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County Government Center
1055 Monterey Street, Room 206
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Submitted online via: https://www.slocounty.ca.gov/Departments/Public-Works/Committees-Programs/Sustainable-Groundwater-Management-Act-(SGMA)/Paso-Robles-Groundwater-Basin/GSP-Development.aspx

Re: Paso Robles Subbasin Draft Groundwater Sustainability Plan

Dear Angela Ruberto,

The Nature Conservancy (TNC) appreciates the opportunity to comment on the Paso Robles Subbasin Draft Groundwater Sustainability Plan (GSP) being prepared under the Sustainable Groundwater Management Act (SGMA). Please note that we have previously submitted comments dated 15 April 2019 on Chapters 4-8 and Appendix B and comments dated 1 July 2019 on Chapters 9-11 of the Paso Robles Subbasin Draft GSP. Where these comments have not yet been addressed in the most recent draft, they are restated in this letter with updated section number and page number callouts. In reviewing this version of the plan, we recognize that several TNC tools and approaches were used in the preparation of the sections related to ecosystems, notably the initial identification of groundwater dependent ecosystems (GDEs) in the Paso Robles Subbasin. This is clearly an important first step; however, our comments in this letter highlight additional refinement, monitoring, and future management activities that are needed to fulfil SGMA requirements with respect to GDEs in this basin.

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 Paso Robles 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. Some of these tools have been used in the preparation of the present draft plan. Additional resources are available and referred to in the comments that follow, and are considered pertinent to the development of this plan.

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 and are developed from 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.

[1] GDEs 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. 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 online[2] 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

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 Paso Robles 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 Lookbook[3] 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 reviewed the Paso Robles Draft GSP. We appreciate the work that has gone into the preparation of this plan. Specifically, we recognize the use of the NC dataset and other TNC guidance for initial identification of GDE areas in the basin. However, we believe that additional work is needed to refine the initial area estimates including identification of species that may be present in the GDEs, development of monitoring plans to address data gaps, and a more complete evaluation of future management actions to protect GDEs in the basin. Hence, we consider the current GSP draft to be **incomplete** under SGMA.

Our specific comments related to the Paso Robles 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 Paso Robles 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 Dataset[2]. **Attachment E** provides an overview of a

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

[3] Available online at: https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/

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.

Best Regards,

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** *23 CCR §354.10*	**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** *23 CCR §354.8*	**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** *23 CCR §354.14*	**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 *23 CCR §354.16*	**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 not* 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 *are available* 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 *are not available* 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
Paso Robles Subbasin Groundwater Sustainability Plan

A complete draft of the Paso Robles Subbasin Groundwater Sustainability Plan (GSP) Public Draft was provided for public review on August 14, 2019. This attachment summarizes our comments on the complete public draft GSP. Please note that we have previously submitted comments dated 15 April 2019 on Chapters 4-8 and Appendix B (now Appendix C) and comments dated 1 July 2019 on Chapters 9-11. Where these comments have not yet been addressed in the most recent draft, they are restated herein with updated section number and page number callouts. Comments are provided in the order of the checklist items included as Attachment A.

<u>Checklist Item 1 - Notice & Communication (23 CCR §354.10)</u>

[Chapter 11 Notice and Communications (including separate Communications and Engagement Plan, Appendix M)]

- Section 3.0 of the Communications and Engagement Plan (Page 6) lists aquatic ecosystems as a beneficial groundwater use. **However, no details are given as to the types and locations of environmental uses and habitats supported, or the designated beneficial environmental uses of surface waters that may be affected by groundwater extraction in the subbasin. 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 Paso Robles Subbasin in **Attachment C** of this letter. Please take particular note of the species with protected status.
    - Lands that are protected as open space preserves, habitat reserves, wildlife refuges, etc. or other lands protected in perpetuity and supported by groundwater or ISWs should be identified and acknowledged.

<u>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</u>

[Section 3.6 Existing Monitoring Programs (p. 3-17)]

- Per the GSP Regulations (23 CCR §354.34 (a) and (b)), monitoring must address trends in groundwater and *<u>related surface conditions</u>* (emphasis added). In order for this section to provide the appropriate context and help assure integration of GSP implementation with other ongoing regulatory programs, this section should describe the following:

- **Monitoring activities and responsibilities by State, Federal and local agencies and jurisdictions related to aquatic resources and GDEs that could be affected by groundwater withdrawals should be discussed.**
- The Critical Habitat for Threatened and Endangered Species website maintained by the US Fish and Wildlife Service (https://fws.maps.arcgis.com/home/webmap/viewer.html?webmap=9d8de5e265ad4fe09893cf75b8dbfb77) identifies lands with endangered and threatened species in the Basin, including species potentially associated with interconnected surface waters ISWs, including Steelhead (Onocorhynchus mykiss). Also please refer to the Critical Species Lookbook[4] 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.**

[Section 3.8.6 Requirements for New Wells (p. 3-30)]

- **Future well permitting must be coordinated with the GSP to assure achievement of the Plan's sustainability goals.**
- 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.**

[Section 3.10 Land Use Plans (p. 3-31)]

- 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. **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, riparian areas, oak woodlands, 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.**

<u>Checklist Items 5, 6, and 7 – Hydrogeologic Conceptual Model (23 CCR §354.14)</u>

[Section 4.1 Subbasin Topography and Boundaries (p. 4-1)]

- Please provide additional information on what data was used to determine that "poor quality" groundwater in the Paso Robles Formation would exclude groundwater from being part of the subbasin.

[4] Available online at: https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/

- Defining the bottom of subbasin based on geochemical properties is a suitable approach for defining the base of freshwater, however, 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.** This will prevent the possibility of extractors with wells deeper than the basin boundary (defined by the base of freshwater) from claiming exemption of SGMA due to their well residing outside the vertical extent of the basin boundary.

[Section 4.7.2 Groundwater Discharge Areas Inside the Subbasin (p. 4-32)]

- We support the use of the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) to map groundwater dependent ecosystems in the Paso Robles Groundwater Basin (GSP Draft Figure 4-18). Since the NC Dataset is intended as a starting point, The Nature Conservancy has developed a Guidance Document to assist GSAs and their consultants in addressing GDEs in GSPs[5]. Also refer to **Attachment D** for best practices when using the NC dataset.
- The identification of GDEs within GSPs is a required GSP element of the Basin Setting Section under the description of Current & Historical Groundwater Conditions (23 CCR §354.16). Recognizing natural points of discharge (seeps & springs) as GDEs is consistent with the SGMA definition of GDEs[6]; **however, we recommend the identification of GDEs (GDE map Figure 4-18) for the Paso Robles basin be moved to Chapter 5: Groundwater Conditions, and elaborated upon with a description of current and historical groundwater conditions in the GDE areas.** Chapter 5 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.
- Decisions to remove, keep, or add polygons from the NC dataset into a basin GDE map should be based on best available science in a manner that promotes transparency and accountability with stakeholders. Any polygons that are removed, added, or kept should be inventoried in the submitted shapefile to DWR, and mapped in the plan. **We recommend revising Figure 4-18 to reflect this recommended methodology.**

[Section 5.2 Change in Groundwater Storage (p. 5-20)]

- Figure 5-11 illustrates that groundwater storage losses occurred during dry years and recovered in wet years. Potential impacts on groundwater storage loss due to

