Consensus Building Institute
100 CambridgePark Drive, Suite 302
Cambridge, MA 02140
TEL: 617. 492.1414
EMAIL: inquire@cbi.org

To: Surface Water Advisory Group Members
From: Bennett Brooks, Consensus Building Institute
Date: October 30, 2020
Re: SWAG Comment on Tech Memo #6

Many thanks for your thoughtful participation in the two SWAG meetings to-date. We very much appreciate the time and thought you've been putting into these discussions.

Attached please find a summary of the comments you provided on Draft Tech Memorandum #6 - Hydrogeologic Conceptual Model and Assessment of Groundwater Conditions - presented at SWAG Meeting #1. Consistent with SGMA guidance, the Subbasin Working Group has considered each individual comment (with technical support from EKI) and put forward a draft plan for addressing these points within its evolving Groundwater Sustainability Plan (also included in the attached document).

A few points to note as you review this document:

- Recommended changes to the draft GSP text that are a direct result of a comment are shown in blue text.
- Green text denotes recommendations the GSAs will consider as part of their on-going responsibility to fill data gaps and update the GSP every five years.
- Changes to the draft GSP that are anticipated as a result of current Proposition 68 activities are also noted.

A similar draft summary document for comments from SWAG Meeting #2 will be prepared and discussed at the November 18 Working Group meeting. We look forward to our next SWAG meeting on December 4. As always, please feel free to reach out if any questions.

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1	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	HCM; 2.3. Physical Characteristics	The median transmissivity value from aquifer testing in the basin plain was 1,900 ft2/day, while the median value from specific capacity tests was 14,700 ft2/day. What is the cause of the discrepancy? How does the 7.5x uncertainty in transmissivity affect the application of groundwater model results?	As discussed in *Section 2.3.7. Hydrogeologic Conceptual Model Data Gaps*, limited well-specific aquifer property data are available. The transmissivity value of 1,900 ft2/day is a single value from a single test result. The estimated transmissivity from specific capacity is based on 42 tests and an empirical relationship reported in Driscoll (1995). The groundwater model will be calibrated based on the best available data and information. Transmissivity estimates from aquifer tests and specific capacity tests are considered along with other data types and sources (e.g. texture, other models, literature values, etc.) as part of model calibration.	None anticipated. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.
2	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	HCM; 2.3. Physical Characteristics	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.	TM#6 was developed based on the best available data and science [CCR §351(h)]. To the best of our knowledge Berkstresser 1973 represents the best available data for the Basin at this time.	None anticipated. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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3	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	HCM; 2.3. Physical Characteristics	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?	Anona's comment was given in the spirit of a colorful anecdote. All available evidence (e.g., boring logs, data from the *Dunn Environmental, 2012 Groundwater Supply Study and Integrated Regional Groundwater Management Plan for the Lake Camanche Water Improvement District No. 7* report, etc.) show some hydrogeologic complexity associated with areas near the Eastern Basin boundary and outcropping of the Carabas Paleo-Ridge; however, all are within the context of a porous media (not fractured) aquifer system. See also response to Comment 5, below.	None anticipated. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.
4	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	HCM; 2.3. Physical Characteristics	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.	The Basin is potentially recharged from multiple exposed Formations. This and the vertical exchange of water between formations is consistent with the conceptualization of a single principal aquifer system.	None anticipated. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.
5	8/4/2020	Amelia Vankeuren, Ph.D./ California State	HCM; 2.3. Physical Characteristics	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	Per 23-California Code of Regulations §351(aa) *"Principal aquifers" refer to aquifers or* ***aquifer systems*** *that store, transmit, and yield significant or economic quantities of groundwater to wells, springs,*	Results of TSS Grant and Proposition 68 efforts will be incorporated into the GSP.

