment E of this letter for more details) or any other locally available data to describe depth to groundwater trends in and around GDE areas, as well as trends in plant growth (e.g., NDVI) and plant moisture (e.g., NDMI). Below is a screenshot example of data available in GDE Pulse for NC dataset polygons found in the Mid-Kaweah Subbasin:



- Once potential GDEs are identified, provide an inventory of the vegetation types or habitat types and rank the vegetation species as having a high, moderate or low value. **Please identify whether any endangered or threatened freshwater species of animals and plants or areas with critical habitat were found in any of the GDEs.** The list of freshwater species located in the Kaweah Subbasin can be found in Attachment C of this letter.

Checklist Items 21 and 22 – Water Budget (23 CCR §354.18)

- [Appendix 2A Section 2.5.1.3 Summary of Water Budget Components (p. 102)]
 - Please clarify what the term “phreatophyte extraction” means. The text states “Phreatophyte extraction consists of removing vegetation in riparian areas to prevent consumptive water use.” If phreatophytes were indeed removed from within the Subbasin, please provide further details. If phreatophyte extraction refers to the uptake of groundwater by phreatophytes, then correct this text. It should be clearly stated if the phreatophytes are referring to GDE vegetation (riparian vegetation). Also the reference is from 2007 and the acreage and ET estimation methodology may be outdated.
 - **Please clarify what assumptions and data were used to calculate the outflow term from groundwater by phreatophytes.**

Checklist Items 23 to 25 – Sustainability Goal (23 CCR §354.24)

- [Section 3.1 Sustainability Goal (p. 3-2)] “The broadly stated sustainability goal for the Kaweah Subbasin as agreed to by the three GSAs therein is, for each GSA to manage groundwater resources to preserve the quality of life through maintaining the viability of existing enterprises of the region, both agricultural and urban.” There

is no mention of protection of ISWs or GDEs, and no indication that environmental stakeholders were consulted. **Please expand the goal to include protection of GDEs, ISWs, and critical habitats.**

- [Section 3.2.1.5 Interconnected Surface Waters (p. 3-4)] The statement “Depletion of interconnected surface waters are minimal and, to the extent they occur, impact only vegetation along the banks of unlined channels within the forebay regions of the aquifer system....” is not backed up by evidence presented in the GSP. **Once ISWs are analyzed per our comments on Checklist Items 8, 9, and 10 above, please revise this section, noting any data gaps to be filled.**

Checklist Item 26 – Measurable Objectives (23 CCR §354.30)

- [Section 5.4.1 Groundwater Level Measurable Objectives (p. 5-18 to 5-20)] The measurable objective was set equal to the water level at 2030 using the 2006-2016 water level trend for each of the wells selected as representative monitoring sites. The specific measurable objectives for all of the selected wells are listed in Table 5-3. **Please explain how the measurable objectives will help achieve the sustainability goal as it pertains to the environment. After GDEs and ISWs are identified, please discuss if any impacts to GDEs or ISWs are expected. Data gaps should be noted and addressed in the Monitoring section.**

Checklist Items 27 to 29 – Minimum Thresholds (23 CCR §354.28)

- [Section 5.3.1 Minimum Thresholds – Chronic Lowering of Groundwater Levels (p. 5-1 to 5-9)] The trend of the 2006-2016 water levels over time was used to set the minimum threshold at 2040 for each of the wells, used as representative monitoring sites, in each of four hydrogeologic zones within the Subbasin (shown on Figure 5.1, p. A5-1). The minimum thresholds and other sustainable criteria for each well are listed in Table 5-3 (p. 5-5). The minimum threshold derived in this manner means that it is based on a pre-SGMA level. **After GDEs are identified, please add discussion of the possible impacts to the environment. Data gaps should be noted and addressed in the Monitoring section.**

Checklist Items 30 to 46 – Undesirable Results (23 CCR §354.26)

- [Section 3.2.2.5 Interconnected Surface Waters (p. 3-7)] **Please specifically cite “periodic comparisons of surface water elevations and flowrate depletion in applicable stream channels and adjacent groundwater” as a data gap and further address in the monitoring section.**
- [Section 3.2.3.5 Interconnected Surface Waters (p. 3-9)] As noted above, an inventory of the vegetation types or habitat types and ranking of the vegetation species as having a high, moderate or low value will provide rationale for the statement that “the intermittent nature of this vegetative habitat is such that its temporary loss does not rise to the level of an undesirable result.”