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

[6] Groundwater dependent ecosystem refer to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. [23 CCR §351 (m)]

groundwater pumping is still very possible, especially since groundwater pumping data has been estimated from groundwater flow models populated with insufficient vertical groundwater gradient data, shallow monitoring data, and surface flow data. Groundwater storage in the Paso Robles formation has also been on a decline since 1980 due to groundwater pumping (Figure 5-12). Understanding groundwater storage fluctuations in the Alluvial Aquifer depends on how vertical groundwater gradients are impacted by pumping and groundwater storage changes in the Paso Robles Formation. **Please address these data gaps in the monitoring network.**

<u>Checklist Items 8, 9, and 10 – Interconnected Surface Waters (ISW) (23 CCR §354.16)</u>

[Section 5.5 Interconnected Surface Waters (p. 5-26)]

- **Please note the following best practices when filling the data gap in delineating any connections between surface water and groundwater.**
    - **Specify what data are used to determine the elevation of the stream or river bottom.**
    - The regulations [23 CCR §351(o)] define interconnected surface waters (ISW) as "surface water that is hydraulically connected <u>at any point</u> by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted". **"<u>At any point</u>" 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. ISWs can be either gaining or losing.
    - Due to limited shallow monitoring wells and stream gauges in the basin, **mapping ISWs are best estimated by first determining which reaches are completely disconnected from groundwater. This approach would involve comparing simulated 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 identified as disconnected surface waters. Also, 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 in future GSPs**.

<u>Checklist Items 11 to 20, Identifying, Mapping, and Describing GDEs (23 CCR §354.16)</u>

[Appendix C: Methodology for Identifying Potential Groundwater Dependent Ecosystems]

- For clarification, iGDEs are mapped polygons in DWR's NC dataset.

- **Please specify what field verification methods (e.g., isotope analysis, enhanced shallow groundwater monitoring) will be used to definitively determine whether potential GDEs are true GDEs.**
- **It is highly advised that multiple depth to groundwater measurements are used to verify whether an iGDE (or NC dataset polygon) is connected to groundwater, so that fluctuations in the groundwater regime can be adequately represented.** The analysis described on p.7 to create Figure C-3 only relies on Spring 2017 depth data, which is also after the Jan 1, 2015 SGMA benchmark date. Also, according to the shallow monitoring well data gaps described in Chapter 5 and 7, there is insufficient data to confidently remove data for NC polygons that are >5km away from a shallow well. See Attachment D of this letter for six best practices when using groundwater data to verify the NC dataset.
- **The NC dataset needs to be groundtruthed with aerial photography to screen for changes in land use that many not be reflected in the NC dataset (e.g., recent development, cultivated agricultural land, obvious human-made features).**
- Grouping multiple GDE polygons into larger units by location (proximity to each other) and principal aquifer will help to characterize GDEs under Section 4.7.2 and would simplify the process of evaluating potential effects on GDEs due to groundwater conditions under GSP Chapter 8: Sustainable Management Criteria.
- **Groundwater conditions within GDEs and the interaction between GDEs and groundwater should be briefly described within the portion of the Basin Setting Section (Section 4.7.2) where GDEs are being identified.**
- Not all GDEs are created equal. Some GDEs may contain legally protected species or ecologically rich communities, whereas other GDEs may be highly degraded with little conservation value. Including a description of the types of species (protected status, native versus non-native), habitat, and environmental beneficial uses (Refer to **Attachment C** for a list of freshwater species found in the Paso Robles Subbasin, refer to Worksheet 2, p.74 of GDE Guidance Document, and see the Critical Species Lookbook[7]) can be helpful in assigning an ecological value to the GDEs. **Identifying an ecological value of each GDE can help prioritize limited resources when considering GDEs as well as prioritizing legally protected species or habitat that may need special consideration when setting sustainable management criteria.**
- Decisions to remove, keep, or add polygons from the NC dataset into a subbasin GDE map should be based on best available science in a manner that promotes transparency and accountability with stakeholders. Any polygons that are removed, added, or kept should be inventoried in the submitted shapefile to DWR, and mapped in the plan. **We recommend revising Figure 4-18 (replicated as Figure C-7) and including it in Chapter 5 to reflect this change. Please provide the final acreage of subbasin GDE polygons.**
- While depth to groundwater levels within 30 feet are generally accepted as being a proxy for confirming that polygons in the NC dataset are connected to groundwater, the variable needs of plant species and their dependence on seasonal and inter-

[7] Available online at: https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/

annual groundwater level fluctuations should be considered when applying this criterion. Studies have found the roots of oaks can extend deeper than 70 feet to extract water from the capillary fringe immediately above the water table during the summer and fall, and that groundwater reserves provide a buffer to rapid changes in their hydroclimate, as long as groundwater reserves are not depleted by drought or human consumption.[8] **It is highly advised that seasonal and interannual fluctuations in the groundwater regime are taken into consideration. Utilizing groundwater data from one point in time or contoured with too few shallow monitoring wells can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs.** Based on a study we recently submitted to Frontiers in Environmental Science Journal, we've observed riparian forests along the Cosumnes River to experience a range in groundwater levels between 1.5 and 75 feet over seasonal and interannual timescales. Seasonal fluctuations in the regional water table can support perched groundwater near an intermittent river that seasonally runs dry due to large seasonal fluctuations in the regional water table. While perched groundwater itself cannot directly be managed due to its position in the vadose zone, the water table position within the regional aquifer (via pumping rate restrictions, restricted pumping at certain depths, restricted pumping around GDEs, well density rules) and its interactions with surface water (e.g., timing and duration) can be managed to prevent adverse impacts to ecosystems due to changes in groundwater quality and quantity under SGMA.

<u>Checklist Items 21 and 22 – Water Budget (23 CCR §354.18)</u>

[Chapter 6. Water Budget (p. 6-1)]

- **Please clarify what assumptions and data were used to calculate Riparian Evapotranspiration**.
- Why was evapotranspiration only calculated for riparian vegetation? In Chapter 3.4.2 of the Draft GSP (p. 3-11), native vegetation was identified as the largest water use sector in the subbasin by land area. **Please estimate evapotranspiration for all native vegetation in the subbasin for the water budget. Environmental beneficial users of groundwater, such as wetlands and phreatophyte (oak) woodlands are of particular importance and should be explicitly mentioned. Calculations should be provided to quantify the amount of ET in the GDEs both spatially and temporally, including water year type. Please identify any data gaps.**

<u>Checklist Items 23 to 46 – Sustainable Management Criteria</u>

[Section 8.1 Sustainability Goal]

[8] Miller and others. 2009. Groundwater Uptake by Woody Vegetation in a Semi-Arid Oak Savannah. Water Resources Research. Volume 46. November.

