Special Joint Meeting of the Delta-Mendota Subbasin Technical Working Group and Coordination Committee

Wednesday, June 8, 2022, 1:00 PM DRAFT

SLDMWA Boardroom, 842 6th Street, Los Banos, CA

Coordination Committee Members and Alternates Present

Chase Hurley – Pacheco Water District/Central Delta-Mendota Region
Jarrett Martin – Central California Irrigation District/SJREC
Ric Ortega – Grassland Water District
Jim Stillwell – Farmers Water District
Augie Ramirez – Fresno County
John Wiersma – San Luis Canal Company/SJREC
Vince Lucchesi – Patterson Irrigation District*

San Luis & Delta-Mendota Water Authority Staff Present

John Brodie

Others Present

Adam Scheuber – Del Puerto Water District*
Maria Encinas – City of Patterson
Fernando Ulloa – City of Patterson*
Chris Rogers – CCID*
Ellen Wehr – Grassland Water District*
Mike Stearns – Panoche Water District
Steve Stadler – San Luis Water District*
Juan Cadena – Mercy Springs Water District*
Kel Mitchel – Turner Island Water District*
David Cory – San Joaquin River Exchange Contractors
Rick Iger – Provost & Pritchard
Lauren Layne – Baker Manock & Jensen*
Anona Dutton – EKI Environment & Water, Inc.*
Meredith Durant – EKI Environment & Water, Inc.*
Leslie Dumas – Woodard & Curran*
Andrew Francis – Luhdorff & Scalmanini*
Nat Kane*
Yvonne Petroni*
Lowell Chow*

* Denotes telephonic/Zoom participation.

1. Call to Order/Roll Call

Jarrett Martin/CCID called the meeting to order at 1:01 PM.

2. **Committees to Consider Corrections or Additions to the Agenda of Items, as authorized by Government Code Section 54950, et seq**

No corrections or additions were made to the agenda of items.

3. **Opportunity for Public Comment**

No public comment was shared.

4. **Committee to Review and Take Action on Consent Calendar**
   a. **Meeting Minutes**
      i. **June 1, 2022 Delta-Mendota Coordination Committee and Technical Working Group Special Joint Meeting**
   b. **Coordination Committee Budget to Actual**

The Committee considered approval of the prior meeting minutes and Budget to Actual Report as presented in the meeting packet. Ric Ortega/Grassland provided the motion and Augie Ramirez/Fresno County seconded. The Committee voted by roll call; the motion was passed unanimously by those present.

5. **Committees to Discuss Revised Water Budget for the Subbasin, Martin**

Leslie Dumas/Woodard & Curran reported that an internal draft of a technical memorandum on the Subbasin water budget has been prepared. Once reviewed, she will provide it to the Committee for incorporation into the revised GSP Common Chapter.

6. **Committees to Discuss Revised Sustainable Management Criteria and Tables for Chronic Lowering of Groundwater Levels, Martin**

The Committees reviewed the revised draft table CC-14 included in the meeting packet and discussed that many wells now included in the Representative Monitoring Network do not have monitoring data prior to 2016 that can be used to set numeric sustainable management criteria. Wells installed within the Subbasin through the DWR TSS program will also not have a historical dataset. At least one GSP group expressed a concern regarding potential impacts due to groundwater pumping outside of the Subbasin. Revision of the draft table is anticipated to address these issues.

7. **Committees to Discuss Revised Sustainable Management Criteria and Tables for Reduction in Groundwater Storage, Martin**

The Committees reviewed the revised draft table CC-15 included in the meeting packet and considered the proposed approach of using water levels as a proxy for the Upper Aquifer, and using land subsidence as a proxy to calculate change in groundwater storage in the Lower Aquifer.

8. **Committees to Consider Revised Sustainable Management Criteria and Tables for Subsidence, Martin**

The Committees considered the revised draft table CC-17 included in the meeting packet. Jarrett Martin reported that Madera County and Merced County have initiated programs in certain areas to reduce groundwater pumping from the Lower Aquifer. Although in the "white area", the pumping reduction is not differentiated between aquifers.

9. **Next Steps**

- John Brodie will work on narrative for the Water Budget "crosswalk" for the Common Chapter for the Subbasin Water Budget. Woodard & Curran will provide the technical memorandum as the basis for the revised narrative.

- Aliso Water District will decide on concurrence with the language in the table for chronic lowering of groundwater levels.

- Jarrett Martin, Chase Hurley/Pacheco Water District, and Vince Lucchesi/Patterson Irrigation District will analyze subsidence data to determine minimum thresholds for the SMC and tables for r subsidence.

- John Brodie will contact DWR regarding the process and timing for submittal of signed resolutions adopting the amended GSP from the GSAs and member agencies.

- Recent revisions to the representative monitoring network, including MTs and MOs, need to be uploaded to the SGMA Portal.

- Any revisions to the sustainable management criteria need to be provided by the next Coordination Committee/Technical Working Group meeting on June 15, 2022. Revision of the Common Chapter and GSPs text to address the four deficiencies identified by DWR will follow.

- Lauren Layne/BMJ will prepare and distribute a template for a Resolution for Adoption of the GSP Revisions for use by the GSP groups and member GSAs.

10. Reports Pursuant to Government Code 54954.2(a)(3)

John Brodie reported on a recent meeting to review and discuss the Central Valley CVH2M-SJB groundwater model that is being developed by the US Bureau of Reclamation. USGS staff did not participate in that meeting. John Brodie will follow up with USGS.

11. Future Meetings

a. **June 15, 2022 8:00AM: Joint Technical Working Group and Coordination Committee**
b. **June 20, 2022 8:00AM: Special Joint Meeting of the Northern and Central Delta-Mendota Management Committees, Central GSA, and the Delta-Mendota Subbasin Coordination Committee**

12. Conference with Legal Counsel – Anticipated Litigation

The Committee met in closed session to confer with legal counsel on significant exposure to litigation pursuant to paragraph (2) of subdivision (d) of Government Code Section 54956.9: (1 case).

13. Report Out of Closed Session, Martin

No reportable actions were identified from Closed Session.

14. ADJOURNMENT

Jarrett Martin adjourned the meeting at 5:33 PM.