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		University, Sacramento		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. o The Site 2 value of 0.25 is a large vertical gradient and suggests separate aquifers in that location o The Site 3 wells are both within the Laguna Formation and thus can't be used to tell if different formations host different aquifers o 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.	*or surface water systems*. There are no barriers to vertical flow between formations indicating they comprise a single aquifer system. Based on the available data there is no compelling reason or benefit to basin management to delineate multiple principal aquifers in the Basin. As discussed in *Section 2.3.7. Hydrogeologic Conceptual Model Data Gaps*, limited well-specific aquifer property data are available. As part of TSS Grant and Proposition 68 funding, geophysical investigations are being conducted to better understand subsurface properties and nested wells ("co-located wells") are being installed to better characterize the vertical and horizontal gradients.	The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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6	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	Current and Historical Groundwater Conditions; 3.2. Change in Groundwater Storage	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?	See *Section 3.2 Change in Groundwater Storage* where a review was conducted on change in storage estimates reported by others over a similar time period, including Faunt et al (2009). EKI's estimate falls within range of other studies and will be improved as information becomes available. Moreover, the work by Faunt focuses on multiple basins and subbasins that span the entire Central Valley, whereas TM#6 completed detailed analysis with focus exclusively on the Basin.	The water budget estimates will be refined once the model is completed.
7	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	Current and Historical Groundwater Conditions; 3.4. Groundwater Quality Concerns	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.	A SGMA-compliant monitoring network for the Basin is in development. As discussed in *Section 2.3.7. Hydrogeologic Conceptual Model Data Gaps* and *Section 3.7.1. Groundwater Conditions Data Gaps*, water quality data are limited spatially. It is expected that through development of the SGMA monitoring network additional data will be compiled and trends can be analyzed.	The GSP text will reflect the final monitoring network and identify data gaps.
8	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	Current and Historical Groundwater Conditions; 3.4. Groundwater Quality Concerns	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	Manganese is monitored by the California Regional Water Quality Control Board and over half of the wells producing samples that exceeded the secondary MCL are from shallow monitoring wells and do not supply water for beneficial use. Basin management pursuant to SGMA is not expected to impact or increase the presence of naturally-occurring manganese.	None anticipated. Available data are already included and discussed.

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				water from those wells is generally not treated or blended to ensure it complies with drinking water standards.		
9	8/4/2020	Amelia Vankeuren, Ph.D./ California State University, Sacramento	Current and Historical Groundwater Conditions; 3.6. Interconnected Surface Water Systems	While the groundwater system is clearly disconnected from the Cosumnes River for much of the sub basin, 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, 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 Folia 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.	See Figures GWC-1 and GWC-2 where dashed lines represent areas of most uncertainty which include the areas near the Cosumnes River to account for the incision of the stream bed and lack of well data. As discussed in *Section 3.7.1. Groundwater Conditions Data Gaps*, shallow wells near surface features and stream gauges are limited in the Basin. As part of TSS Grant and Proposition 68 funding the GSAs are planning on installing additional wells, including a well near a gauging station to develop additional data for interconnected groundwater and surface water evaluation.	Results of the TSS Grant and Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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10	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	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	TM#6 was developed based on the best available data and science [CCR §351(h)]. Source i) was used in the development of TM#6. There are wells in the SGMA monitoring network from this dataset. Source ii) was used in the development of TM#6 and data are in the DMS. The data are also being used as part of the Proposition 68 funded Isotopic Recharge Characterization Study. Source iii) was published after TM#6 was released, but will be reviewed and incorporated as applicable. Data from source iv) will be considered during the Proposition 68 Groundwater Dependent Ecosystem (GDE) Verification task.	Results of Proposition 68 efforts and review of Source iii will be incorporated into the GSP.

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11	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	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.	The Markovich articles are conceptual modeling studies and do not provide Basin-specific data to support their hypothesis. TM#6 was developed based on the best available data and science [CCR §351(h)] and assumptions regarding recharge can be reviewed as part of model calibration, water level and water quality data collection over time.	A reference to this document will be incorporated into the draft GSP.

