Surface Water Advisory Group
Compiled Comments on Technical Memo #6

Updated: August 13, 2020

Context: After the July 31st SWAG kick-off meeting, SWAG members were invited to submit written comments on Technical Memo #6 within a week of the July 31st meeting. This document compiles the submitted comments. (Note: Commenters' contact information was intentionally removed)

Contents

Amelia Vankeuren, Ag-Res (Elk Grove)

From: Amelia Vankeuren
Subject: Re: Comments on SWAG meeting
Date: August 3, 2020 at 4:35:09 pm EDT
To: Stephanie Horii <shorii@cbi.org>, <bbrooks@cbi.org>

Hi Stephanie and Bennett,
Thank you for facilitating the Cosumnes SWAG meeting last week. I appreciate the enormous amount of work that went into developing TM6 and everyone's time last week discussing the findings. I have some lingering questions and comments (attached). Please let me know if you have any questions or need additional information.
Best,
Amelia

--
Amelia Vankeuren, Ph.D.
Assistant Professor
Geology Department
California State University, Sacramento

Comments from review of TM6 and SWAG meeting 1:

Conceptual Model

The median transmissivity value from aquifer testing in the basin plain was 1,900 ft^2/day, while the median value from specific capacity tests was 14,700 ft^2/day. What is the cause of the discrepancy? How does the 7.5x uncertainty in transmissivity affect the application of groundwater model results?

The base of fresh groundwater for the basin is based on a map from 1973 that was a large-scale study and has relatively few data points within the Cosumnes Subbasin. Also, the base of freshwater could have changed in the last 50 years. Is there more detailed or updated information available? The California Geologic Energy Management Division, US Geological Survey California Water Science Center, and Sacramento State Geology Department have a project determining the depth of the base of freshwater in the southern Central Valley using resistivity logs from well drilling records. A similar method could be applied to recently drilled deep wells in the Cosumnes Subbasin to create a more detailed map, or at least verify that the base of freshwater has not changed.

Given the highly variable nature of groundwater elevation in the foothill area and Anona's comment about productive and dry wells occurring 100 ft from each other, water in the foothills is governed by fracture flow, not porous media flow, and thus behaves very differently from the basin plain. How do you justify modeling and managing the two areas as a single aquifer?

The statement on page 26 that "*areas of exposed Laguna Formation and Mehrten Formation are likely important for recharging downslope wells extracting water from these formations"* is in conflict with the idea that there is one principal aquifer. This statement implies that vertical recharge through overlying formations is restricted.

Even within the basin plain, the evidence presented to justify a single principal aquifer is not compelling.

- Spatial distribution of both shallow and deep wells across the basin demonstrates that both shallow and deep groundwater is usable, not that they are connected
- Vertical gradient values in Fig-GWC-03 do not allow you to conclude there is a single aquifer: only sites 1 and 4 even potentially indicate that there may be a single aquifer.
    - The Site 2 value of 0.25 is a large vertical gradient and suggests separate aquifers in that location
    - The Site 3 wells are both within the Laguna Formation and thus can't be used to tell if different formations host different aquifers
    - Given the variability of water level elevation in the foothills and the fact that those wells are likely fed by fractured rock flow, Sites 5-8 are not relevant to conditions in the basin plain that makes up most of the subbasin area
- Water quality (based on the Stiff diagrams) does not prove a single aquifer. Laguna Formation wells have lower solute concentration than Merhten Formation wells. Additionally, similar solute concentrations can occur in separate aquifers if the rock type is similar.

While the subbasin may act as a single principal aquifer, that must be demonstrated by evaluating water level records from co-located shallow and deep wells to verify that a) the water level elevation in the wells are the same at the same time point and 2) that the water level elevation in the wells behave similarly over time.

I recognize that co-located wells are in short supply and recommend the installation of several nested monitoring wells with screened intervals in each of the main formations to truly demonstrate a single principal aquifer system.

<u>Groundwater storage declines</u>
The estimate of decline in water storage is about ½ that calculated by Faunt et al. (2009) for the basin. What accounts for the difference? How does uncertainty in the change in groundwater storage affect decisions on the management of the basin?

<u>Groundwater quality</u>
Groundwater quality data are very sparse. There needs to be a plan for better monitoring going forward to ensure that groundwater quality is preserved throughout the basin.