- This section states that the groundwater resources in the Paso Robles Subbasin will be managed for the long-term community, financial and environmental benefit of Subbasin users. The discussion of how this goal will be achieved references cultural, community and business needs and related management actions and projects to obtain sustainability, but provides no explanation how environmental beneficial uses will be protected. **Please describe how the sustainability of environmental groundwater and interconnected surface water uses will be protected, and what management actions and conceptual projects will address environmental beneficial uses and users of groundwater.**

[Section 8.2 General Process for Establishing Sustainable Management Criteria]

- Stakeholder involvement is crucial when establishing sustainable management criteria. The role of the GSA is to represent and balance the needs of *all groundwater* beneficial uses and users in the basin, which has been expressed in the Sustainability goal in Section 8.1. According to p. 8-5, only rural residents, farmers, local cities and the county were surveyed to gather input on sustainable management criteria. **Please specify what information or efforts have been used/made to protect the interests of environmental users and disadvantaged community members.**
- SGMA requires that sustainable management criteria are consistent with other state, federal or local regulatory standards [23 CCR§354.28(b)(5)]. No reference is made to the review of supporting documents for General Plan Conservation or Land Use Elements, or to the review of environmental management studies and documents such as Biological Assessments, Biological Opinions, HCPs, NCCPs, or other studies regarding the current and historical conditions of the beneficial uses being evaluated. **Please describe what process was used to identify other regulatory standards that need consideration when establishing minimum thresholds for sustainability criteria, especially those related to protected habitats, minimum flow requirements and habitat conservation plans. Please provide detail on how sustainable management criteria were developed for GDEs and streamflow habitat, and how the above supporting documents were considered.**

[Section 8.3 Chronic Lowering of Groundwater Levels Sustainable Management Criteria]

- [8.3.2] The definition of 'significant and unreasonable' is a qualitative statement that is used to describe when undesirable results would occur in the basin, which is then related to how 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 modify the local definition for 'significant and unreasonable' (provided on p. 8-7), so that it also specifies potential effects on environmental beneficial users of groundwater in the basin.**
- [8.3.3] Under SGMA, Measurable Objectives are to be established to achieve the sustainability goal of the basin within 20 years of Plan implementation [23 CCR §

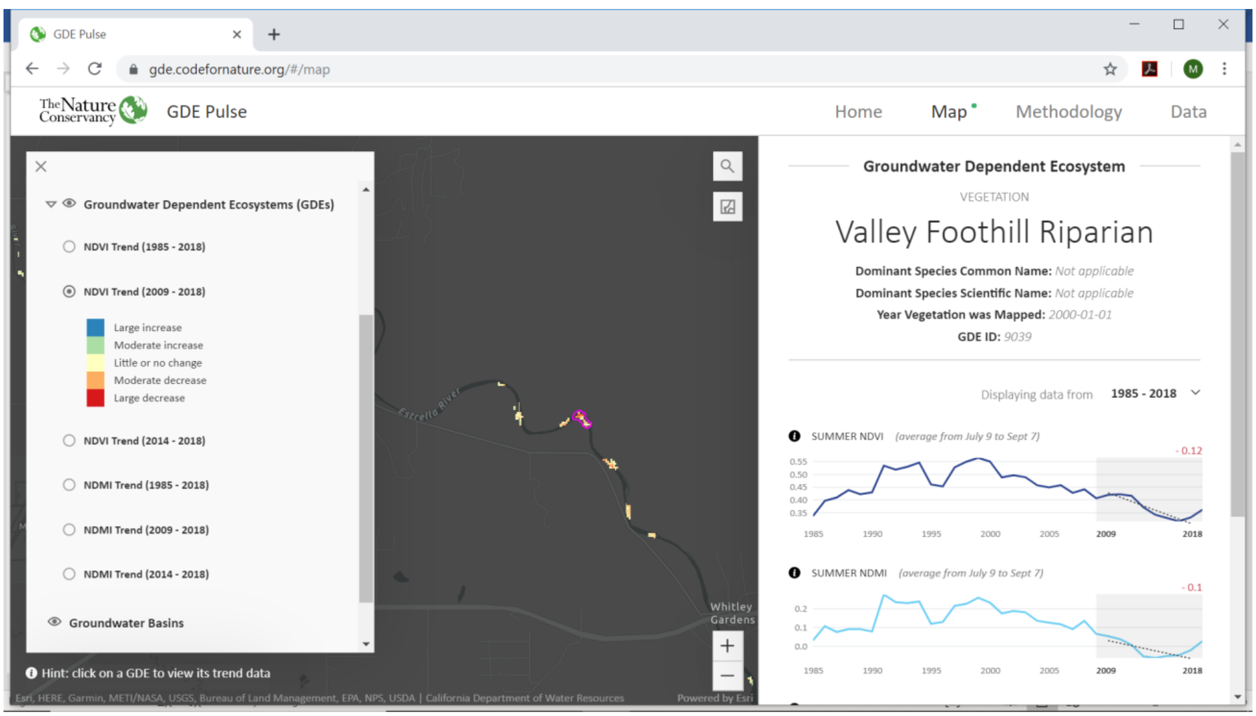
354.30 (a)]. **Please modify the methodology for setting measurable objectives for groundwater levels so that it helps attain the sustainability goal defined on p. 8-4:** "sustainably manage the groundwater resources of the Paso Robles Subbasin for long-term community, financial, ***and environmental*** benefit of Subbasin users. … In adopting this GSP, ***it is the express goal of the GSAs to balance the needs of all groundwater users*** in the Subbasin, within the sustainable limits of the Subbasin's resources." (emphasis added)

  - Section 8.3.3.1 states that environmental interests were considered when establishing measurable objectives. **Please provide a discussion regarding the environmental beneficial uses and users that were considered and how this was accomplished.**
  - Section 8.3.3.2 and 8.3.3.3 present measurable objective for specific wells completed in each principal aquifer, but provide no discussion how a determination was made that these groundwater levels are protective of environmental beneficial uses and users, including GDEs. **Chronic lowering of groundwater levels can have a direct effect on environmental beneficial users and this effect should be considered when setting measurable objectives for this sustainability indicator and discussed in this section and supporting materials provided. Section 8.3.3.1 should describe how environmental beneficial uses and users, including GDEs were considered when establishing measurable objectives for chronic lowering of groundwater levels. Section 8.3.3.2 and 8.3.3.3 should describe how the identified measurable objectives will succeed in preventing significant and unreasonable harm to environmental beneficial uses of groundwater, including GDEs.**

- [8.3.4] **Chronic lowering of groundwater levels can have a direct effect on environmental beneficial users and this effect should be considered when setting minimum thresholds for this sustainability indicator and discussed in this section and supporting materials provided.** A technically defensible approach is to use 10-year baseline period of groundwater elevation data (2005-2015) to establish how groundwater conditions during that time period affect different beneficial water uses and users across the basin, including GDEs**. Please document the consideration of the following when establishing minimum thresholds for chronic lowering of groundwater levels:**
  - The relationship between the minimum threshold for chronic lowering of groundwater levels and potential significant and unreasonable impacts to GDEs and ecological beneficial uses of surface water are not described. **Please provide additional analysis to substantiate that the potential impacts of applying the proposed minimum thresholds will not cause significant and unreasonable impacts to GDEs and ecological beneficial uses of ISW, or identify this as a data gap.**
  - The potential effects of undesirable results on environmental beneficial users are not described and quantified. **Please expand the section to describe the potential effects of undesirable results on all beneficial uses and users, including environmental uses and users.**

- Are the proposed minimum thresholds consistent with other state, federal or local regulatory standards, including those applicable to interconnected surface waters, protected habitats and habitat conservation plans? [23 CCR§354.28(b)(5)]?
- Are there environmental beneficial groundwater users that need consideration, particularly those that are legally protected under the United States Endangered Species Act or California Endangered Species Act? (See **Attachment C** in the attached letter for a list of freshwater species located in the Paso Robles Subbasin)?