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MEMORANDUM

TO: Delta-Mendota Subbasin GSAs

CC: John Brodie, San Luis & Delta-Mendota Water Authority

FROM: Leslie Dumas and Natalie Cochran

DATE: June 9, 2022

RE: Response to Deficiency 1

The Delta-Mendota Subbasin (Subbasin) received a Consultation Initiation Letter (Letter) on January 21, 2022 from the California Department of Water Resources (DWR). The Letter identified four potential deficiencies across the six Subbasin Groundwater Sustainability Plans (GSPs) which may preclude DWR's approval, as well as potential corrective actions to address each potential deficiency. The Letter thus initiated consultation between DWR, the Basin Manager, Plan Managers, and the Subbasin's 23 Groundwater Sustainability Agencies (GSAs) on February 18, 2022 regarding the amount of time needed to address the potential deficiencies and corrective actions. Subsequent meetings were held on March 7, March 30, April 19, and May 24, 2022 to discuss the Subbasin's proposed approach to addressing the identified deficiencies. This memorandum has been prepared in response to the first deficiency identified in the Letter, based on direction provided by the DWR and approved by the Delta-Mendota Subbasin Coordination Committee (DMCC or Coordination Committee) ~~and DWR~~. It is intended to supplement the six Subbasin GSPs that were submitted in January 2020 and ~~fill potential gaps~~additional clarifications on coordination that was identified in the Letter provided by DWR.

Commented [JM1]: Wonder if we should pick a different clarifier, letter is fairly vague and only the capital L distinguishes this specific letter.

Deficiency 1, as described in the DWR January 21, 2022 letter, is summarized as follows:

Potential Deficiency 1: The GSPs do not use the same data and methodologies.

Specifically, the letter focused on the water budget, change in groundwater storage and sustainable yield presented in the Common Chapter as problematic. The Letter then went on to identify potential corrective actions that could address Deficiency 1:

"The Common Chapter and the Technical Memoranda do not provide sufficient explanation to confirm that the GSPs have been developed using the same data and methodologies and that elements of the GSPs have been based upon consistent interpretations of the Subbasin's setting. As presented, the GSPs use different data and methodologies that rely upon multiple versions of the Subbasin setting, with many of the GSPs defining their own version of a hydrogeological conceptual model, often for very small areas of the Subbasin. The 23 GSAs developing the six GSPs ***should provide supporting information that is sufficiently detailed and provide explanations that are sufficiently thorough and reasonable to explain how the various components of each GSP will together achieve the Subbasin's common sustainability goal. The explanation should describe how the sustainable management criteria established for each GSP (including management areas if applicable) relate to each other and how they are collectively informed by the basin setting, including the water budget, change in groundwater storage, and sustainable yield, on the Subbasin-wide level.****"*

Use of Common Data and Methodologies

The Letter indicates that "a statement that the GSPs are coordinated without accompanying explanation is not sufficient coordination" and goes on to say that "Department staff find that the Plan for the Subbasin does not utilize same data and methodologies to support the various water budget, change in storage, and sustainable yield approaches; therefore, it is unclear how the GSAs will reach, let alone track, sustainability throughout the Subbasin in a coordinated manner." The following subsections summarize how the 23 GSAs and their respective six GSPs coordinated and used the same data and methodologies to support the "sum-of-the-parts" approach to compiling water budgets, change in storage calculations, and sustainable yield at the Subbasin-level using the same data and methods, as required by the Sustainable Groundwater Management Act (SGMA) and GSP Emergency Regulations~~, and is intended to supplement the amendments made to the Common Chapter in regards to the water budgets and change in storage and calculation of Subbasin sustainable yields.~~

Commented [JM2]: No longer a tech memo. We should also think about referencing GW storage and SY since those responses will likely be located in a different section of the common chapter.

Water Budget

Regarding coordination and use of the same data and methodologies for water budget development, the Letter states that "while the categories of inflows and outflows were agreed upon by the Coordination Committee for the land surface budget and groundwater budget, each of the GSP areas prepared separate water budgets using different modeling methods while often relying upon customized hydrogeological conceptual models which were then 'rolled-up' to the Subbasin level." DWR states that "it is uncertain whether the outflow from a particular GSP within the Subbasin is comparable to the inflow from an adjacent GSP area, as there is no coordinated explanation provided in the Plan." Additionally, the Letter indicates that "some of the GSP groups used numerical models to calculate the inflows and outflows from the respective GSP areas while others used non-numerical and spreadsheet models – there was no explanation in the Common Chapter that indicated how these differing modeling approaches used the same data or methodology." The Letter also references Technical Memoranda #1 and #3, *Common Datasets and Assumptions used in the Delta-Mendota Subbasin GSPs* and *Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield*, respectively.

The purpose of the eight Technical Memoranda appended to the Common Chapter is to document the use of common data and methodologies across the six Subbasin GSPs pursuant to Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 and as described in the Subbasin Coordination Agreement. In preparing the water budgets, each GSP group coordinated use of publicly available data sets along with the best available data for their GSP region. While the same data were used, the terminology used to describe those data sets were not consistent across the basin. The Delta-Mendota Subbasin GSAs acknowledge additional detail is needed to demonstrate that all water budget components across the six Subbasin GSPs utilize the same data and methodologies. As such, subsequent to receipt of the Letter, the Delta-Mendota Technical Working Group met to identify the specific data used and to develop a consistent terminology for the various water budget components. Additionally, the Technical Working Group attempted to simplify the presentation of the Subbasin water budgets through a reduction in the number of water budget components. The following describes the mapping of the original GSP water budget components into the revised simplified coordinated water budget component terminology.