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12	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	2.1.4 Principal Aquifer 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.	Per 23-California Code of Regulations §351(aa) *"Principal aquifers" refer to aquifers or aquifer systems that store, transmit, and* ***yield significant or economic quantities of groundwater*** *to wells, springs, or surface water systems*. SGMA is focused on the management of Principal Aquifers. Perched aquifers, if they exist in the Basin, are not part of the Principal Aquifer, and there is no known data available to delineate them. Proposition 68 funding is supporting GDE verification and geophysical studies, and any evidence of perched aquifers will be documented as part of that effort.	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed on perched aquifers, it will be incorporated into future updates of the GSP (e.g., with respect to monitoring and potentially aquifer testing to assess connectivity, if any, to the Principal Aquifer).
13	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	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.	As discussed in *Section 3.7.1. Groundwater Conditions Data Gaps*: few shallow wells are located within the Basin. None of the well log data we have reviewed in developing the cross sections indicated presence of a perched aquifer. That being said, Proposition 68 funding is supporting GDE verification and geophysical studies, and any evidence of perched aquifers will be documented as part of that effort.	Results of Proposition 68 efforts will be incorporated into the GSP. To the extent that information is developed on perched aquifers, it will be incorporated into future updates of the GSP.

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14	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	2.2 Cross Sections	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	We appreciate the identification of these additional sources of potential information. TM#6 relies on tools and sources suggested by DWR and consistent for the entirety of the basin. The USGS 10-meter DEM was used as recommended by DWR in Section 7 of their HCM Best Management Practices for Sustainable Management of Groundwater (DWR, 2016).	Uncertainties associated with use of the DEM data will be described, and the potential ability to improve estimated land surface elevations at well locations, stream bed elevations, and so forth, if the data are available, can be considered to improve inferred groundwater depths and gradients. It is anticipated that the cross-sections will be improved with additional data as part of the 5-year update, including more precise elevation data, as appropriate.

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15	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	2.2 Cross Sections; 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.	Comment noted.	Additional explanation of groundwater trends will be provided.
16	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	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	We appreciate the identification of these additional sources. Hydrologic Soil Groups of the NRCS soil surveys were used as recommended and provided in Section 5 of the HCM Best Management Practices for Sustainable Management of Groundwater (DWR, 2016). The UC Davis SAGBI dataset has already been incorporated into the GSP work effort. The boring data set relied on by Maples et al. (2020) was provided to EKI and considered in development of the DMS and TM#6. The Maples (2020) document was published six months after TM#6 was released, but can be reviewed and incorporated as applicable.	Information from Maples et al. (2020) will be incorporated to the extent applicable. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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				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.		
17	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	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).	Spring 2018 and Fall 2018 groundwater contours were generated by using the contouring and 3D surface mapping software program Surfer® from Golden Software, LLC. First, the default Kriging gridding method was used with a cell size of 500 ft x 500 ft to create the groundwater elevation grid across the Basin from the available water level elevation data. Then, groundwater elevation contours were created from the Basin wide groundwater elevation grid. Contours were smoothed out by using the "high smoothing" option within the Surfer® software. Development of the Basin contours was also informed by review of available data and contour maps in the adjacent basins.	A footnote will be added to the GSP to describe the contouring method.

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18	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.1.1 Groundwater Elevation Contour Maps; 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).	The data from the additional datasets described in comments to Section 2.2 were considered for TM#6; please see response to Comment 10. DTW maps are not required by SGMA but were included in TM#6 to support additional analysis and evaluation of potential GDEs in the Basin. TM#6 reports that DTW can range about 10 feet between the highest water levels in the spring and lowest water levels in the fall. Hence, as noted in TM#6, the area underlain by water within 30 ft bgs is therefore likely greater under spring conditions.	None anticipated as data are already incorporated.
19	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.1.1 Groundwater Elevation Contour Maps; Depth to Groundwater	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.	Depth to water contours were downloaded from DWR's GICIMA website and used directly for qualitative comparison to the contours in Figures GWC-4 & GWC-15.	None.

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20	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.1.1 Groundwater Elevation Contour Maps; Depth to Groundwater	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.	Comment noted.	Acknowledge limitations of DEM in characterizing stream channel dimensions.