- [Section 5.3.1.2 Undesirable Results (p. 5-2)] After the identification and evaluation of potential GDEs is completed, this section should discuss impacts to those GDEs. Specifically,
 - For chronic lowering of water level, the GSP Committee considered that one-third of the representative monitoring sites (wells) exceeding minimum thresholds for water levels would constitute an undesirable result. There appears to be no additional guidance to protect potential GDEs or ISWs. **Please discuss how this undesirable result can be used to avoid impacts to GDEs or ISWs.**
 - There appears to be no consideration of undesirable results on land uses that include and consider recreational uses (e.g. fishing/hunting, hiking, boating) and property interests that include and consider privately and publicly protected conservation lands and open spaces, including wildlife refuges, parks and natural preserves. **Please describe how impacts to these types of properties will be avoided.**
 - **Please provide more specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs.** The definition of 'significant and unreasonable' is a qualitative statement that is used to describe when undesirable results would occur in the basin, such that a minimum threshold can be quantified. Potential effects on all beneficial users of groundwater in the basin need to be taken into consideration. According to the California Constitution Article X, §2, water resources in California must be "put to beneficial use to the fullest extent of which they are capable". **Please identify appropriate biological indicators that can be used to monitor potential impacts to environmental beneficial users due to groundwater conditions. Refer to Appendix E of this letter for an overview of a free, new online tool for monitoring the health of GDEs over time.**

Checklist Items 47, 48 and 49 – Monitoring Network (23 CCR §354.34)

- [Section 4.4 Groundwater Level Monitoring Network (p.4-6 to 4-11)]
 - The GSP proposes to use groundwater level monitoring for chronic groundwater level. Some of the monitoring wells are missing well construction information (only 22 of 37 wells are complete). Only 14 of the 37 wells are screened in the Upper Aquifer. The missing well information is a known data gap and was acknowledged on p. 4-15. Two multi-level wells are proposed to help fill this data gap, shown on Figure 4-7 (p. 4-22). **The missing information should be obtained or a different well selected for monitoring.**
 - "As stated previously, the interconnection of surface water and groundwater was disrupted many decades ago in the MKGSA. Therefore, a monitoring network and monitoring is not required for this GSA (p. 4-14)." Data has not been presented to substantiate this statement. **Please provide additional analysis to back-up this conclusion.**

- Per the GSP Regulations (23 CCR §354.34 (a) and (b)), monitoring must address trends in groundwater and related surface conditions (emphasis added). Groundwater level monitoring alone may be insufficient to establish a linkage between groundwater extraction and potentially resulting impacts to environmental resources associated with GDEs and ISWs. The cause-effect relationship between groundwater levels and the biological responses that could result in significant and unreasonable impacts to ISWs and GDEs depends on a number of complicated factors, and this relationship is not characterized or discussed. As such, it is not possible to determine whether the proposed monitoring, minimum thresholds and measurable objectives are sufficiently protective to ensure significant and unreasonable impacts to GDEs and ISWs will be prevented. **Please add monitoring of potential GDEs and at any locations where ISWs have been or were previously present.**
- [Section 8.1 Annual Reporting Summary to DWR (p. 8-1 to 8-2)] “Groundwater contour maps submitted during the first five years may reflect a composite of the principal aquifers within the subbasin due to data gaps as discussed in Section 2 of this Plan. As additional dedicated monitoring wells are installed, and as more knowledge is gained regarding subbasin hydrogeology, groundwater conditions within each separate aquifer will be better understood (p. 8-1).” **A groundwater elevation map should be prepared for the Upper Aquifer above the Corcoran Clay**, as that is the only way one can determine the appropriate depth relationships between the surface water and the groundwater, which are needed to designate a GDE. Mixing shallow and deep wells, particularly when confined conditions may be present, can be misleading.