During development of the GSP, the Delta-Mendota Technical Working Group met monthly to ensure modeling methods and approaches were comparable between the six Subbasin GSP water budgets, including using comparable inflows and outflows between GSP regions. (Please note that all meetings were held according to the Brown Act and meeting notes available at deltamendota.org.) Technical Memorandum #1 appended to the Common Chapter states that "boundary flows were evaluated by comparing inflows and outflows assessed by each GSP Group's water budget analyses and associated data, as well as groundwater flow trends from groundwater contours and hydrogeologist input. Each set of neighboring GSP Groups had independent meetings to coordinate and compare their respective contributions to inflows and outflows, and the results were provided and discussed by the Delta-Mendota Subbasin's Technical Working Group and Coordination Committee." Regarding the use of numerical, analytical, and spreadsheet models by the six GSP groups, Technical Memorandum #3 appended to the Common Chapter documents meetings held in September and November 2017 with Trevor Joseph (Senior Engineering Geologist and DWR's SGMA Program Lead, at the time) and other DWR representatives (Mark Nordberg, Tyler Hatch, and Amanda Peisch-Derby) discussing the use of numerical and analytical models in the Subbasin, demonstrating that the hydrologic principles and equations used for both types of modeling in the Delta-Mendota Subbasin are the same. **Table 1**~~**Table 1**~~ documents the data sources utilized in each of the six Subbasin GSPs' historical (Water Year [WY] 2003 to 2012) and current water budgets (WY 2013), and **Table 2**~~**Table 2**~~ includes the same information for the projected water budget (WY 2014-2070). As previously noted, efforts were made to use the same data throughout the Subbasin, where available; however, due to variability in data availability throughout the Subbasin, the best available data were used and characterized appropriately.

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The revised water budgets contained in the redline version of the Common Chapter contains a simplified list of water budget components that utilize the same data and methods as contained in the original water budgets, simply mapped to a consistent set of terminology. The revised land surface budget and groundwater budget that align with the revised data categories identified in **Table 1**~~**Table 1**~~ and **Table 2**~~**Table 2**~~ are presented respectively for the historical water budget in **Table 3**~~**Table 3**~~ and **Table 4**~~**Table 4**~~, for the current water budget in **Table 5**~~**Table 5**~~ and **Table 6**~~**Table 6**~~, and for the projected water budget with climate change factors and projects and management actions in **Table 7**~~**Table 7**~~ and **Table 8**~~**Table 8**~~.

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It might just be me but I was envisioning something different with this narrative. I like the background but thought we would do something like below but more detailed.

Precipitation

The collective GSP's in the Delta-Mendota Subbasin used PRISM and CIMIS stations to determine the annual amount of precipitation across each specific GSP area. PRISM is.....i would assume CIMIS stations are used in the PRISM model...articulate how this is similar data ie. Rain gauges.

For projected water budgets we used historical data from PRISM/CIMIS to collect historic precipitation. We used the climate change model to establish a 2030 factor and 2070 factor etc.

Applied Water – Groundwater

Each GSP used the best available data. Where actual volumetric flow meter data was available, the GSP's used that data. Absent flow meters the GSP's deferred to using electricity bills (explain how PGE bills are used as a proxy to determine total pumping…turn kW-hr into HP into some efficiency into flow rate/volume) or crop consumptive use to get a net groundwater pumping (did we assume an irrigation efficiency and add that to get gross pumping or did we just use net pumping and assume no deep percolation…again many ways to skin the cat but where possible we should articulate what we did)

For projected pumping, we assumed the same pumping as the proxy historical year, added Projects and Management Actions to fine tune the water budget.

Surface Water Inflow

USBR CVO reports…..

Projected: looked at climate change to determine Shasta Critical years…

Table 1. Historic and Current Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) and California Irrigation Management Information System (CIMIS)	PRISM		PRISM and CIMIS	PRISM and CIMIS	CIMIS
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use	Flow meters	Flow meters, power bills, and consumptive use	Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports	Unused	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records	Central Valley Project (CVP) refuge water supply delivery data	USBR CVO and SWRCB diversion reports	USBR CVO; CDEC where available, water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation	Unused	Unused	Non-effective precipitation and agency measured spills Where non-effective precipitation is precipitation in excess of evapotranspiration (ET) on uplands and wetlands; all precipitation on developed land; 50% of annual precipitation is effective on agricultural land, 40% of annual precipitation is runoff and 10% is deep percolation on agricultural land	Irrigation efficiency calculation (ET and non-effective precipitation)	Used non-effective precipitation as runoff and measured spil Flow meter readings
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS; 0.8% reference evapotranspiration (ET_o), applied to estimate of surface area and time facility wetted	Vegetation coefficients and CIMIS				
Land Surface	Outflow	Deep Percolation	Land Surface Budget Inflow - Outflow					

Commented [NC3]: Since we changed this category from "Applied Water - Imported Surface Water", do we need to revise this row since it's no longer just applied water?

Commented [NC4]: Since we changed this category from "Runoff", do we need to revise this row?

Commented [NC5]: Andrew Francis to provide data source.

<table>
<tr><th>Water Budget</th><th>Flow Direction</th><th>Flow Budget Category</th><th>Aliso Water District</th><th>Farmers Water District</th><th>Fresno County</th><th>Grassland</th><th>Northern & Central Delta-Mendota</th><th>San Joaquin River Exchange Contractors</th></tr>
<tr><td>Groundwater</td><td>Inflow</td><td>Infiltration</td><td colspan="6">Land Surface Budget Inflow - Outflow</td></tr>
<tr><td>Groundwater</td><td>Inflow</td><td>Lateral subsurface flow - Upper Aquifer</td><td>Darcy's equation (groundwater levels and transmissivities)</td><td rowspan="2" colspan="3">Darcy's equation (groundwater levels and transmissivities)</td><td>Darcy's equation (groundwater levels and transmissivities) with exception of Coast Range foothills, where assumed 20% of precipitation</td><td rowspan="2">Darcy's equation (groundwater levels and transmissivities)</td></tr>
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<tr><td>Groundwater</td><td>Outflow</td><td>Extraction - Upper Aquifer</td><td>Consumptive use and irrigation efficiency</td><td rowspan="2">Flow meters</td><td rowspan="2">Flow meters, power bills and consumptive use</td><td rowspan="2">Flow meters and consumptive use</td><td rowspan="2">Flow meters and consumptive use. Total extractions split 80% from Upper Aquifer and 20% from Lower Aquifer. Identified data gap to be filled.</td><td>Flow meters</td></tr>
<tr><td>Groundwater</td><td>Outflow</td><td>Extraction - Lower Aquifer</td><td>Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer</td><td>Assumed 10% of total pumping</td></tr>
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<tr><td>Groundwater</td><td>Change in Storage</td><td>Lower Aquifer</td><td>Land subsidence as proxy</td><td>Land subsidence as proxy</td><td>Assumed to be 20% of total change in storage</td><td>Land subsidence used as proxy</td></tr>
</table>