- The [GDE Pulse]() web application developed by The Nature Conservancy (**Attachment E**) provides easy access to 35 years of satellite data to view trends of vegetation metrics, groundwater depth (where available), and precipitation data. This satellite imagery can be used to observe trends for NC dataset polygons within the Subbasin, and relate those trends to nearby groundwater level trends. Over the past 10 years (2009-2018), some NC dataset vegetation polygons have experienced adverse impacts to vegetation growth and moisture in the western portion of the Subbasin. An example is shown in the screen shot below. **Please review these spatial patterns and, where possible, correlate them with water level trends when developing minimum thresholds. Any indications of adverse trends and any data gaps should be identified.**



- [8.3.4.2] This section states that only one monitoring well was identified where minimum thresholds could be assessed in the Alluvial Aquifer. This is a significant data gap for a variety of beneficial uses and users, including GDEs and interconnected surface water. **Please describe a plan in the Monitoring network chapter on how the GSA will install shallow monitoring wells in the alluvial aquifer if confidentially agreements prevent existing wells from being used as**

representative monitoring wells for the Chronic Lowering of Groundwater sustainability indicator in this important aquifer.

- [8.3.4.4 and 8.3.4.6] The description of how the groundwater elevation minimum thresholds affect interconnected surface waters and ecological land uses and users is inadequate for the following reasons:
    - The draft GSP has failed to describe current and historical groundwater conditions near GDE areas, the nature of the GDEs and their potential sensitivity to groundwater level declines, and the potential effect of groundwater level declines on GDEs. Thus, it is impossible to assess how the proposed minimum thresholds relate to historical groundwater conditions in the GDE and whether potential adverse effects could occur to the GDEs as a result of groundwater conditions. **Please include a discussion of how minimum thresholds will affect the GDEs identified in Appendix C and identify any data gaps.**
- [8.3.4.7] The identified GDEs have not been adequately described or characterized. Different GDE species will have different susceptibilities to groundwater level declines. Please refer to the Critical Species Lookbook[9] to review and discuss the potential groundwater reliance of critical species in the basin. Legally protected species located with GDEs have not been identified. Thus, it is impossible to evaluate whether federal, state, or local standards exist for groundwater elevations needed to protect these listed species. **Please provide a discussion regarding how the selected minimum thresholds will affect compliance with federal, state and local standards related to protected habitats, protected species, and other requirements, such as biological opinions, habitat conservation plans and other applicable standards.**
- [8.3.4.9] Irreversible harm to GDEs can occur within a relatively short period of time. This section summarizes interim milestones to prevent chronic lowering of groundwater levels to achieve the sustainability goal by at least 2040. **Please discuss how significant and unreasonable harm to GDEs will be prevented in the interim.**
- [8.3.5.1 and 8.3.5.3] The GSP proposes to allow violation of minimum thresholds at a certain percentage of locations prior to considering threshold violations as representative of an undesirable result. As stated above, damage to GDEs is often irreversible, leading to the permanent loss of a protected resource. A percentage violation trigger is therefore inadequate to assure that the sustainability goals of the GSP are met. **Please elaborate on how the exceedance criteria would be applied in a way that is protective of significant and unreasonable harm to GDEs. A procedure should be included for violation of minimum thresholds that includes early identification of potential GDE impacts and prioritization potentially impacted areas for investigation of impacts and appropriate response actions. This could be accomplished efficiently and cost-effectively through the use of remote sensing tools, such as GDE Pulse or other remote sensing approaches.**

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[9] Available online at: https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/

[Section 8.8 Depletion of Interconnected Surface Water Sustainable Management Criteria]

- The GSP fails to establish measurable objectives or minimum thresholds for this sustainability indicator, citing it as a data gap. The existence of riparian GDEs along the streams in the basin has been identified in Appendix C, and their connection to groundwater is assumed. Their occurrence in the riparian zone means that these GDEs should be considered a beneficial user of groundwater that could be affected by chronic groundwater level decline as discussed above, as well as beneficial users of surface water that could be depleted by groundwater extraction. **A more robust discussion of the known facts regarding these surface-groundwater interactions in the riparian zone should be provided. In addition, more detailed discussion regarding specific data gaps should be included. In our opinion, these changes are required in order for the GSP to be found adequate.**
- [8.8.1] While there are certainly data gaps and a need for additional shallow monitoring wells in the Alluvial aquifer to map ISWs, there is also a need to enhancing monitoring of stream flow and vertical groundwater gradients. After filling the data gaps for ISWs and further analysis**, specific plans and schedules should be provided for the establishment of minimum thresholds for ISWs.**
- [8.8.2] There is a need to evaluate and discuss potential effects on beneficial uses of surface and groundwater. In addition, the applicable state, federal and local standards for the protection of aquatic, riparian and other protected habitats should be discussed. This is necessary, at a minimum, so that the nature of the data gaps can be understood. **Please refer to Attachment C for a list of freshwater species in Paso Robles Subbasin that may be exist within ISWs. 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 freshwater species list. 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. Please refer to the Critical Species Lookbook[10] to review and discuss the potential groundwater reliance of critical species in the basin.**

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

[Section 7.2.1 Groundwater Level Monitoring Network Data Gaps (p. 7-10)]

- The last row of Table 7-3 states that "Data must be able to characterize conditions and monitor adverse impacts to beneficial uses and users identified within the basin". Aside from GDEs mapped in the basin (Figure 4-18), environmental surface water

[10] Available online at: https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/

users have not been identified in the GSP thus far. 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, nor is possible to monitor ISWs in a way that can "identify adverse impacts on beneficial uses of surface water" [23 CCR §354.34(c)(6)(D)]. For your convenience, we've provided a list of freshwater species within the boundary of the Paso Robles basin in **Attachment C**. Our hope is that this information will help your GSA better evaluate and monitor 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 freshwater species list, and how best to monitor them. 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. **Please identify appropriate biological indicators that can be used to monitor potential impacts to environmental beneficial users as a current data gap and make plans to reconcile these in Chapter 10 (Plan Implementation).**

[Section 7.6.1 Interconnected Surface Water Monitoring Data Gaps (p. 7-25)]

- In addition to the need for additional shallow monitoring wells in the Alluvial aquifer to map ISWs, **there is also a need to enhancing monitoring of stream flow and vertical groundwater gradients by installing more stream gauges and clustered/nested wells near streams, rivers or wetlands.** Ideally, co-locating stream gauges with clustered wells that can monitor groundwater levels in both the Alluvial and Paso Robles Formation aquifers would enhance understanding about where ISWs exist in the basin and whether pumping is causing depletions of surface water or impacts on beneficial users of surface water and groundwater.
- **There is a need to integrate biological indicators that can monitor adverse impacts to beneficial uses of surface water and groundwater within ISWs.**
- **Please provide sufficient detail for the investigation and monitoring program including stream gauges, screened intervals and aquifers of the shallow wells and frequency of monitoring, in order to describe monitoring of both the extent of ISWs and the quantity of surface water depletions from ISWs.**

[Chapter 10 Groundwater Sustainability Plan Implementation]

- **Please describe the expansion of the monitoring program and specify what types of monitoring will be done to identify impacts to GDEs. Be specific in describing wells and screened intervals that represent the water levels of both the Alluvial Aquifer and Paso Robles Formation Aquifer.**

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

[Chapter 9 Management Actions and Projects]