Checklist Items 50 and 51 – Projects and Management Actions to Achieve Sustainability Goal (23 CCR §354.44)

- [Section 7 Projects and Management Actions (p. 7-1)] A summary of projects and management actions are listed on p. 7-1 and described in the following pages (p. 7-2 through 7-30).
 - Most of the proposed projects involve recharge to groundwater. “Visalia Eastside Regional Park & Groundwater Recharge project to be built by the City of Visalia consists of a 250-acre park featuring diverse recreational opportunities, native plants, wildlife habitat, and integrated groundwater replacement and storm water retention facilities (p. 7-26).” This is an example of a project with environmental benefits and multiple other benefits. Consistent with existing grant and funding guidelines for SGMA-related work, priority should be given to multi-benefit projects that can address water quantity as well as providing environmental benefits or benefits to disadvantaged communities. **Please state how ISWs and GDEs will benefit or be protected, or what other environmental benefits will accrue.**

- Recharge ponds, reservoirs and facilities for managed stormwater recharge can be designed to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. In some cases, such facilities have been incorporated into local HCPs, more fully recognizing the value of the habitat that they provide and the species they support. For projects that will be constructing recharge ponds, **please identify if there will be habitat value incorporated into the design and how the recharge ponds will be managed to benefit environmental users.**

Attachment C

Freshwater Species Located in the Kaweah Subbasin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result “depletion of interconnected surface waters”, Attachment C provides a list of freshwater species located in the Kaweah Subbasin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the GSA’s boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015⁷. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife’s BIOS⁸ as well as on The Nature Conservancy’s science website⁹.

Scientific Name	Common Name	Legally Protected Species		
		Federal	State	Other
Birds				
<i>Actitis macularius</i>	Spotted Sandpiper			
<i>Aechmophorus clarkii</i>	Clark's Grebe			
<i>Aechmophorus occidentalis</i>	Western Grebe			
<i>Agelaius tricolor</i>	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
<i>Aix sponsa</i>	Wood Duck			
<i>Anas acuta</i>	Northern Pintail			
<i>Anas americana</i>	American Wigeon			
<i>Anas clypeata</i>	Northern Shoveler			
<i>Anas crecca</i>	Green-winged Teal			
<i>Anas cyanoptera</i>	Cinnamon Teal			
<i>Anas discors</i>	Blue-winged Teal			
<i>Anas platyrhynchos</i>	Mallard			
<i>Anas strepera</i>	Gadwall			
<i>Anser albifrons</i>	Greater White-fronted Goose			
<i>Ardea alba</i>	Great Egret			
<i>Ardea herodias</i>	Great Blue Heron			
<i>Aythya affinis</i>	Lesser Scaup			
<i>Aythya americana</i>	Redhead		Special Concern	BSSC - Third priority
<i>Aythya collaris</i>	Ring-necked Duck			
<i>Aythya marila</i>	Greater Scaup			

⁷ Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoS ONE, 11(7). Available at: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710>

⁸ California Department of Fish and Wildlife BIOS: <https://www.wildlife.ca.gov/data/BIOS>

⁹ Science for Conservation: <https://www.scienceforconservation.org/products/california-freshwater-species-database>

<i>Aythya valisineria</i>	Canvasback		Special	
<i>Botaurus lentiginosus</i>	American Bittern			
<i>Bucephala albeola</i>	Bufflehead			
<i>Bucephala clangula</i>	Common Goldeneye			
<i>Butorides virescens</i>	Green Heron			
<i>Calidris alpina</i>	Dunlin			
<i>Calidris mauri</i>	Western Sandpiper			
<i>Calidris minutilla</i>	Least Sandpiper			
<i>Chen caerulescens</i>	Snow Goose			
<i>Chen rossii</i>	Ross's Goose			
<i>Chlidonias niger</i>	Black Tern		Special Concern	BSSC - Second priority
<i>Chroicocephalus philadelphia</i>	Bonaparte's Gull			
<i>Cistothorus palustris palustris</i>	Marsh Wren			
<i>Cygnus columbianus</i>	Tundra Swan			
<i>Cypseloides niger</i>	Black Swift	Bird of Conservation Concern	Special Concern	BSSC - Third priority
<i>Egretta thula</i>	Snowy Egret			
<i>Empidonax traillii</i>	Willow Flycatcher	Bird of Conservation Concern	Endangered	
<i>Fulica americana</i>	American Coot			
<i>Gallinago delicata</i>	Wilson's Snipe			
<i>Grus canadensis</i>	Sandhill Crane			
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Bird of Conservation Concern	Endangered	
<i>Himantopus mexicanus</i>	Black-necked Stilt			
<i>Icteria virens</i>	Yellow-breasted Chat		Special Concern	BSSC - Third priority
<i>Ixobrychus exilis hesperis</i>	Western Least Bittern		Special Concern	BSSC - Second priority
<i>Limnodromus scolopaceus</i>	Long-billed Dowitcher			
<i>Lophodytes cucullatus</i>	Hooded Merganser			
<i>Megaceryle alcyon</i>	Belted Kingfisher			
<i>Mergus merganser</i>	Common Merganser			
<i>Mergus serrator</i>	Red-breasted Merganser			
<i>Numenius americanus</i>	Long-billed Curlew			
<i>Numenius phaeopus</i>	Whimbrel			
<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron			
<i>Oxyura jamaicensis</i>	Ruddy Duck			