Table 2. Projected Water Budget Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM), applying climate change factors (CCF)	PRISM, applying CCF [1]	PRISM, applying CCF [1]	PRISM and California Irrigation Management Information System (CIMIS), applying CCF	PRISM and CIMIS, applying CCF	CIMIS, applying CCF
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use	Consumptive use	Consumptive use	Flow meters and consumptive use	Flow meters and consumptive use (where available, balance term where unavailable)	Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports, using water year (WY) types as a proxy	Unused	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO), using WY types as a proxy	Central Valley Project (CVP) refuge water supply delivery data, using WY types as a proxy	USBR CVO and SWRCB diversion reports, using WY types as a proxy	USBR CVO; California Data Exchange Center (CDEC) where available, using WY types as a proxy; Water infiltration study used otherwise
Land Surface	Inflow	Project Effects	Unused	Unused	Unused	Unused	Estimated Effects of Projects and Management Actions for the specified Flow Category	
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	Unused	Unused	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	
Land Surface	Outflow	Evapotranspiration	Crop evapotranspiration calculated using crop coefficient (K_c) and reference evapotranspiration (ET_o) adjusted for climate change with Hargreaves Samani and PRISM temperature; Canal/reservoir evapotranspiration estimated using historic data adjusted for climate change	Vegetation coefficients and CIMIS				2030 CCF (2014-2045) and 2070 CCF (2046-2070); WY types used as proxy and multiplied by CCF
Land Surface	Outflow	Deep Percolation	Land Surface Inflow - Outflow					
Land Surface	Outflow	Project Effects	Unused	Unused	Unused	Unused	Estimated Effects of Projects and Management Actions for the specified Flow Category	Unused

Commented [NC6]: Andrew Francis to provide data source.

<table>
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<tr><td>Groundwater</td><td>Outflow</td><td>Lateral subsurface flow - Lower Aquifer</td><td>Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer</td><td>Unused</td><td>Assumed 20% of total inflows. Identified data gap that once filled will use same methodology as Upper Aquifer.</td></tr>
<tr><td>Groundwater</td><td>Outflow</td><td>Flow to Lower Aquifer</td><td>Unused</td><td>Unused</td><td>Unused</td><td>Provided by Kenneth D. Smith and Associates - vertical flow using Darcy's equation</td><td>Unused</td><td>Unused</td></tr>
<tr><td>Groundwater</td><td>Outflow</td><td>Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow</td><td>Unused</td><td>Unused</td><td>Unused</td><td>Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy</td><td>Unused</td><td>Unused</td></tr>
</table>

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</table>

[1] For years PRISM data was not available (1965-1980), representative water years from the PRISM data set were selected based on the measured precipitation at CDEC stations MED and MDR

Table 3. Delta-Mendota Subbasin Historical Water Budget, Land Surface Budget (Revised Table CC-8)

<<insert table>>

Table 4. Delta-Mendota Subbasin Historical Water Budget, Groundwater Budget (Revised Table CC-9)

<<insert table>>

Table 5. Delta-Mendota Subbasin Current Water Budget, Land Surface Budget (Revised Table CC-10)

<<insert table>>

Table 6. Delta-Mendota Subbasin Current Water Budget, Groundwater Budget (Revised Table CC-11)

<<insert table>>

Table 7. Delta-Mendota Subbasin Projected Water Budget, Land Surface Budget with Climate Change Factors and Projects and Management Actions (Revised Table CC-12)

<<insert table>>

Table 8. Delta-Mendota Subbasin Projected Water Budget, Groundwater Budget with Climate Change Factors and Projects and Management Actions (Revised Table CC-13)

<<insert table>>

Change in Storage

The Letter states that "additional explanation of historical, current, and projected change in groundwater storage for the Subbasin is warranted, as well as a straightforward quantification of overdraft throughout the Subbasin. The compilation of water budgets and the estimation of change in groundwater storage for the Subbasin does not appear to use the same data and methodology, or the Plan lacks adequate explanation for how or why the various approaches in the GSPs can be considered as using the same data and methodologies." Additionally, the Letter stated "The explanation related to coordinated change in storage calculations and water budgets is insufficient, especially since information presented in text, and data displayed in figures and tables, do not seem to correlate with each other and it is uncertain what the current loss of storage is throughout the Subbasin. Statements in Common Chapter Section 4.2.3, state that, 'For information on how change in storage was calculated, refer to Section 4.3.3 – *Water Budgets of this Common Chapter*.' However, Section 4.3.2 only states, 'Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.' This fragmented and multi-staged presentation of information is insufficient to demonstrate that the various GSPs are coordinated – Section 4.2.3 of the Common Chapter refers readers to Section 4.3.2, which then refers readers to six different GSP sections." In response, please refer to **Table 1**~~Table 1~~ and **Table 2**~~Table 2~~ for information regarding the use of same data and methodologies used to calculate change in storage across the six Subbasin GSPs for the historical, current, and projected water budgets, respectively, with Subbasin-level change in storage presented in **Table 4**~~Table 4~~ for the historical water budget, **Table 6**~~Table 6~~ for the current water budget, and **Table 8**~~Table 8~~ for the projected water budget. The revised simplified water budget categories, along with a description of how the original water budget categories in each GSP are mapped to the simplified water budget categories and the data used to quantify each water budget category and the associated tables, are presented in the redline Common Chapter.

The Letter goes on to state: "The Plan's change in groundwater storage assessment considered a sum-of-the-parts methodology, combining the change in groundwater storage from each GSP area to determine the overall change in groundwater storage for the Subbasin without a clear quantification of overdraft occurring throughout the Subbasin. Per the Common Chapter, despite recharge outpacing extractions, an overall declining trend in groundwater storage was observed in both aquifers between 2003-2013. Cumulative change in storage declined more rapidly in the Upper Aquifer compared to the Lower Aquifer, declining by about 1,300,000 acre-feet in the Upper Aquifer and 678,000 acre-feet in the Lower Aquifer. However, when 'rolling-up' the water budget information in Tables CC-9 and CC-11, which reflect the Subbasin's historical and current water budgets, the cumulative change in storage in the Upper Aquifer reflects a loss of 624,000 acre-feet and a loss of 375,000 acre-feet in the Lower Aquifer, with a total loss of storage within the Subbasin of 1,003,000 acre-feet. Clarification on the Subbasin's cumulative change in storage and total amount of overdraft is required, because the overdraft information does not align throughout the six GSPs." The following revisions have been made to the Common Chapter and six Subbasin GSPs:

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Commented [NC7]: SJREC states 50 TAF in overdraft for the whole subbasin

NCDM states 42,000 AF for Upper Aquifer and 8,000 AF for Lower Aquifer in overdraft

Aliso states 2,200 AFY of overdraft

Fresno claims no overdraft

Farmers says 600 AFY overdraft

Grassland indicates overdraft is calculated using annual change in storage but doesn't state quantity

Commented [NC8R7]: I think each GSP is using the same methods to quantify overdraft. So we will just need to make sure the #s reported in each GSP align with overall subbasin overdraft.