The percent of wells with exceedances in manganese is concerning. Though manganese does not have an enforceable maximum contaminant level, recent studies have demonstrated health effects and other states do regulate it in drinking water (e.g., https://www.health.state.mn.us/communities/environment/water/docs/contaminants/mangnsefctsht.pdf) Manganese should be monitored over time to ensure that groundwater management does not cause increases in manganese particularly in domestic wells used for drinking water as the water from those wells is generally not treated or blended to ensure it complies with drinking water standards.

Surface Water Depletion

While the groundwater system is clearly disconnected from the Cosumnes River for much of the subbasin, it is critical to determine the downstream extent of that disconnection so we can understand where groundwater management might alter river flow. Fig-GWC-14 demonstrates that as far upstream as the McConnell stream gaging station, the river could be connected. There is *at most* a 20 ft difference between stream stage and water level in the upstream well. During storm events, there is less than 5 ft difference between water level and stream stage, and for the year of 2017, there was less than 15 ft difference. Also, the both observation wells are too far from McConnell (over 2 miles) to directly compare water level elevation to that in the stream. It should be determined if the new monitoring wells that Laura Foglia mentioned will be sufficient to determine level of hydraulic connection, or if new monitoring wells should be installed.

Furthermore, to determine the level of hydraulic connection between groundwater and a stream, the groundwater elevation should be compared to that of the river bed, not the river stage (the top of the river water surface).

The McConnell station has flow data for 1940-1985 and river stage data post 1985. Why don't you use a stream rating curve to combine those data into a longer timeseries? There would be some uncertainty in the calculated values, but the longer dataset would be valuable.

Bill Myers, Sheldon Community Association

From: William Myers
Subject: Remote sensing of plant communities
Date: August 2, 2020 at 10:47:01 pm EDT
To: Bennett Brooks <bbrooks@cbi.org>

Hi Bennett,

In reference to our little discussion about use of remote sensing technology, it occurs to me that a leading and easily approachable authority on the topic is Rosie Yacoub, who runs a GIS program of this type for the Dept of Fish and Game (website: Vegetation Classification and Mapping Program). Her email address is rosalie.yacoub@wildlife.ca.gov. My understanding is that this program provides public access to a number of existing maps, plus a variety of remote sensing tools quite capable of identifying areas of plant growth associated with groundwater dependent ecosystems, although I understand they demand trained expertise to apply and interpret correctly. They do not necessarily tell you the source of water on which they draw however, such as discriminating between growth drawing directly on groundwater and similar growth drawing moisture from alternative sources.

I would think that consultants working on the gsp probably are aware of these maps and at least some of the tools, but my question is whether they are making use of the most recent and sophisticated tools available. I'm not sure the state necessarily owns all these tools, but I would think that Rosie would be aware of them.

All the best,

Bill

ECOS, The Nature Conservancy, and Cosumnes Coalition

On 8/7/20, 1:01 PM, "Melinda Frost-Hurzel" wrote:

Greetings Stephanie and Bennet--

Thank you for the opportunity to provide initial comments on TM 6. These initial comments offer additional technical information, perspectives, and suggestions; we look forward to continued dialogue in development of the Cosumnes Subbasin GSP.

If you have questions or information to offer in response to these comments, please use reply all.

Cheers,

Melinda

ECOS, The Nature Conservancy, and Cosumnes Coalition Initial Comments on Draft Technical Memorandum #6 – Hydrogeological Conceptual Model and Groundwater Conditions, prepared by EKI Environment and Water, Inc., Dated 27 November 2019

Thank you for the opportunity to review and comment on the document. It is clear that substantial time and effort went into preparing the document and the associated analyses. The document is well organized and easy to follow. The document comprises several draft chapters of the Groundwater Sustainability Plan for the Cosumnes Subbasin (5-022.16) presenting the hydrogeological conceptual model (pursuant to 23-California Code of Regulations [CCR] §354.14) and current and historical groundwater conditions (pursuant to 23-CCR §354.16). Comments are organized by section or provided as more general feedback.