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21	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	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	TM#6 findings are consistent with the work of multiple other researches, which indicate that the Cosumnes River flows are disconnected from underlying groundwater along most of its reach within the Basin; a finding that is supported in your Comment 9. TM#6 <u>does not</u> make the case that "the entirety of the Cosumnes River within the Basin as well as all other surface waters in the Basin … as **not** being interconnected surface waters". However, we appreciate the identification of these additional sources and will review them. As discussed in *Section 3.7.1. Groundwater Conditions Data Gaps*: few shallow wells are located near surface water features and few to none of the wells are located adjacent to an existing river/stream gauging station. This continues to represent a data gap in the evaluation of riparian GDEs as well as interconnected groundwater and surface water. As part of TSS Grant and Proposition 68 funding, geophysical investigations are being conducted to better understand subsurface properties along the Cosumnes River, nested wells ("co-located wells") are being installed to better characterize shallow conditions and two stream gauges are being installed.	Results of TSS Grant and Proposition 68 efforts will be incorporated into the GSP, as will relevant information from the modeling and the identified sources. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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				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 hydrofacie 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		

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				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.		

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22	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.6 Interconnected Surface Water Systems	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.	The UCD groundwater observatory wells, that fall within the Basin, and their data, are already included in the Basin DMS. Please see response to Comment 10. As discussed in *Section 3.7.1. Groundwater Conditions Data Gaps*: few shallow wells are located near surface water features and few to none of the wells are located adjacent to an existing river/stream gauging station. This continues to represent a data gap in the evaluation of riparian GDEs as well as interconnected groundwater and surface water. As part of TSS Grant and Proposition 68 funding, geophysical investigations are being conducted to better understand subsurface properties along the Cosumnes River, nested wells ("co-located wells") are being installed to better characterize shallow conditions and two stream gauges are being installed.	Results of the TSS Grant and Proposition 68 efforts will be incorporated into the GSP. The relationship between the water levels and the riverbed will be clarified. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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23	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.6 Interconnected Surface Water Systems	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.	As discussed in *Section 3.7.1. Groundwater Conditions Data Gaps* there are data gap in the evaluation of riparian GDEs as well as interconnected groundwater and surface water. As part of TSS Grant and Proposition 68 funding, geophysical investigations are being conducted to better understand subsurface properties along the Cosumnes River, nested wells ("co-located wells") are being installed to better characterize shallow conditions and two stream gauges are being installed.	Results of Proposition 68 efforts will be incorporated into the GSP. Use of the tools noted herein will be mentioned in the GSP as a potential means to address the data gap as part of GSP implementation. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.
24	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.6 Interconnected Surface Water Systems	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,	As discussed in *Section 3.7.1. Groundwater Conditions Data Gaps*: few shallow wells are located near surface water features and few to none of the wells are located adjacent to an existing river/stream gauging station. This represents a data gap in the evaluation of riparian GDEs as well as interconnected groundwater and surface water. That being said, the best data	Results of TSS Grant Proposition 68 efforts will be incorporated into the GSP, as well as an uncertainty discussion with respect to interconnected surface waters.

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				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.	available suggest that water levels in the Principal Aquifer in the vicinity of Dry Creek and other surface water features within the Basin are as much as 130 feet below ground surface– strongly suggesting a disconnect. Historical data suggest about a 10 foot fluctuation between seasonal highs and lows within the Basin, which does not change this conclusion (see Figures GWC-14 and GWC-4). As part of TSS Grant and Proposition 68 funding, geophysical investigations are being conducted to better understand subsurface properties along the Cosumnes River, nested wells ("co-located wells") are being installed to better characterize shallow conditions and two stream gauges are being installed.	The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.
25	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.6 Interconnecte d Surface Water Systems	It is recommended that coordination be made with the South American Subbasin (5- 21.65) GSP to ensure 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-Joaquin Basin (5-022.16) GSP how the shared boundary of Dry Creek is defined.	Three of the Basin GSAs manage areas north and south of the Cosumnes River (Sacramento County, Sloughhouse and Omochumne-Hartnell GSAs), facilitating coordination with the South American Subbasin. Coordination with the ESJ Subbasin included regular attendance at monthly meetings, meeting with representatives to discuss modeling and water budget results, and review and feedback on the ESJ Draft GSP. Additionally, as part of Proposition 68 funding a facilitated Surface Water Adivsory Group (SWAG) has been created	All coordination and stakeholder efforts are being tracked and will be documented in the GSP.