- Text updated on <<include page reference>> of the Common Chapter identifies the correct cumulative change in storage in each principal aquifer between 2003 and 2013, which is -624,000 acre-feet in the Upper Aquifer and -375,000 acre-feet in the Lower Aquifer.

Annual Reports to the GSP require reporting of change in groundwater storage for the prior water year. DWR notes in the Letter that in the Water Year 2020 Annual Report, four methods for the Upper Aquifer and two methods for the Lower Aquifer were identified as being used to calculate change in storage by various GSP groups. As part of the process to address Potential Deficiencies, the six GSP groups have coordinated and agreed upon a common methodology for calculating change in storage that will be applied in future Annual Reports, starting for Water Year 2022:

- Upper Aquifer: Difference in groundwater elevation between the prior and current water year using seasonal high condition contour maps and specific yield estimates.

- Lower Aquifer: Difference in land surface elevation between the prior and current water year. The GSP groups are working to fill gaps in Lower Aquifer groundwater level monitoring and once complete, change in groundwater storage will be calculated using the same methods as the Upper Aquifer.

As a cross-check against the annual change in storage calculated using the aforementioned methodology, hydrographs at individual representative monitoring locations have, and will continue to be, analyzed and aggregated to confirm the annual calculation.

<u>Sustainable Yield</u>

The Letter states: "The Common Chapter (Section 4.3.4) and Technical Memoranda #3 address the methodology for calculating sustainable yield in the Subbasin. Of the six GSPs, three provide a sustainable yield specifically for the GSP area while the other three rely upon the estimate for the entire Subbasin." The Letter also notes that "as indicated throughout the Plan, a sustainable yield estimate is not established for each GSP area and those estimates are not correlated with undesirable results." Following discussion during the joint DMCC and Technical Working Group meetings on May 11 and June 1, 2022, the Subbasin sustainable yield estimates are presented in the Common Chapter. For those GSPs choosing to present GSP region-specific sustainable yield values, the individual GSPs have been modified to include text describing how their GSP-specific sustainable yield was estimated and how that estimate is consistent with what is presented in the Common Chapter.

When discussing the Upper Aquifer sustainable yield estimate, the Letter quotes the Common Chapter as saying, "given existing Subbasin data gaps and uncertainties associated with the data used to develop the water budgets and this estimate, it was also decided that a +/- 10% factor should be applied to determine a range for the Upper Aquifer sustainable yield value. The +/- 10% factor is applied based on the percentage difference between the values from change in storage Subbasin contour mapping for the historic water budget period and the reported changes in storage from the Subbasin consolidated historic water budgets (WY2003-2012) for the Upper Aquifer." DWR indicates that "at a Subbasin scale, the Common Chapter did not clarify what the 'data gaps and uncertainties associated with the data used' were and did not further explain why the 10 percent factor was chosen." In reference to the Lower Aquifer sustainable yield, the Letter quotes Technical Memorandum #3 as saying, "[t]he distribution of known lower aquifer water level data and extraction volume data are limited and not sufficient to allow for a calculation of lower aquifer sustainable yield."

As a result of discussions during the joint DMCC and Technical Working Group meetings on May 11 and June 1, 2022, no changes have been made to the sustainable yield for the Upper Aquifer. As described in the Common Chapter, the Upper Aquifer sustainable yield was estimated using the following calculation:

Upper Aquifer Sustainable Yield = (Pumping + Change in Storage) + (Outflow – Inflow)

Recognizing that the Lower Aquifer sustainable yield value presented in the Common Chapter was based on a study conducted in a separate subbasin, the Delta-Mendota Technical Working Group and DMCC has been recalculated using subsidence rate data measured at two locations along the Delta-Mendota Canal (DMC) at which subsidence has been observed to be occurring at an accelerated rate relative to other locations in the Subbasin - at Pool 8 and Pool 18 of the DMC. Using the observed subsidence rates measured between 2014 and 2018 at these two locations, the number of years required for subsidence to continue at this rate for 2 feet of subsidence to occur (the revised minimum threshold for inelastic land subsidence for the Subbasin) was estimated. Estimated total Lower Aquifer sustainable yield (e.g., the total volume of Lower Aquifer groundwater that can be extracted across the subbasin before undesirable results, defined as 2 feet of inelastic subsidence, were to occur) was then calculated by multiplying the number of years of Lower Aquifer pumping to occur before 2 feet of subsidence occurs by the average annual Lower Aquifer change in storage estimated in the Subbasin historic water budget between Water Year 2014 and Water Year 2017. This methodology resulted in a total estimated Lower Aquifer sustainable yield of 1,303,846 AF using subsidence rates at Pool 8, and 1,130,000 AF using subsidence rates at Pool 18. This correlates to an annual Lower Aquifer sustainable yield over the 20-year implementation window of 65,192 AFY and 56,500 AFY, respectively, or an average annual Lower Aquifer sustainable yield of 60,846 AFY. This methodology and calculation has been added to the revised Common Chapter accordingly.

<u>Additional Coordination Components</u>

The Letter states: "In addition to water budget, change in groundwater storage, and sustainable yield, Water Code Section 10727.6 requires the following additional components to use the same data and methodologies when developing a Plan. As summarized below, these components also do not appear to use the same data and methodologies, or the Plan lacks sufficient explanation of how or why these various approaches should be considered as using the same data and methodologies." The following subsections describe how the six Subbasin GSPs will be modified to use the same data and methodologies or how the approaches contained in each GSP should be considered as using the same data and methodologies for groundwater elevation data, groundwater extraction data, surface water supply, and total water use.