- As stated in GSP Section 5.5, a data gap exists around interconnected surface waters (ISWs) in the Paso Robles Subbasin. Please recognize the data gap in this Chapter and the possibility that if ISWs are present in the Subbasin, there is a need to establish sustainable management criteria for ISWs in the basin and include ISWs as a specific sustainability indicator to be addressed by management actions and projects as described herein. **For the management actions and projects already identified, state how GDEs and ISWs will be benefited or protected. If GDEs and ISWs will not be adequately protected by those listed, please include and describe additional management actions and projects.**
- An important data gap already recognized is the lack of publicly available groundwater elevation data in the Alluvial Aquifer. As discussed in TNC's comments on Section 8.3 above, a scientifically robust methodology must be proposed for establishing the initial minimum thresholds for the Alluvial Aquifer. **In light of the data gap regarding Alluvial Aquifer groundwater data, please be more specific in stating how GDEs and ISWs would benefit from management actions and projects, and how actions and projects will be evaluated to assess whether adverse impacts to GDEs will be mitigated or prevented**:
    - Promote Stormwater Capture (Page 9-10): Please describe how recharge from unallocated storm flows will be evaluated to assess benefits to GDEs and ISWs.
    - Mandatory Pumping Reductions (Page 9-13): Please discuss the data gap for wells screened in the alluvial aquifer and the data gap for vertical gradient between the alluvial aquifer and Paso Robles Formation, since most wells are screened in the Paso Robles aquifer. When these data gaps are resolved, it will become clearer how mandatory pumping reductions could also benefit GDEs and ISWs.
    - Conceptual Projects (Pages 9-18 to 9-44): Most of the conceptual projects involve in-lieu recharge for the direct use of recycled wastewater. Thus, the recycled water would replace pumped groundwater. Since these conceptual projects are location-specific, please highlight the benefits of these conceptual projects on specific mapped GDEs and ISWs.
- For more case studies on how to incorporate environmental benefits into groundwater projects, please visit our website: https://groundwaterresourcehub.org/case-studies/recharge-case-studies/

Attachment C

Freshwater Species Located in the Paso Robles 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 Paso Robles 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 Paso Robles groundwater basin 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. 2015[11]. 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 BIOS[12] as well as on The Nature Conservancy's science website[13].

Scientific Name	Common Name	Legally Protected Status		
		Federal	**State**	**Other**
BIRD				
Actitis macularius	Spotted Sandpiper			
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	SSC	BSSC - First priority
Aix sponsa	Wood Duck			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas cyanoptera	Cinnamon Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Anser albifrons	Greater White-fronted Goose			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya affinis	Lesser Scaup			
Aythya collaris	Ring-necked Duck			
Aythya valisineria	Canvasback		SSC	
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			

[11] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710
[12] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS
[13] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Calidris mauri	Western Sandpiper			
Chen caerulescens	Snow Goose			
Chen rossii	Ross's Goose			
Chroicocephalus philadelphia	Bonaparte's Gull			
Cistothorus palustris palustris	Marsh Wren			
Egretta thula	Snowy Egret			
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Gallinula chloropus	Common Moorhen			
Geothlypis trichas trichas	Common Yellowthroat			
Haliaeetus leucocephalus	Bald Eagle	Bird of Conservation Concern	Endangered	
Icteria virens	Yellow-breasted Chat		SSC	BSSC - Third priority
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus merganser	Common Merganser			
Mergus serrator	Red-breasted Merganser			
Numenius americanus	Long-billed Curlew			
Nycticorax nycticorax	Black-crowned Night-Heron			
Oxyura jamaicensis	Ruddy Duck			
Pandion haliaetus	Osprey		Watch list	
Pelecanus erythrorhynchos	American White Pelican		SSC	BSSC - First priority
Phalacrocorax auritus	Double-crested Cormorant			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Recurvirostra americana	American Avocet			
Riparia riparia	Bank Swallow		Threatened	
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa solitaria	Solitary Sandpiper			
Vireo bellii	Bell's Vireo			
Vireo bellii pusillus	Least Bell's Vireo	Endangered	Endangered	

Xanthocephalus xanthocephalus	Yellow-headed Blackbird		SSC	BSSC - Third priority
CRUSTACEAN				
Branchinecta lynchi	Vernal Pool Fairy Shrimp	Threatened	SSC	IUCN - Vulnerable
Cyprididae fam.	Cyprididae fam.			
Hyalella spp.	Hyalella spp.			
Pacifastacus spp.	Pacifastacus spp.			
FISH				
Oncorhynchus mykiss - SCCC	South Central California coast steelhead	Threatened	SSC	Vulnerable - Moyle 2013
Catostomus occidentalis mnioltiltus	Monterey sucker			Least Concern - Moyle 2013
Catostomus occidentalis occidentalis	Sacramento sucker			Least Concern - Moyle 2013
Cottus gulosus	Riffle sculpin		SSC	Near-Threatened - Moyle 2013
Entosphenus tridentata ssp. 1	Pacific lamprey		SSC	Near-Threatened - Moyle 2013
Lavinia exilicauda exilicauda	Sacramento hitch		SSC	Near-Threatened - Moyle 2013
Lavinia exilicauda harengeus	Monterey hitch		SSC	Vulnerable - Moyle 2013
Oncorhynchus mykiss irideus	Coastal rainbow trout			Least Concern - Moyle 2013
Orthodon microlepidotus	Sacramento blackfish			Least Concern - Moyle 2013
Ptychocheilus grandis	Sacramento pikeminnow			Least Concern - Moyle 2013
Oncorhynchus mykiss - SCCC	South Central California coast steelhead	Threatened	SSC	Vulnerable - Moyle 2013
HERP				
Actinemys marmorata marmorata	Western Pond Turtle		SSC	ARSSC

Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Anaxyrus boreas halophilus	California Toad			ARSSC
Anaxyrus californicus	Arroyo Toad	Endangered	SSC	ARSSC
Pseudacris cadaverina	California Treefrog			ARSSC
Pseudacris hypochondriaca	Baja California Treefrog			
Pseudacris regilla	Northern Pacific Chorus Frog			
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	SSC	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	SSC	ARSSC
Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	SSC	ARSSC
Taricha torosa	Coast Range Newt		SSC	ARSSC
Thamnophis hammondii hammondii	Two-striped Gartersnake		SSC	ARSSC
Thamnophis sirtalis infernalis	California Red-sided Gartersnake			Not on any status lists
Thamnophis sirtalis sirtalis	Common Gartersnake			
INSECT & OTHER INVERT				
Acentrella spp.	Acentrella spp.			
Agabus spp.	Agabus spp.			
Ambrysus mormon	Creeping water bug			Not on any status lists
Antocha spp.	Antocha spp.			
Argia emma	Emma's Dancer			
Argia lugens	Sooty Dancer			
Argia spp.	Argia spp.			
Argia vivida	Vivid Dancer			
Baetidae fam.	Baetidae fam.			
Baetis spp.	Baetis spp.			
Berosus punctatissimus	Water scavenger beetles			Not on any status lists
Berosus spp.	Berosus spp.			
Callibaetis spp.	Callibaetis spp.			