<i>Pelecanus erythrorhynchos</i>	American White Pelican		Special Concern	BSSC - First priority
<i>Phalacrocorax auritus</i>	Double-crested Cormorant			
<i>Phalaropus tricolor</i>	Wilson's Phalarope			
<i>Plegadis chihi</i>	White-faced Ibis		Watch list	
<i>Pluvialis squatarola</i>	Black-bellied Plover			
<i>Podiceps nigricollis</i>	Eared Grebe			
<i>Podilymbus podiceps</i>	Pied-billed Grebe			
<i>Porzana carolina</i>	Sora			
<i>Rallus limicola</i>	Virginia Rail			
<i>Recurvirostra americana</i>	American Avocet			
<i>Riparia riparia</i>	Bank Swallow		Threatened	
<i>Setophaga petechia</i>	Yellow Warbler			BSSC - Second priority
<i>Tachycineta bicolor</i>	Tree Swallow			
<i>Tringa melanoleuca</i>	Greater Yellowlegs			
<i>Tringa semipalmata</i>	Willet			
<i>Tringa solitaria</i>	Solitary Sandpiper			
<i>Xanthocephalus xanthocephalus</i>	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
Crustaceans				
<i>Branchinecta lynchi</i>	Vernal Pool Fairy Shrimp	Threatened	Special	IUCN - Vulnerable
<i>Lepidurus packardii</i>	Vernal Pool Tadpole Shrimp	Endangered	Special	IUCN - Endangered
Fishes				
<i>Catostomus occidentalis occidentalis</i>	Sacramento sucker			Least Concern - Moyle 2013
<i>Cottus gulosus</i>	Riffle sculpin		Special	Near-Threatened - Moyle 2013
<i>Lampetra hubbsi</i>	Kern brook lamprey		Special Concern	Vulnerable - Moyle 2013
<i>Lavinia exilicauda exilicauda</i>	Sacramento hitch		Special	Near-Threatened - Moyle 2013
<i>Lavinia symmetricus symmetricus</i>	Central California roach		Special Concern	Near-Threatened - Moyle 2013
<i>Mylopharodon conocephalus</i>	Hardhead		Special Concern	Near-Threatened - Moyle 2013
<i>Oncorhynchus mykiss irideus</i>	Coastal rainbow trout			Least Concern - Moyle 2013
<i>Orthodon microlepidotus</i>	Sacramento blackfish			Least Concern - Moyle 2013

<i>Ptychocheilus grandis</i>	Sacramento pikeminnow			Least Concern - Moyle 2013
Herps				
<i>Actinemys marmorata marmorata</i>	Western Pond Turtle		Special Concern	ARSSC
<i>Ambystoma californiense californiense</i>	California Tiger Salamander	Threatened	Threatened	ARSSC
<i>Anaxyrus boreas boreas</i>	Boreal Toad			
<i>Rana boylei</i>	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
<i>Spea hammondi</i>	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
<i>Taricha torosa</i>	Coast Range Newt		Special Concern	ARSSC
<i>Thamnophis couchii</i>	Sierra Gartersnake			
<i>Thamnophis sirtalis sirtalis</i>	Common Gartersnake			
Insects and Other Invertebrates				
<i>Eulimnichus analis</i>				Not on any status lists
<i>Ischnura barberi</i>	Desert Forktail			
Mammals				
<i>Castor canadensis</i>	American Beaver			Not on any status lists
<i>Lontra canadensis canadensis</i>	North American River Otter			Not on any status lists
<i>Ondatra zibethicus</i>	Common Muskrat			Not on any status lists
Mollusks				
<i>Physella virgata</i>	Protean Physa			CS
Plants				
<i>Alnus rhombifolia</i>	White Alder			
<i>Ammannia coccinea</i>	Scarlet Ammannia			
<i>Anemopsis californica</i>	Yerba Mansa			
<i>Azolla filiculoides</i>	NA			
<i>Baccharis glutinosa</i>	NA			Not on any status lists
<i>Bidens laevis</i>	Smooth Bur-marigold			
<i>Carex densa</i>	Dense Sedge			
<i>Cephalanthus occidentalis</i>	Common Buttonbush			
<i>Cyperus acuminatus</i>	Short-point Flatsedge			