Groundwater Elevation Data

The Letter indicates: "General statements in the Technical Memoranda indicate groundwater elevation data would use information provided by local agencies, State and federal sources, and rely upon best management practices and/or best modeled or projected data available; however, few details were provided to explain what those sources were. Most details were spread throughout the six GSPs in an uncoordinated manner." The following groundwater elevation data was utilized in the development of the six Subbasin GSPs with appropriate page references for each GSP cited:

- DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) Program (Aliso Water District GSP, Technical Memorandum #1, pp. 514)
- DWR's Water Data Library (WDL) (Aliso Water District GSP, Technical Memorandum #1, pp. 514)
- Groundwater level data from local monitoring programs or landowners (Aliso Water District GSP, Technical Memorandum #1, pp. 514; Aliso Water District GSP, Section 5.1.2, pp. 136)

Commented [LD9]: GSP reps - please revised/add to accordingly

It was also noted in the Letter that "some GSP areas plan to measure groundwater elevations to the nearest 0.01 foot while others state elevations will be measured to the nearest 1.0 foot. Some of the GSPs state that measuring to the nearest 0.1 foot or 0.001 foot is not feasible for most measurement methodologies, which is not an accurate statement. The GSP Regulations require measuring groundwater elevations to an accuracy of at least 0.1 feet." The following GSPs have been revised to align with § 352.4(a)(3) of the GSP Emergency Regulations and correctly indicate that field measurements of elevations will be reported to an accuracy of 0.1 feet relative to NAVD88:

- Aliso Water District GSP, Section 5.2, pp. 159-160
- Grassland GSP, Section 5.3, pp. 211

More generally, all six Subbasin GSPs will align § 352.4 of the GSP Emergency Regulations and the following revisions have been made to the GSPs, as appropriate.

Commented [LD10]: Should we also include in the Common Chapter that the six GSPs will abide by Section 352.4?

Groundwater Extraction Data

Commented [LD11]: GSP reps - how deep do we want to go in responding to this comment? Do we just reference Table 1 which maps the water budget components, including estimates of groundwater extraction?

The Letter states that "other than stating groundwater extraction data were estimated or measured by local GSAs for use in individual GSPs, no other organized effort to describe this coordination requirement was provided in the Common Chapter – information was found throughout the six GSPs covering the Subbasin." The following sections of each of the six Subbasin GSPs elaborate on how groundwater extraction data presented in the GSP were calculated or estimated:

- Aliso Water District GSP Section 3.3.2.1.5, pp. 72 and Section 3.3.2.4.1, pp. 83
    - Closure term for the surface water system calculated using the following equation:

$$GW = \left[\frac{(CD - EP)}{IE}\right] - SW$$

Where:

GW = Groundwater Pumped for Irrigation
CD = Crop Demand
EP = Effective Precipitation
IE = Irrigation Efficiency
SW = Surface Water for Irrigation

- Farmers Water District GSP Section 3.3.1.2.2, pp. 121
    - "The total amount of extracted groundwater is composed of the groundwater used to irrigate crops in FWD [Farmers Water District] and pumped into the Mendota Pool for delivery to other GSAs in the Subbasin. Groundwater pumping within FWD is metered and comes primarily from the Upper Aquifer. Historically, there were four wells that were composite wells with a very small amount of perforations located in the uppermost portion of the Lower Aquifer. Three of these wells have been modified to seal off the perforations in the Lower Aquifer. The fourth well is expected to be destroyed as part of the San Joaquin River Restoration Project. FWD groundwater pumping is known for the entire historic and current water budget periods and was used in the in the flow model development and projected water budget simulations. In the projected water budget, groundwater pumping for irrigation purposes is based on the current (2013) land use, and groundwater pumped for discharge into the Mendota Pool is based on the MPG [Mendota Pool Group] Exchange Program EIR/EIS (LSCE, 2018)."
- Fresno County GSP Section 3.3.3.2, pp. 136
    - "The total amount of extracted groundwater is composed of groundwater used to irrigate crops in FCMA [Fresno County Management Area] (adjacent pumping) or pumped into the Mendota Pool for delivery to other GSAs in the Subbasin (transfer pumping). These activities in the MPG areas have been well documented on a monthly basis for the entire historic/current water budget periods. For simulations of historic and current periods, known groundwater pumping (both adjacent and transfer) was assigned to some known wells in FCMA, where records of pumping were available on a monthly basis. For areas where known adjacent pumping was not sufficient to meet the demand of groundwater for irrigation, required additional pumpage was estimated using land use and climatic data. In the projected water budget, groundwater pumping for irrigation purposes is based on the current year (2013) land use and groundwater pumped for discharge into the Mendota Pool is based on the MPG Exchange Program EIR/EIS (LSCE, 2019). All groundwater pumping in FCMA is from the Upper Aquifer, and all pumping wells simulated in the model are located outside the MWA [Mendota Wildlife Area] because groundwater was not used for irrigation in MWA."
- Grassland GSP Section 3.3.2.1, pp. 137
    - "Groundwater pumping is metered in the GGSA [Grassland Groundwater Sustainability Agency] (Subarea 1 for Water Budget purposes) and much of the MCDMGSA [Merced County Delta-Mendota Groundwater Sustainability

Agency] (Subareas 2). Groundwater pumping for areas within Subarea 2 that are not metered were estimated using a consumptive use of applied water method (Equation 3-2). All consumptive use within the unmetered areas is assumed to be met with groundwater. Pumping was calculated as vegetation/crop demand with an irrigation efficiency factor of 80% applied to account for losses, primarily deep percolation into the aquifer. Groundwater pumping is an outflow to the groundwater system and an inflow to the land surface system.

Equation 3-2 Groundwater Pumping

$$GW = \left[\frac{(CD)}{IE}\right]$$

Where:

GW = Groundwater Pumped for Irrigation
CD = Crop Demand
IE = Irrigation Efficiency"

- Northern & Central Delta-Mendota GSP Appendix D pp. 11
  - "GSA member agencies provided groundwater pumping volumes as available for their service areas for each year in the Historic & Current Water Budgets. It was assumed that the data available to the agencies described all significant pumping occurring within their services areas. If no pumping data were available for an agencies service area, CVHM2 model results were considered. Accuracy of the CVHM2 model results was evaluated using professional judgment and local knowledge. The groundwater pumping volume reported in the Historic & Current Water Budgets is the sum of the water removed from the aquifer through pumping. CVHM2 results represent less than 10% of the total pumping volumes reported in the Historic & Current Water Budgets."
- San Joaquin River Exchange Contractors GSP Section 2.2.3.1, pp. 81
  - "Each year the Exchange Contractors prepare a report on well pumping inside the entities and includes pumping from the surrounding area. The total groundwater pumping came from those reports. Groundwater extractions from the Lower Aquifer are estimated at 10% of the total pumping. The cost to drill and pump a well in the upper aquifer is significantly cheaper when compared to a well pumping from the lower aquifer. In most areas of the SJREC GSA, the upper aquifer provides good quality and quantity of groundwater which has limited the number of wells drilled to extract from the lower aquifer. This assumption is consistent with the known data from the SJREC member entity owned wells."