Centroptilum spp.	Centroptilum spp.			
Chaetarthria bicolor	Water Scavenger Beetles			Not on any status lists
Chaetarthria ochra	Water Scavenger Beetles			Not on any status lists
Cheumatopsyche spp.	Cheumatopsyche spp.			
Chironomidae fam.	Chironomidae fam.			
Chironomus spp.	Chironomus spp.			
Cladotanytarsus spp.	Cladotanytarsus spp.			
Coenagrionidae fam.	Coenagrionidae fam.			
Corisella spp.	Corisella spp.			
Corixidae fam.	Corixidae fam.			
Cricotopus spp.	Cricotopus spp.			
Dicrotendipes spp.	Dicrotendipes spp.			
Dytiscidae fam.	Dytiscidae fam.			
Enallagma civile	Familiar Bluet			
Enallagma cyathigerum	Common blue damselfly			Not on any status lists
Enochrus carinatus	Water Scavenger Beetles			Not on any status lists
Enochrus cristatus	Water Scavenger Beetles			Not on any status lists
Enochrus piceus	Water Scavenger Beetles			Not on any status lists
Enochrus pygmaeus	Water Scavenger Beetles			Not on any status lists
Enochrus spp.	Enochrus spp.			
Ephemerella spp.	Ephemerella spp.			
Ephemerellidae fam.	Ephemerellidae fam.			
Ephydridae fam.	Ephydridae fam.			
Eukiefferiella spp.	Eukiefferiella spp.			
Fallceon quilleri	A Mayfly			
Graptocorixa spp.	Graptocorixa spp.			
Gyrinus spp.	Gyrinus spp.			
Helichus spp.	Helichus spp.			
Helicopsyche spp.	Helicopsyche spp.			
Hetaerina americana	American Rubyspot			
Hydrochus spp.	Hydrochus spp.			
Hydrophilidae fam.	Hydrophilidae fam.			
Hydroporus spp.	Hydroporus spp.			
Hydropsyche spp.	Hydropsyche spp.			
Hydropsychidae fam.	Hydropsychidae fam.			
Hydroptila spp.	Hydroptila spp.			
Hydryphantidae fam.	Hydryphantidae fam.			
Ischnura spp.	Ischnura spp.			
Laccobius ellipticus	Water scavenger beetles			Not on any status lists
Laccobius spp.	Laccobius spp.			

Laccophilus maculosus	Dingy Diver			Not on any status lists
Lepidostoma spp.	Lepidostoma spp.			
Leptoceridae fam.	Leptoceridae fam.			
Libellula saturata	Flame Skimmer			
Limnophyes spp.	Limnophyes spp.			
Liodessus obscurellus	Predacious Diving Beetle			Not on any status lists
Macromia magnifica	Western River Cruiser			
Malenka spp.	Malenka spp.			
Microcylloepus spp.	Microcylloepus spp.			
Microtendipes spp.	Microtendipes spp.			
Nectopsyche spp.	Nectopsyche spp.			
Ochthebius spp.	Ochthebius spp.			
Ophiogomphus bison	Bison Snaketail			
Optioservus spp.	Optioservus spp.			
Oreodytes spp.	Oreodytes spp.			
Paracloeodes minutus	A Small Minnow Mayfly			
Paracymus spp.	Paracymus spp.			
Paratanytarsus spp.	Paratanytarsus spp.			
Peltodytes spp.	Peltodytes spp.			
Phaenopsectra spp.	Phaenopsectra spp.			
Plathemis lydia	Common Whitetail			
Postelichus spp.	Postelichus spp.			
Procladius spp.	Procladius spp.			
Pseudochironomus spp.	Pseudochironomus spp.			
Psychodidae fam.	Psychodidae fam.			
Rheotanytarsus spp.	Rheotanytarsus spp.			
Rhyacophila spp.	Rhyacophila spp.			
Sigara mckinstryi	A Water Boatman			Not on any status lists
Sigara spp.	Sigara spp.			
Simuliidae fam.	Simuliidae fam.			
Simulium spp.	Simulium spp.			
Sperchon spp.	Sperchon spp.			
Sperchontidae fam.	Sperchontidae fam.			
Stictotarsus spp.	Stictotarsus spp.			
Sweltsa spp.	Sweltsa spp.			
Tanytarsus spp.	Tanytarsus spp.			
Tipulidae fam.	Tipulidae fam.			
Tramea lacerata	Black Saddlebags			
Tricorythodes spp.	Tricorythodes spp.			
Wormaldia spp.	Wormaldia spp.			
MAMMAL				
Castor canadensis	American Beaver			Not on any status lists

MOLLUSK				
Gyraulus spp.	Gyraulus spp.			
Lymnaea spp.	Lymnaea spp.			
Menetus opercularis	Button Sprite			CS
Physa spp.	Physa spp.			
Pisidium spp.	Pisidium spp.			
Planorbidae fam.	Planorbidae fam.			
PLANT				
Alnus rhombifolia	White Alder			
Ammannia coccinea	Scarlet Ammannia			
Anemopsis californica	Yerba Mansa			
Azolla filiculoides	Mosquito Fern			
Baccharis salicina	Willow Baccharis			Not on any status lists
Bolboschoenus maritimus paludosus	Saltmarsh Bulrush			Not on any status lists
Callitriche heterophylla bolanderi	Large Water-starwort			
Callitriche marginata	Winged Water-starwort			
Castilleja minor minor	Alkali Indian-paintbrush			
Castilleja minor spiralis	Large-flower Annual Indian-paintbrush			
Cotula coronopifolia	Brass Buttons			
Crassula aquatica	Water Pygmyweed			
Crypsis vaginiflora	African Prickle Grass			
Cyperus erythrorhizos	Red-root Flatsedge			
Eleocharis macrostachya	Creeping Spikerush			
Eleocharis parishii	Parish's Spikerush			
Epilobium campestre	Smooth Boisduvalia			Not on any status lists
Epilobium cleistogamum	Cleistogamous Spike-primrose			
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle		SSC	CRPR - 1B.2
Eryngium vaseyi vaseyi	Vasey's Coyote-thistle			Not on any status lists
Euthamia occidentalis	Western Fragrant Goldenrod			
Helenium puberulum	Rosilla			
Hydrocotyle verticillata verticillata	Whorled Marsh-pennywort			
Juncus dubius	Mariposa Rush			
Juncus effusus effusus	Common Bog Rush			
Juncus luciensis	Santa Lucia Dwarf Rush		SSC	CRPR - 1B.2
Juncus macrophyllus	Longleaf Rush			
Juncus xiphioides	Iris-leaf Rush			

Limosella aquatica	Northern Mudwort			
Marsilea vestita vestita	Hairy Waterclover			Not on any status lists
Mimulus guttatus	Common Large Monkeyflower			
Mimulus latidens	Broad-tooth Monkeyflower			
Mimetanthe pilosa	Snouted Monkey Flower			Not on any status lists
Montia fontana fontana	Fountain Miner's-lettuce			
Navarretia prostrata	Prostrate Navarretia		SSC	CRPR - 1B.1
Paspalum distichum	Joint Paspalum			
Persicaria lapathifolia	Common Knotweed			Not on any status lists
Persicaria maculosa	Spotted Ladysthumb			Not on any status lists
Phacelia distans	Common Phacelia			
Pilularia americana	Pillwort			
Plagiobothrys acanthocarpus	Adobe Popcorn-flower			
Plantago elongata elongata	Slender Plantain			
Platanus racemosa	California Sycamore			
Psilocarphus brevissimus brevissimus	Dwarf Woolly-heads			
Ranunculus aquatilis diffusus	Whitewater Crowfoot			Not on any status lists
Rorippa curvisiliqua curvisiliqua	Curve-pod Yellowcress			
Rumex conglomeratus	Green Dock			
Rumex salicifolius salicifolius	Willow Dock			
Salix exigua exigua	Narrowleaf Willow			
Salix laevigata	Polished Willow			
Salix lasiolepis lasiolepis	Arroyo Willow			
Schoenoplectus americanus	Three-square Bulrush			
Schoenoplectus pungens longispicatus	Three-square Bulrush			
Schoenoplectus pungens pungens	Common Threesquare			
Schoenoplectus saximontanus	Rocky Mountain Bulrush			
Typha domingensis	Southern Cattail			
Typha latifolia	Broadleaf Cattail			
Veronica anagallis-aquatica	Water Speedwell			