1. Cosumnes Basin Data Management System

In addition to those data sources listed in Table DMS-1 it is recommend that reasonable effort is taken to review the following sources for additional data not already included in the DMS that may increase the spatial and/or temporal resolution of information presented in the study:

i) California Groundwater Observatory - http://ucwater.org/gw_obs/
ii) Groundwater-quality data in the Mokelumne, Cosumnes, and American River Watersheds Shallow Aquifer Study Unit, 2016-2017 - https://www.sciencebase.gov/catalog/item/5a57c638e4b01e7be245cf12
iii) Data from "Domestic Well Vulnerability to Drought Duration and Unsustainable Groundwater Management in California's Central Valley" (Pauloo et al. 2019) - https://datadryad.org/stash/dataset/doi:10.25338/B8Q31D
iv) Cosumnes Research Group - https://watershed.ucdavis.edu/doc/cosumnes-research-group

Source (i) includes a set of shallow groundwater (GW) wells along the Cosumnes River managed by University of California Davis. The full set of these data should be used to supplement information on GW levels, potential interconnection of GW with the Cosumnes River, and in the analysis of groundwater dependent ecosystems (GDEs). Source (iii) comprises a geospatial dataset of 943,469 well completion reports and 20 years of groundwater elevations from domestic wells across California's Central Valley. Source (iv) includes a compendium of resources and research conducted by University of California's Center for Watershed Sciences. These data should be reviewed and are known to include GW, surface water (SW), and topographic information (https://watershed.ucdavis.edu/doc/cosumnes-research-group/data-access).

2.1.2. Lateral Basin Boundaries

The document states, "The eastern boundary of the Basin is the only boundary with a structural restriction to groundwater flow, caused by thinning sediments abutting low-permeability crystalline rocks and the Foothills Fault System." It is agreed the low storage and hydraulic conductivities typically envisioned for low-permeability crystalline rocks can act to restrict groundwater flow, however there is alternative research suggesting that subsurface inflow of groundwater to lowland aquifers from mountain blocks may be significant especially from fractured crystalline systems (Markovich et al. 2016, 2019). Please provide additional information to support the conclusions made in the document regarding the eastern boundary of the Basin.

2.1.4. Principal Aquifers and Aquitards

This section presents the case for a single Principal Aquifer within the Basin. The arguments for a single aquifer system are well presented however, it is recommended that characterization and discussion of shallow perched aquifers in the Basin be included as such information is presently absent from this section of the document. These perched aquifers are known to be associated with the heterogeneous sedimentary units, such as clay-rich aquitards, formed by fluvial deposits common to the various river networks in the Basin (Fleckenstein et al., 2004, 2006; Niswonger & Fogg, 2008; Rhode et al., 2019). The relationship between these shallow units and the deeper principal as well as other hydrologic processes should be contextualized as they are informative of the broader hydrogeologic conditions in the Basin required to be discussed pursuant to SGMA (e.g. how fluctuations in the principal aquifer may interact with these features, river seepage/leakage interactions, and ecological significance of these units). We respect that it is fair to acknowledge that these features may be unproductive and what that means for their management under SGMA regulations.

2.2. Cross Sections

On page 19 the document states, "The cross-sections depict materials that comprise the Principal Aquifer and all materials that could reasonably be tapped for groundwater supply." It is recommended that reasonable effort be made to identify locations in these sections with a high probability for shallow perched aquifers.

On page 19 sources used to generate the cross section are listed. It is recommended that land surface elevations extracted from the USGS 10-meter digital elevation model (DEM) be supplemented with other high resolution elevation data including but not limited to:

i) LiDAR data available in the Basin from: https://viewer.nationalmap.gov/basic/
ii) Flood-inundation map and water-surface profiles for floods of selected recurrence intervals, Cosumnes River and Deer Creek, Sacramento County, California - https://pubs.er.usgs.gov/publication/ofr98283
iii) Topographic surveys of the Cosumnes River and floodplain available from: https://watershed.ucdavis.edu/doc/cosumnes-research-group/data-access
iv) River profiles from FEMA Flood Insurance Study Number 06067CV001D available from: https://www.fema.gov/flood-maps/products-tools

Regarding source (iii) survey data are under the "geomorphology' link. These data should be used to update secondary work products based on the Basin DEM as necessary including estimates of depth to water (DTW).

Cosumnes River Focused Cross-Sections

On page 22 within the discussion of the Cosumnes river cross sections it is recommended that additional historic hydrological context be provided regarding the projected groundwater elevations and referenced hydraulic disconnect. We respect that data are limited and these may be the only measurements available for the given analysis. Further, we understand their use to document "current" conditions. However, the groundwater elevations shown were measured in Fall 2018 a period representing a seasonal low at the end of an extremely dry period as noted in Sections 3.1.1 and 3.1.2, respectively and feel such information is relevant to readers and stakeholders.