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					from Basin stakeholders, includes neighboring Basin representatives, to focus on surface water, groundwater and GDE management in the Basin. The Cosumnes and adjacent basins are coordinating in model development as well (i.e., the CoSANA model).	
26	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	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.	Figure GWC-15, which shows the NCCAG datasets, depth to water measurements, and contours, shows that the contours represent Fall 2018 conditions.	None anticipated.
27	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	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).	Figure GWC-15 includes Spring 2018 DTW. Proposition 68 funding is supporting GDE verification studies which will be conducted following TNC Guidance documents and available water level data from the DMS.	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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28	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	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.	Please see response to Comment 10. We also note that the UCD wells cover only a small portion of the Basin near the river; most of the wells are in the South American Subbasin. Pauloo et al. (2019) and TM 6 both rely on the Well Driller Reports (WDRs) compiled by DWR. Figure GWC-15 maps potential GDEs, and the mapping exercise included identifying the range in DTW<30' delineated by spring (seasonal high) and fall (seasonal low) water levels in the Primary Aquifer during the period 2011 through 2018. All potential GDEs overlying the resulting range in areas with DTW<30' are included in Figure GWC-15. Proposition 68 funding is supporting additional GDE verification studies.	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.
29	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	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.	Figure GWC-15 maps potential GDEs, and the mapping exercise included identifying the range in DTW<30' delineated by spring (seasonal high) and fall (seasonal low) water levels in the Primary Aquifer during the period 2011 through 2018. All potential GDEs overlying the resulting range in areas with DTW<30' are included in Figure GWC-15. Proposition 68 funding is supporting additional GDE verification studies.	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be

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						incorporated into future updates of the GSP.
30	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	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)	Figure GWC-15 maps potential GDEs, and the mapping exercise included identifying the range in DTW<30' delineated by spring (seasonal high) and fall (seasonal low) water levels in the Primary Aquifer during the period 2011 through 2018. All potential GDEs overlying the resulting range in areas with DTW<30' are included in Figure GWC-15. Proposition 68 funding is supporting additional GDE verification studies.	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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31	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	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.	Figure GWC-15 maps potential GDEs, and the mapping exercise included identifying the range in DTW<30' delineated by spring (seasonal high) and fall (seasonal low) water levels in the Primary Aquifer during the period 2011 through 2018. All potential GDEs overlying the resulting range in areas with DTW<30' are included in Figure GWC-15. Proposition 68 funding is supporting additional GDE verification studies.	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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32	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	Consider the following 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.	These resources will be considered as part of the Proposition 68 funded GDE verification effort.	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.
33	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	3.7 Groundwater Dependent Ecosystems	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	Figure GWC-15 maps potential GDEs, and the mapping exercise included identifying the range in DTW<30' delineated by spring (seasonal high) and fall (seasonal low) water levels in the Primary Aquifer during the period 2011 through 2018. All potential GDEs overlying the resulting range in areas with DTW<30' are included in Figure GWC-	Results of Proposition 68 efforts will be incorporated into the GSP. The GSAs are planning to address data gaps as part of GSP

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				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	15. Proposition 68 funding is supporting additional GDE verification studies.	implementation. To the extent that additional information is developed as part of GSP implementation and other coordinated efforts, it will be incorporated into future updates of the GSP.

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				water levels elevations to better understand GDEs in the Basin.		
34	8/7/2020	Melinda Frost-Hurzel, ECOS, The Nature Conservancy, and Cosumnes Coalition	General Comments	How do you envision the use of modeling (e.g. CoSANA model) to update or inform the findings above?	The model will be used to support water budgeting, evaluation of sustainability criteria, and evaluation of projects and management actions.	The GSP will be updated to reflect modeling results.
35	8/2/2020	Bill Myers, Sheldon Community Association		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	This information has been provided to the Basin GSAs.	None anticipated.

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				necessarily owns all these tools, but I would think that Rosie would be aware of them.		
36	8/8/2020	Ted Rauh, Sacramento Central Groundwater Authority		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.	Comment noted.	None anticipated.