Veronica catenata	Chain Speedwell			Not on any status lists
Notes: ARSSC = At-Risk Species of Special Concern BSSC = Bird Species of Special Concern CRPR = California Rare Plant Rank CS = Currently Stable SSC = Species of Special Concern				

Attachment D

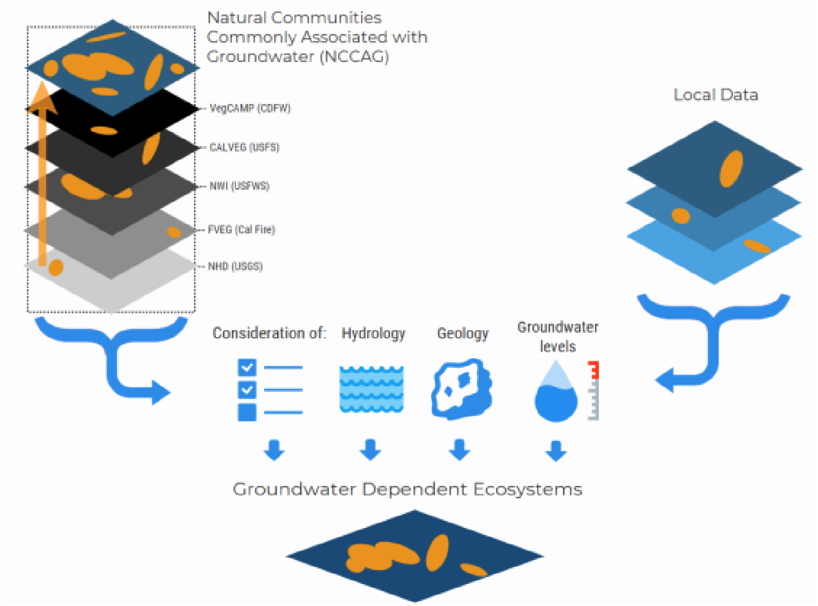
The Nature Conservancy

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) online[14] 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)[15]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.



[14] *NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/*

[15] 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 California[16]. 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 dataset[17] on the Groundwater Resource Hub[18], 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 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*.

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[16] *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*

[17] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/

[18] *The Groundwater Resource Hub: www.GroundwaterResourceHub.org*

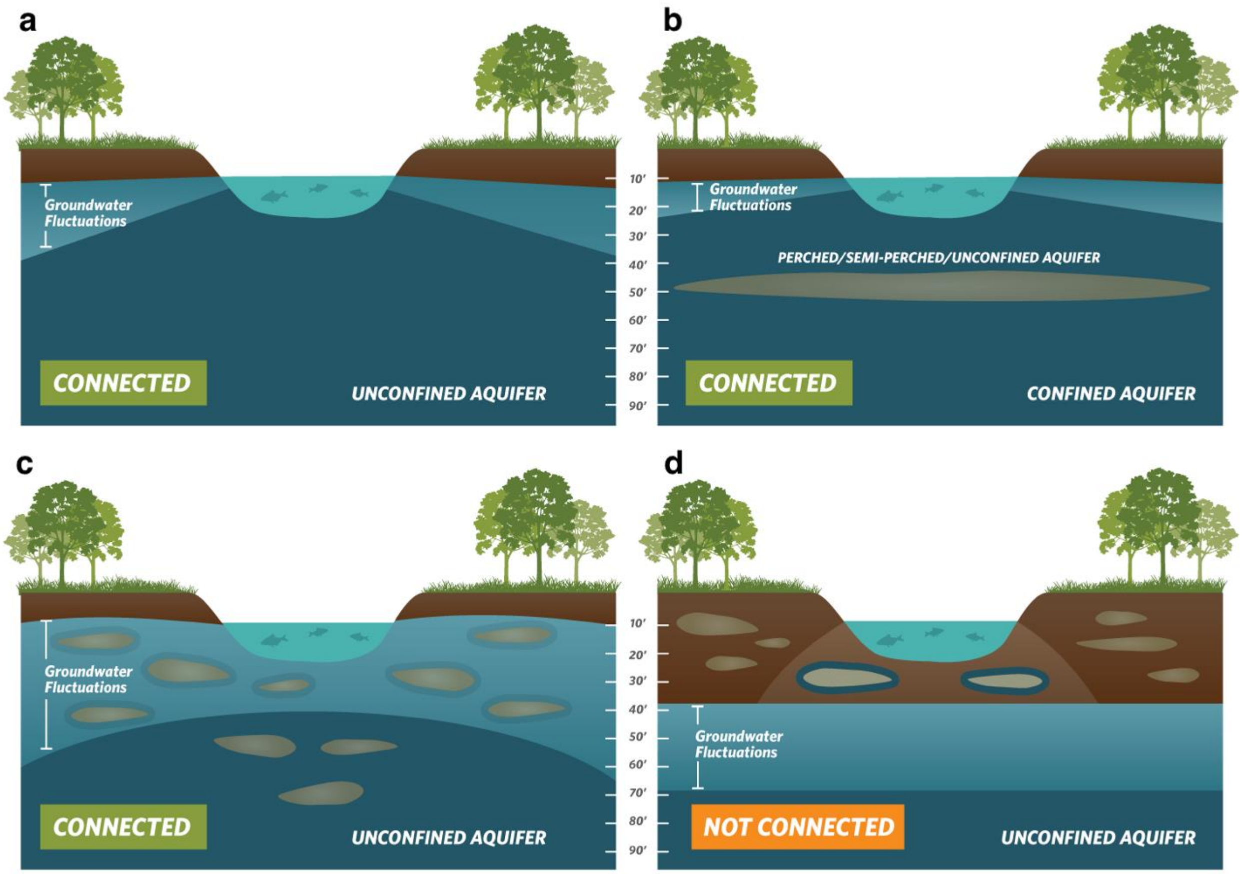

Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. **(b)** Depth-to-groundwater in the shallow aquifer is connected to overlying 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 budgets[19] 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 baseline[20] 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 approach[21] 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 document[4], 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 feet[4] 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 Viewer[22]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP <u>until</u> data gaps are reconciled in the monitoring network (see Best Practice #6).

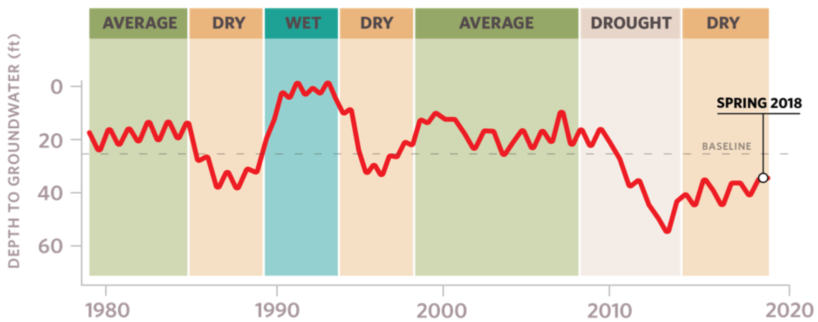

Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so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

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[19] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[20] *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)]*

[21] 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 GSPs[4]).

[22] *SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?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 animals[23], 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).