2.3.4. Groundwater Recharge and Discharge Areas

Determinations of watershed processes (e.g. runoff, infiltration, and recharge) from Hydrologic Soil Group, such as those made in this section, are often uncertain. For example surface runoff through infiltration excess overland flow (Hortonian overland flow) as suggested on page 25 is rare in many environments with the exception of highly arid, disturbed, or urbanized environments (Beven, 2006; see also Brighenti et al., 2019 and Huang et al., 2013). Similarly, recharge potential is poorly described by soil class alone (Maples et al. 2020). It is recommended that the authors consider making updates to this section accordingly.

In analyzing GW recharge potential Maples et al. (2020) present a proxy parameter related to upscaled vertical saturated hydraulic conductivity and unsaturated-zone thickness that reasonably corresponds to simulated recharge. The UC Davis SAGBI dataset (available at https://casoilresource.lawr.ucdavis.edu/sagbi/) offers another index for recharge potential that is more informative than soils data, though its utility still requires further field verification.

3.1.1. Groundwater Elevation Contour Maps

Please indicate how Spring 2018 and Fall 2018 groundwater contours were generated. For example, what was the method of interpolation? How many points were used in the contouring process and what was the spatial density? It is also recommended that uncertainty in the mapped groundwater contours be reported or at the very least addressed. For example the

Kriging interpolation method has the benefit of addressing uncertainty through calculation of standard errors associated with predicted values which can be used to generate prediction confidence intervals. Such uncertainty is critical when using hard thresholds to define or characterize resources in the Basin and its inclusion would make such analyses more robust and associated decision making more defensible.
Where possible please indicate how comparison contours were generated (i.e. North American Subbasin Alternative, DWR GICIMA, and Eastern San Joaquin Subbasin Draft GSP). It is highly recommended the method for generating the GICIMA contours be discussed as these data are used in subsequent sections of the document (3.6 and 3.7).

Depth to Groundwater

It is recommended that depth to water (DTW) estimates are updated using the additional datasets described in comments to Section 2.2 above. Uncertainty in DTW estimated should also be reported where feasible pursuant to comments to Section 3.1.1 above. Further, it is recommended that Spring 2018 data be used to produce additional DTW estimates for that time period corresponding to shallower water levels. These data should be used to supplement further analysis (e.g. Section 3.6 and 3.7).
Please describe how depth to water contours from DWR's GICIMA were generated, namely the source of the land surface elevations and as previously mentioned the GW interpolation method.
Please address or otherwise call out that DEM elevations along river corridors are unlikely to accurately represent channel bed elevations. Such inaccuracies may be due several factors, not limited to:

i) The DEM resolution of 10 m is not capable of accurately mapping many stream channels in the Basin, particularly those narrower than this scale, thus leading to interpolation errors.
ii) Methods used to produce the DEM do not include bathymetric surveys of the channel bed and thus likely represent water surface elevations resulting in overestimation of the land surface in such locations.

If such considerations have already been addressed in the DEM please describe the actions taken. If no future action is taken to update the DEM along stream corridors please address the comment above and consider further action to make reasonable estimates of the magnitude of uncertainty, which the authors of this document are happy to discuss separately.

3.6. Interconnected Surface Water Systems

This section of the document presents the case for the entirety of the Cosumnes River within the Basin as well as all other surface waters in the Basin being classified as **not** being interconnected surface waters. Similar findings documenting contemporary disconnection between the Cosumnes River and the underlying aquifer have been reported by others (Fleckenstein et al. 2004; Robertson-Bryan, 2006). Historically, Cosumnes flows were regularly supplemented through connection to the regional GW table. This association served to sustain the Cosumnes particularly during summer and fall. Supplementing of these dry season flows had critical ecological importance to the fluvial-riparian ecosystem, especially migrating fall-run Chinook salmon. Disconnection of the Cosumnes initiated in the mid 1940's due to increased