Cyperus erythrorhizos	Red-root Flatsedge			
Downingia bella	Hoover's Downingia			
Echinodorus berteroi	Upright Burhead			
Eleocharis macrostachya	Creeping Spikerush			
Epilobium cleistogamum	Cleistogamous Spike-primrose			
Eryngium pinnatisectum	Tuolumne Coyote-thistle		Special	CRPR - 1B.2
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle		Special	CRPR - 1B.2
Eryngium vaseyi vaseyi	Vasey's Coyote-thistle			Not on any status lists
Euthamia occidentalis	Western Fragrant Goldenrod			
Lasthenia ferrisiae	Ferris' Goldfields		Special	CRPR - 4.2
Lasthenia fremontii	Fremont's Goldfields			
Leersia oryzoides	Rice Cutgrass			
Lemna minor	Lesser Duckweed			
Ludwigia peploides peploides	NA			Not on any status lists
Marsilea vestita vestita	NA			Not on any status lists
Mimulus cardinalis	Scarlet Monkeyflower			
Mimulus guttatus	Common Large Monkeyflower			
Mimulus tricolor	Tricolor Monkeyflower			
Myosurus minimus	NA			
Myriophyllum hippuroides	Western Water-milfoil			
Orcuttia inaequalis	San Joaquin Valley Orcutt Grass	Threatened	Endangered	CRPR - 1B.1
Paspalum distichum	Joint Paspalum			
Phyla nodiflora	Common Frog-fruit			
Plagiobothrys acanthocarpus	Adobe Popcorn-flower			
Platanus racemosa	California Sycamore			
Puccinellia simplex	Little Alkali Grass			
Rumex occidentalis				Not on any status lists
Sagina saginoides	Arctic Pearlwort			
Salix exigua exigua	Narrowleaf Willow			
Salix gooddingii	Goodding's Willow			
Salix laevigata	Polished Willow			
Salix lasiolepis lasiolepis	Arroyo Willow			

Stachys albens	White-stem Hedge-nettle			
Typha domingensis	Southern Cattail			
Typha latifolia	Broadleaf Cattail			

Attachment D

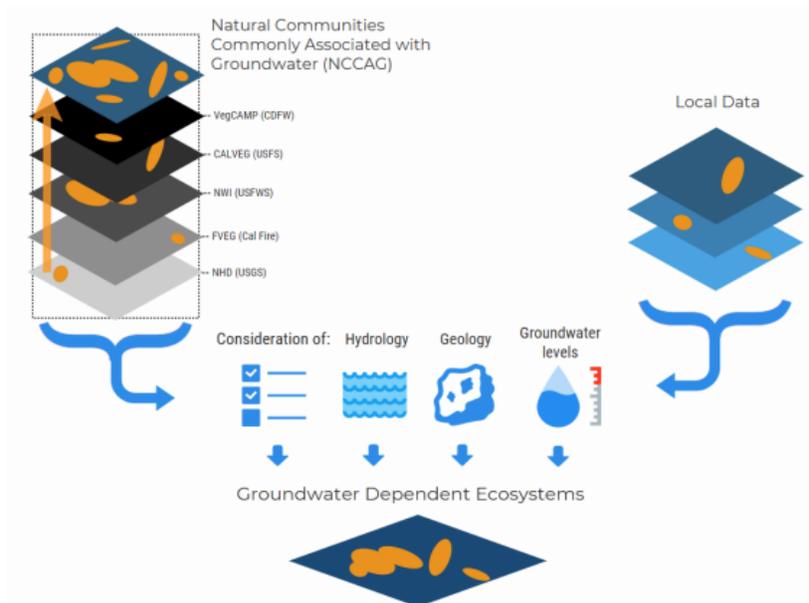


July 2019



IDENTIFYING GDEs UNDER SGMA Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online¹⁰ to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)¹¹. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.