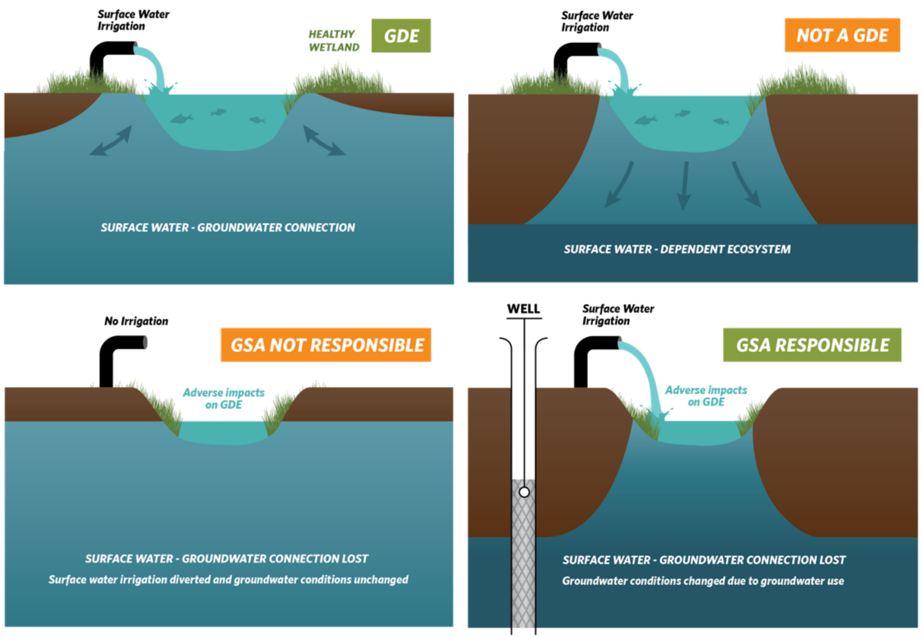


Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. **(Right)** Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. **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.

[23] *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.

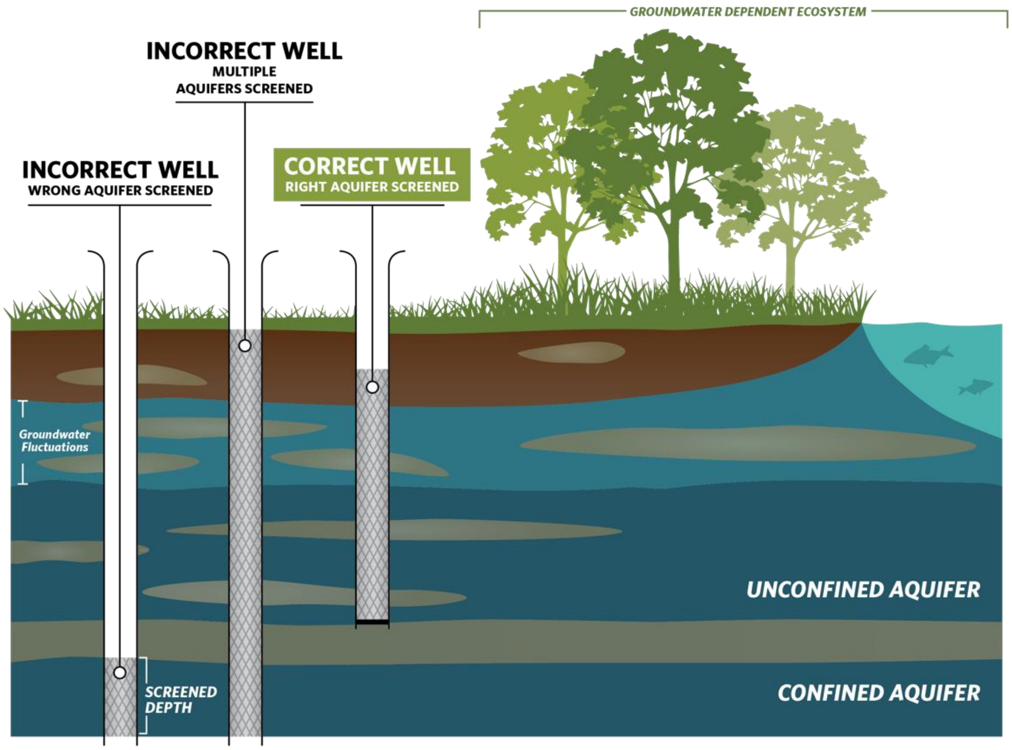


Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

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)[24] 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.

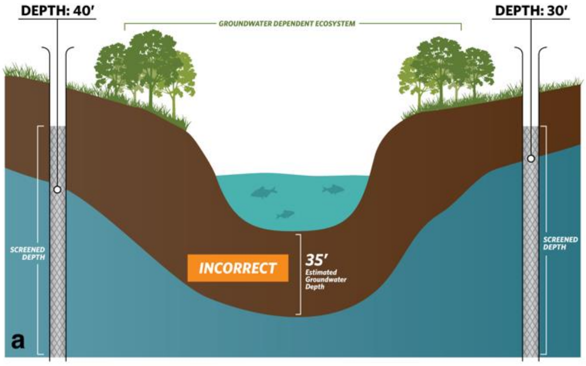


Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. **(b)** Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

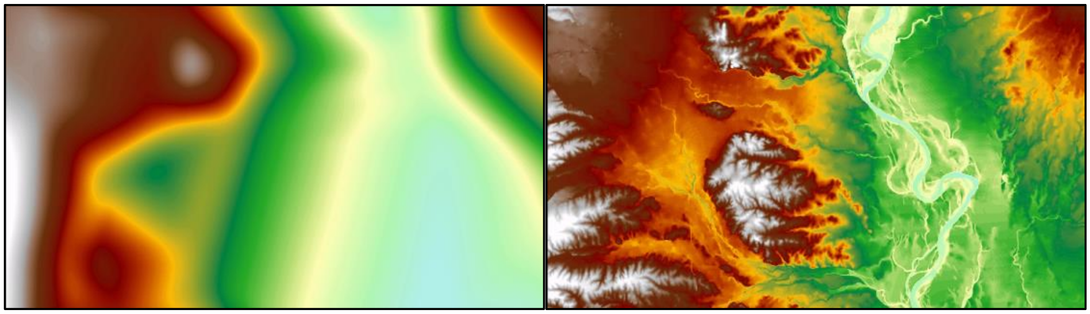


Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. **(Right)** Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation 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.

[24] 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.

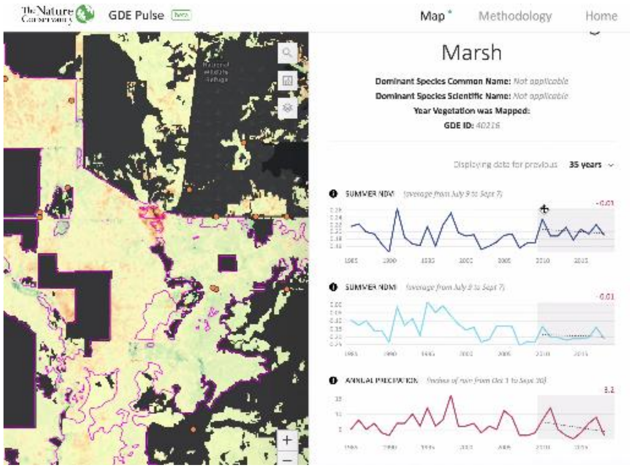
Attachment E

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.

The Nature Conservancy
Protecting nature. Preserving life.

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 Dataset[25]. 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 dataset[26]. 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.

[25] *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/#*

[26] The PRISM dataset is hosted on Oregon State University's website: http://www.prism.oregonstate.edu/