GW withdrawals and lowering of the GW table. Increased GW pumping in subsequent decades has exasperated this issue further, resulting in continued lowering of the regional GW table and increasing the disconnect with the River. This disconnection has proved particularly impactful to the health of chinook fishery amongst other organisms and ecosystem processes. While the findings from the document and the above referenced sources discuss the rivers contemporary disconnection, several studies and datasets provide an alternate scenario supporting that in recent times portions of the river remain hydraulically connected to aquifer (Fleckenstein et al. 2006; Niswonger, 2006, Niswonger & Fogg, 2008; unpublished analysis by Larry Walker and Associates, 2020). Findings from these sources are summarized below.
Near river SW-GW interactions are strongly influenced by various scales of localized subsurface heterogeneity. Such heterogeneity is often described by the arrangement of hydrofacies which possess highly variable conductivities amongst other physical properties. Spatial variability in hydrologic processes due to hydrofacy organization can result in localized mounding of GW or formation of perched water tables near the active channel bed and within the extent of paleochannels and associated floodplain surfaces (Niswonger & Fogg, 2008). These localized effect can serve to reduce or even reverse flow gradients between SW and GW and have been documented to facilitate GW-SW interconnection in several Californian Rivers thought to be disconnected from their regional GW tables, a list which includes the Cosumnes (Fleckenstein et al., 2006; Niswonger 2005; Niswonger & Fogg, 2008). For instance, conducting multiple simulations with a ground water–surface water model along the Cosumnes with several equally likely geostatistical simulations of aquifer heterogeneity Fleckenstein et al. (2006) identified several locations that exhibited local reconnection between the river bed and GW levels that could even serve to create gaining conditions. These simulation findings were corroborated by observations of shallow local saturated zones below the river channel during the wet season.

The difficulty in representing the complex lithology of alluvial sediments along river channels means it is not uncommon for such conditions to be inaccurately quantified. For example, such connections could be missed by monitoring networks (e.g. wells) where observed GW levels instead measure heads of the deeper aquifer rather than water levels immediately below the river (Fleckenstein et al., 2006). Common modeling (GW or coupled GW-SW) strategies (e.g. those that use mean monthly flows, simplified river geometry, calibrated conductivities of bed, and uniform laterally extensive aquifers) also have been found to be inappropriate when considering the ecological dynamics of river-aquifer systems (Fleckenstein et al., 2006).

In light of the information presented above and contained in the referenced studies we kindly recommend this information be addressed as it provides strong support of the fact that portions of the river should be classified as an interconnected surface water per the definition provided in the document pursuant to SGMA. We further recommend that historical SW-GW interconnection in the Basin be discussed to provide context of current conditions.

In addition to the broad discussion/comment above additional comments or datasets recommended to supplement the current level of analysis are included below:

- It is recommended that the complete set of shallow well maintained by the UCD groundwater observatory (http://ucwater.org/gw_obs/) be used in the analysis of the SW-GW interconnection along the Cosumnes. These wells should be coupled with nearby channel bed elevations rather than stage elevations as the latter does not represent the actual elevation for a potential SW-GW connection and is an inadequate means of characterizing such a connection (as is suggested at the bottom of page 46 [“This water level elevation differential suggests that there is a significant unsaturated aquifer zone beneath the river in this portion of the Basin”] and by Figure GWC-14). Channel bed elevation data is available from sources (ii and iii) identified in comments to Section 2.2. Description of methods for the recommended analysis is outside the scope of this comment document and can be discussed separately.
- In many years the Cosumnes and other Basin rivers run dry during summer and fall. The use of high-resolution satellite imagery should be explored for identifying locations along the river that have water present as this is a strong indicator of locations with sustained SW-GW interconnection. Imagery products such as data from the Copernicus Sentinel-2 mission (https://sentinel.esa.int/web/sentinel/missions/sentinel-2) are freely available. Other sources such as Planet (https://www.planet.com/) should also be explored. Description of methods for the recommended analysis is outside the scope of this comment document and can be discussed separately.
- DTW contours were used as an indicator for a lack of SW-GW connection (page 47), principally for surface waters where no other information was available. It is recommended that the DTW data be updated pursuant to the comments made to Section 3.1.1 above (e.g. include uncertainty estimates in DTW data, update land surface elevation where better data is present, contextualize that DTW contours are based on Fall 2018 condition which is a seasonal low at the end a dry period). Further, use of this one dataset to conclude that Dry Creek or other surface water features in the Basin are not interconnected is considered inadequate given the definition of interconnectedness provided, the points made in the beginning of this section, the potential for other analyses (e.g. bullet point two above), and the lack of uncertainty characterization.
- It is recommended that coordination be made with the South American Subbasin (5-21.65) GSP to insure consistency in how the shared boundary of the Cosumnes River is defined regarding its status as an interconnected SW. Similarly, there should be coordination/consistency with the Eastern San-Juaquin Basin (5-022.16) GSP how the shared boundary of Dry Creek is defined.