Additional detail about groundwater extraction data in the following sections of the Common Chapter:

- <<include reference to where this is incorporated in the Common Chapter>>

The Letter goes on to say, "as presented in the six GSPs, groundwater extraction data was estimated using cropping data, recorded by meters, was 'well documented' using land use and climatic data, compiled and estimated through model output, or was voluntarily reported by others. Few details, if any, were found in the six GSPs that describe the coordinated extraction data collection methodology and how it will be applied comparably throughout the Subbasin's groundwater sustainability program." As shown in **Table 1**, groundwater extraction was estimated using meters, where available. Where metered data were not available, groundwater extractions were estimated using land use/cropping data, if those data were available, or by the best means possible as appropriate for that location.

Surface Water Supply

Commented [LD12]: GSP reps - same question as for groundwater pumping

The Letter states: "Surface water supply and the methods used to quantify that supply is provided using modeling assumptions, landowner reported data, and other methodology. Few details, if any, were found in the six GSPs that describe the coordinated surface water supply data collection methodology, other than using a 'sum-of-the-parts' water budget approach." The following sections of each of the six Subbasin GSPs elaborate on how surface water supply data presented in the GSP were estimated:

- Aliso Water District GSP Section 3.3.2.1.1, pp. 70
    - "AWD [Aliso Water District] has limited access to surface water. There are private landowners that have rights to surface water, mainly during high-flow years, and have mechanisms in place to receive transfer water when available, When water is available for diversion under the private lawful rights, it is diverted directly from the SJR [San Joaquin River] to the Lone Willow Slough and from the SJR to the Chowchilla Bypass flood control facility through the bifurcation structure. Historically, growers along the Bypass diverted high-flow water through coordination with the Lower San Joaquin River Levee District. However, since the implementation of SGMA, the SWRCB has been working to establish a process to obtain rights to this water. The District was originally developed anticipating construction of the never-built USBR Mid-Valley Canal, as a result AWD has limited involvement in individual grower operations in the past, although this is expected to change due to the enactment of SGMA. This makes gathering historical data complex. Few growers keep detailed records of flows taken off the Bypass or SJR system during flood events. According to the SJRRP [San Joaquin River Restoration Program] modeling and existing records, AWD landowners have diverted an average of approximately 8,400 AF a year of surface water for irrigation and direct recharge during the 10-year average hydrologic period as shown in Table 3-7. Acquisition of additional surface water for irrigation is listed in the projected water budget as a future project. It is anticipated that the District will get a minimum of 10,000 AF/Y during high-flow water years in addition to acquisition of water from the system by private entities."
- Farmers Water District GSP Section 3.3.1.1.1, pp. 119
    - "Surface water inflows and outflows represent the total amount of surface water entering and leaving FWD in streams or canals. The San Joaquin River is

the primary surface water feature in the vicinity of FWD. The SJR does not flow directly through FWD but flows westward along the FWD norther boundary. For the historic, current, and projected periods, surface water flow values used in the flow model are based on SJR flow measured downstream of Gravelly Ford (USGS #11253058), as well as, downstream of the Chowchilla Bypass intake (USGS #11253115) to account for diversions of excess flood water of SJR through the Chowchilla Bypass. The Mendota Pool Is also located adjacent to FWD, similar to the SJR. However, for purposes of the land surface budget, the Mendota Pool is treated as a lake feature and the seepage from the Mendota Pool to FWD is accounted for and described in Section 3.3.1.1.6. The Mendota Pool was described this way because there are no gage stations or readily available data that quantify the flow of the Mendota Pool in the vicinity of FWD. therefore, this surface water feature is accounted for in the land surface budget in the outflow as seepage to the groundwater system."

- Fresno County GSP Section 3.3.2.1, pp 134-135

  - "For the historic, current and projected periods, surface water flow values used in the flow model are based on flow of SJR measured values downstream of Gravelly Ford (USGS #11253058), as well as downstream of the Chowchilla Bypass intake (USGS #11253115) to account for diversion of excess flood water of SJR through the Chowchilla Bypass.

    Surface water inflows and outflows represent the total amount of water entering and leaving FCMA in streams or canals. The primary surface water features in the vicinity of the FCMA are the Mendota Pool (the Pool) consisting of the San Joaquin River branch and the Fresno Slough, San Joaquin River (SJR) upstream of the Pool, James Bypass, and several minor irrigation canals (Figure 3-10). The Pool receives surface water from the SJR, Delta-Mendota Canal (DMC), and flood flows of Kings River via James Bypass/Fresno Slough. Furthermore, pumped groundwater is also discharged into the Pool by the MPG and others for exchange and for irrigation of lands adjacent to the Pool using the Pool as a conveyance. Under normal conditions, flow in the Pool (the Fresno Slough portion) is to the south towards the southern end of the FCMA. During flood events of the Kings River, flood flows are directed north into the Fresno Slough portion of the Pool creating a northerly flow condition. The primary canals that convey water from the northern end of the Pool are the CCID Main Canal, CCID Outside Canal, Firebaugh Intake Canal, and Columbia Canal. Several parties divert water from the southern end of the Pool via Lateral 6 and Lateral 7 canals.

    The flow model calculated the flow of the SJR to the Pool using SJR flow values measured downstream of Gravelly Ford (USGS #11253058), as well as downstream of the Chowchilla Bypass in take (USGS #12253115) to account for diversion of excess flood water of SJR through the Chowchilla Bypass. Flow of James Bypass that is measured near San Joaquin (USGS $11253500, CDEDC JBP) was used to calculate its flow that enters the Pool. Flow of the DMC was specified based on data available from the San Luis Delta-Mendota Water

Authority (SLDMWA). Diversions from the Pool to the Firebaugh Canal, CCID Outside Canal, CCID Main Canal, and Columbia Canal were specified based monthly diversion volumes reported by USBR."