¹⁰ NC Dataset Online Viewer: <https://gis.water.ca.gov/app/NCDatasetViewer/>

¹¹ California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf>

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California¹². It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset¹³ on the Groundwater Resource Hub¹⁴, a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should be done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer.*

¹² For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf

¹³ "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: <https://groundwaterresourcehub.org/qde-tools/gsp-guidance-document/>

¹⁴ The Groundwater Resource Hub: www.GroundwaterResourceHub.org

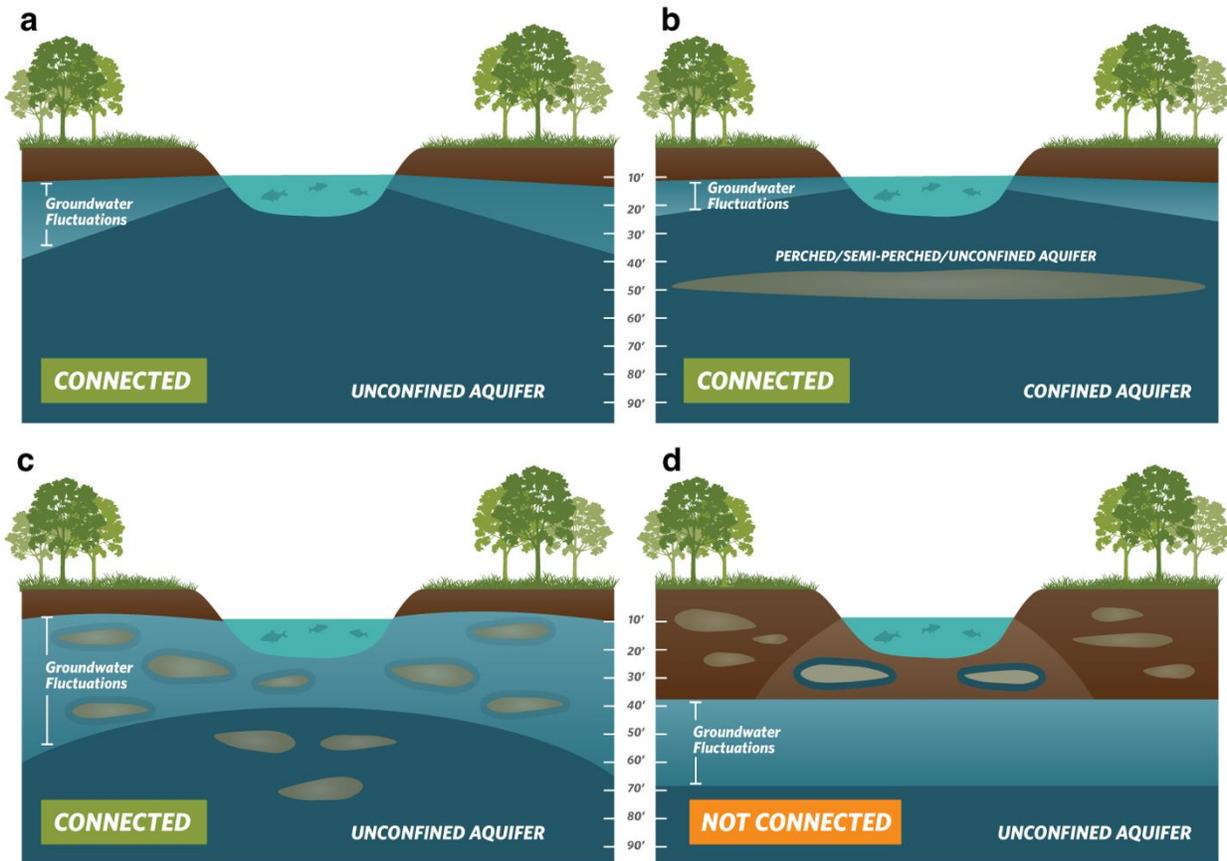


Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. **(b)** Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. **Bottom: (c)** Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem’s connection to groundwater. **(d)** Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California’s climate. DWR’s Best Management Practices document on water budgets¹⁵ recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline¹⁶ could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach¹⁷ for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC’s GDE guidance document⁴, one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California’s Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California’s GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet⁴ of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer¹⁸. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).



Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

¹⁵ DWR. 2016. Water Budget Best Management Practice. Available at:

https://water.ca.gov/LegacyFiles/groundwater/sqm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

¹⁶ Baseline is defined under the GSP regulations as “historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin.” [23 CCR §351(e)]

¹⁷ Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs⁴).

¹⁸ SGMA Data Viewer: <https://sgma.water.ca.gov/webqis/?appid=SGMADataViewer>

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals¹⁹, which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

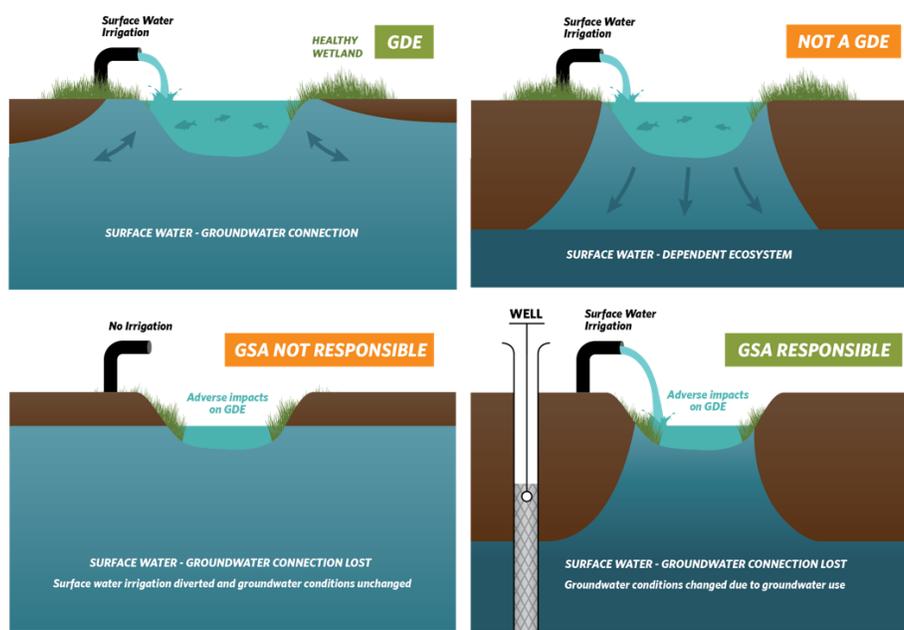


Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. **(Right)** Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. **Bottom: (Left)** An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. **(Right)** Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

¹⁹ For a list of environmental beneficial users of surface water by basin, visit: <https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/>

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.
- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.
- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