3.7. Groundwater Dependent Ecosystems

The first set of comments below includes recommendations for additional sources of data to be used in the hydrologic component of the GDE analysis as well as comments intended to clarify, supplement, or otherwise improve the presented analysis.

- On page 47 of the document it states, “The NCCAG dataset was used in conjunction with depth to water measurements, both contours and point values at wells, to identify potential GDEs in the Basin.” Please be explicit about the source and date of the “contours and point values” used.
- The use of multiple datasets spanning 2011-2018 (page 48) in the analysis of GDEs is appreciated but should be supplemented further (e.g. Spring 2018 DTW data per comment to Section 3.1.1. and next bullet point).
- It is recommended that additional data sources identified in comments to Section 1 be used to update the GDE analysis. Specifically the complete set of shallow wells maintained by the UCD groundwater observatory (http://ucwater.org/gw_obs/) as well as domestic well data from Pauloo et al. (2019) should be used. The complete temporal resolution of the data can be simplified to the shallowest water level recorded for each well. Where data shows DTW<30’, GDE’s associated with that well (e.g. within 3.1 miles) should not be eliminated from the dataset. If any water level data indicate DTW<30’ the GDE should not be removed from the dataset.
- It is recommended that the DTW data used in the GDE analysis be updated using the additional datasets described in this comment document where feasible and appropriate (e.g. both land surface and groundwater levels). Estimates of uncertainty in DTW should be addressed as suggested by this document or otherwise discussed. Where uncertainty in DTW exceeds the 30’ threshold (e.g. 95% confidence interval shows DTW<30’) GDE’s should not be removed from the dataset.
- Please include discussion of the assumptions and scientific basis for the 3.1 mile search radius (page 48). It would seem there are several implicit assumptions that must hold in order for this distance to be relevant and allow GW elevations to be constant between well and GDE as appears to be the case described in the document (e.g. terrain is flat or constant water level slope, homogeneity of subsurface properties). Following such discussion it is recommended that the analysis be updated to account for circumstances where the underlying assumptions may not be true, for instance along river corridors and within the historical extent of paleochannels and floodplain surfaces where a complex subsurface is present. One option would be to exclude DTW data if the well is located in a different lithology than the potential GDE being evaluated (Figure HCM-2).
- When comparing DTW data for wells within 3.1 miles of a potential GDE were differences in land surface elevation between the well and the potential GDE accounted for? For instance if the DTW at the well location is 39’ but the difference in land surface between the well and the GDE is 10’ it may be reasonable to conclude that DTW at the GDE is 29’ and thus below the 30’ threshold. Please discuss and update analysis where appropriate.

The next set of comments includes recommendations for additional data sources for use in mapping and describing the ecological relevance of GDEs.

- California Aquatic Resource Inventory (CARI) (available at https://www.sfei.org/cari) includes aggregated data from sources that may not have been used in the NCCAG dataset and conceptually could be used to help validate GDE presence/absence.
- The South Sacramento Habitat Conservation Plan (https://www.southsachcp.com/) includes an aquatic resources inventory for the Cosumnes and Deer Creek and land cover mapping (https://www.southsachcp.com/uploads/4/8/8/9/48899225/appendix_i_arp_vol_ii_appendices.pdf [page 103] and https://www.southsachcp.com/uploads/4/8/8/9/48899225/appendix-e-1_land_cover_type_mapping_report.pdf). Depending on availability of geospatial data these resources could conceptually be used to help validate GDE presence/absence.

The final comment addresses a conceptual treatment on defining and describing GDEs.

- SGMA defines GDEs as, "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." Dependence in this definition has largely been interpreted as the resource(s) in question having physical access to GW. Given California's Mediterranean climate any period of physical access indicates a dependency. For many GDEs present in today's landscape physical access to GW that historically existed has been lost. This begs the question of whether the resource(s) in question are GDEs or not. The severing of access to GW does not change the fundamental nature of the resource. The resource is still dependent on GW even if this dependency cannot be satisfied. The consequences of the loss of connection are complex depending on numerous ecological, hydrologic, and societal variables rendering the ecological trajectory of the resource difficult to predict. For instance if GW dependence was necessary to support regeneration, the resource may continue to persist but in a state of continued decline until a shift in ecological regime occurs, while under other circumstances the health at GDE may not be significantly impaired. In this vein identification of GDEs truly requires both a long historic perspective to evaluate the physical access of GW to these resources and that the resources are still present on the landscape (e.g. biotic communities, hydrogeomorphic indicators). Under SGMA, it may be argued that GDEs meeting the above criteria but whose contemporary physical access to GW no longer exists are still GDEs in that their fundamental nature hasn't changed, it is simply that they are not subject to SGMA requirements and outside the scope of management under SGMA. There is inherent ecological value in this distinction and how society describes the resources being analyzed that is worth addressing. It is recommended that reasonable effort be made to use existing historic water levels elevations to better understand GDEs in the Basin.

General Comments

- How do you envision the use of modeling (e.g. CoSANA model) to update or inform the findings above?

References Cited

Beven, Keith J. (2006). Streamflow generation processes. Benchmark papers in hydrology, 1. Wallingford : International Association of Hydrological Sciences.

Tássia Mattos Brighenti, Nadia Bernardi Bonumá, Raghavan Srinivasan, Pedro Luiz Borges Chaffe. (2019) Simulating sub-daily hydrological process with SWAT: a review. Hydrological Sciences Journal 64:12, pages 1415-1423.

Fleckenstein J, Anderson M, Fogg G, Mount J, (2004). Managing Surface Water-Groundwater to Restore Fall Flows in the Cosumnes River. Journal of Water Resources Planning and Management 130(4): 301-
310. doi: 10.1061/(ASCE)0733-9496(2004)130:4(301)

Fleckenstein JH, Niswonger RG, Fogg GE, (2006). River-Aquifer Interactions, Geologic Heterogeneity, and
Low Flow Management. Ground Water 44(6): 837-853. https://doi.org/10.1111/j.1745-6584.2006.00190.x

Maples, S. R., Foglia, L., Fogg, G. E., and Maxwell, R. M.: Sensitivity of hydrologic and geologic parameters on recharge processes in a highly heterogeneous, semi-confined aquifer system, Hydrol. Earth Syst. Sci., 24, 2437–2456, https://doi.org/10.5194/hess-24-2437-2020, 2020.

Markovich, K., H, Manning, A. H., Condon, L. E., & McIntosh, J. C. (2019). Mountain-block recharge: A review of current understanding. Water Resources Research, 55, 8278– 8304. https://doi.org/10.1029/2019WR025676

Markovich, K. H., Maxwell, R. M., and Fogg, G. E. (2016). Hydrogeological response to climate change in alpine hillslopes. Hydrol. Process., 30: 3126– 3138. doi: 10.1002/hyp.10851.

Niswonger, R. G. (2006), The hydroecological significance of perched groundwater beneath streams, Ph.D. dissertation, 171 pp., Hydrol. Sci. Grad. Group, Univ. of Calif., Davis.

Niswonger, R. G., and G. E. Fogg (2008), Influence of perched groundwater on base flow, Water Resour. Res., 44, W03405, doi:10.1029/2007WR006160.

Pauloo, R. & Dahlke, H. & Escriva-Bou, A. & Fencl, A. & Guillon, H. & Fogg, G.E. (2019). Domestic Well Vulnerability to Drought Duration and Unsustainable Groundwater Management in California's Central Valley. Environmental Research Letters, 10.1088/1748-9326/ab6f10

Rohde M.M., Sweet S.B., Ulrich C., and Howard J. (2019). A Transdisciplinary Approach to Characterize Hydrological Controls on Groundwater-Dependent Ecosystem Health. Front. Environ. Sci. 7:175. doi: 10.3389/fenvs.2019.00175

Ted Rauh, Sacramento Central Groundwater Authority

From: ted rauh
Date: Saturday, August 8, 2020 at 3:43 PM
To: 'Stephanie Horii' <shorii@cbi.org>
Subject: RE: [Reminder] Cosumnes SWAG - Comments due on Mtg #1 Materials

Hi Stephanie,
I read with interest the comments submitted to you by Melinda. I understand these comments reflect technical expertise and personal knowledge of individuals who have responsibility for, or work in, the geographical area of concern. I find the suggestions they make and the technical citations and studies they reference add additional depth to the analysis of this region. I look forward to the technical team's review of these suggestions and hope that the data and studies can be incorporated into the ongoing analysis. The addition of pertinent analysis will afford us all a greater understanding of the connectivity between the Cosumnes and the underlying subbasins, improve the modeling of the subbasin boundary, and improve our understanding of GDE's along its reach.
Thank you for consideration of my comments,
Ted