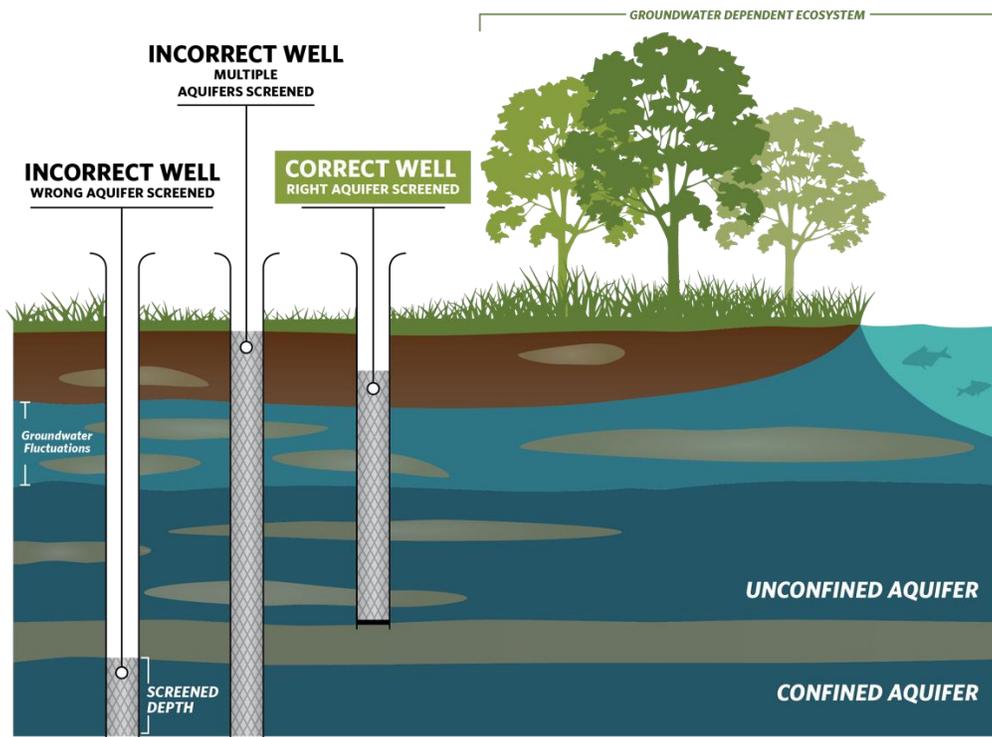


Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate **groundwater elevations** at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)²⁰ to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

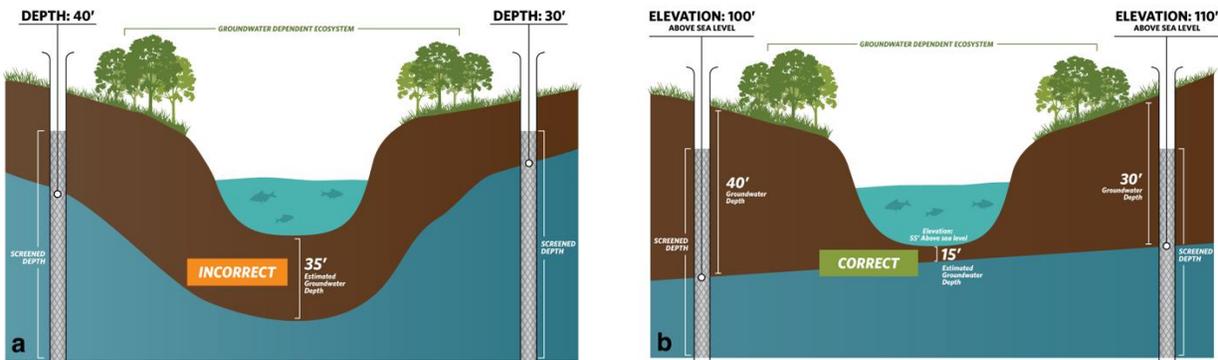


Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. **(b)** Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

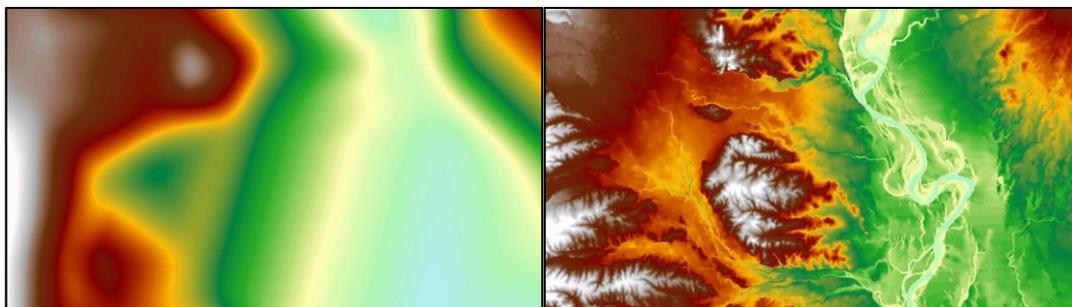


Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. **(Right)** Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

²⁰ USGS Digital Elevation Model data products are described at: <https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services> and can be downloaded at: <https://iewer.nationalmap.gov/basic/>

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, **The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network.** Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. 23 CCR §341(g)(1)

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. 23 CCR §351(m)

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. 23 CCR §351(o)

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. 23 CCR §351(aa)

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Attachment E

GDE Pulse

A new, free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data.



Visit
<https://gde.codefornature.org/>



Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset²¹. The following datasets are included:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset²². The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

²¹ The Natural Communities Commonly Associated with Groundwater Dataset is hosted on the California Department of Water Resources' website: <https://gis.water.ca.gov/app/NCDatasetViewer/#>

²² The PRISM dataset is hosted on Oregon State University's website: <http://www.prism.oregonstate.edu/>