- Grassland GSP Section 3.3.2.1, pp. 136
  - "**Surface Water**

    Both the GGSA and MCDMGSA (Subareas 1 and 2, respectively, See Figure 2-1) have lands within their jurisdictions that receive federally contracted CVP surface water from USBR for private, state, and federal refuges. During wet winter years, they also have the ability to receive Section 215 flood water from USBR. An additional source of surface water includes groundwater imported from outside the GSA that is pumped into Subarea 2 and delivered to managed wetlands in Subarea 1 through the surface water delivery system (see Groundwater discussion below). Total values for delivered surface water for Subarea 1 can range from 125,000 AF during critically dry years to nearly 270,000 AF during wet years. In Subarea 2 surface water deliveries range from 31,000 AF during critically dry years to 52,000 AF during a wet year.

    Surface Water Inflows

    Non-CVP surface water inflows occur from surrounding agricultural districts and local waterways due to the low-lying elevation of the Plan Area. These inflows are accounted for in the surface water totals above. Typically, these inflows are unmetered but have been quantified using observed flow rates as they pass into the Plan Area, along with known watershed capacity characteristics. Surface water inflows have decreased over time with increased agricultural irrigation efficiencies. Non-CVP surface water inflows to Subarea 1 (GGSA area) are estimated at 30,600 AF under the current water budget and 33,800 AF under the average historic water budget. Some of these non-CVP surface water inflows may flow through into Subarea 2 (MCDMGSA area), but there are few independent sources of non-CVP surface water inflows to Subarea 2. Therefore, no additional value for non-CVP surface water inflows was assigned to Subarea 2 in the development of the Plan Area water budgets."

- Northern & Central Delta-Mendota GSP Appendix D, pp. 10
  - "GSA member agencies provided delivery data as it was available for their service areas for each year in the Historic & Current Water Budgets. It was assumed that the data reported by the agencies described all of the surface water being applied within their service areas. Deliveries from the Central Valley Project, State Water Project, and the San Joaquin River, and other local streams and rivers were included. If no data were available, CVHM2 model results were considered and used if the values were considered sufficiently accurate for the area. Accuracy of the CVHM2 model results was evaluated using professional judgement and local knowledge. The surface water deliveries volume reported in the Historic & Current Water Budgets is the sum of all agency delivery data and applicable CVHM2 results. CVHM2 results

represent less than 1% of the total surface water delivery volumes reported in the Historic & Current Water Budgets."

- San Joaquin River Exchange Contractors GSP Section 2.2.3.1, pp. 81
  - "The Surface water allocation is determined based on the FNF at Shasta per the Exchange Contract. All historic water years from 1939 – 2018 were non-critical (100% allocation) with the exception of 1977, 1991, 1992, 1994, 2014, and 2015. Actual surface water deliveries are measured consistent with industry standards and requirements. Surface Water Deliveries are reported in total acre-feet."

As shown in **Table 1**, surface water diversions and application were estimated using metered data, where available. Where metered data were not available, estimates of applied surface water were calculated using land use/cropping data, if those data were available, or by the best means possible as appropriate for that location.

Total Water Use

The Letter states: "Historical, current, and project water budgets for land surface and groundwater are provided in Tables CC-8 through CC-13 of the Common Chapter; however, total water use is not provided for the Subbasin. Technical Memorandum #1 states, 'Total Water Use was estimated or measured by local GSAs for use in the development of individual GSPs. Total water use included in the Delta-Mendota Subbasin water budgets was compiled from the individual GSP water budgets.' Total inflows and total outflows are presented on the tables, but not total water use." The water budget tables (**Table 3**~~Table 3~~ through **Table 8**~~Table 8~~) in the Common Chapter reflect total water use for the Delta-Mendota Subbasin in the historical, current, and projected water budgets.

Commented [LD13]: GSP reps - This is another area where there's some inconsistency in the GSP regs. The Coordination Agreement section of the regs (§ 357.4(b)(3)(B)) references total water use but it's not a required component of the water budgets in the individual GSPs. We could include in the water budget tables, or a separate table (GW + SW)? We have other water uses like recycled water or recirculation, but those supplies are, for the most part, incorporated into SW. Thoughts on how to proceed with this?

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Additional Narrative to Support Water Budget Explanation in Amended GSP
Response to Deficiency No. 1 Identified by DWR for the Delta-Mendota Subbasin
(EKI C00041.03) **DRAFT**

The purpose of the text below is to provide additional explanation regarding the revised presentation of the Water Budget tables that will be included in the amended Common Chapter of the Delta-Mendota Subbasin (Subbasin) Groundwater Sustainability Plan (GSP).

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The data and methodologies used to develop the water budgets in the six individual GSPs (and compiled herein as the Subbasin Water Budget) were coordinated, with the express objective to "rely on the best available information and best available science to quantify the water budget for the basin" (Title 23 of the California Code of Regulations [23 CCR] § 354.18(e)). Given the complex nature of the Subbasin, different data sets and methodologies were appropriate for and/or available in different portions of the Subbasin. As such, a significant effort was made by the Groundwater Sustainability Agencies (GSAs) to: (1) identify the different sources and accuracy of the available data; (2) consolidate these data and associated methodologies into a general hierarchy for use by the GSAs to honor the local conditions, while maintaining consistency with the intent of 23 CCR § 354.18(e); and (3) standardize the terminology for purposes of the Common Chapter presentation of the Subbasin Water Budget. These standardized water budget components and data sources are presented in Tables 1 and 2 and are further described below, while acknowledging that significant additional detail is presented in the six underlying GSPs. In some cases, data were not available or applicable, as acknowledged below and in the tables. Additionally, in some cases the specific terminology and/or the details of the calculations included in each underlying GSP remains unique relative to the standardized terminology and descriptions presented below; a full reconciliation of water budget nomenclature will be conducted as part of the 2025 GSP updates, as well as updates to the datasets and methodologies employed.

LAND SURFACE WATER BUDGET

The data sources/methodologies used to estimate the six major components of the Historical and Current Land Surface Water Budgets are summarized in Table 1 and for the Projected Land Surface Water Budgets in Table 2. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. For purposes of the Subbasin GSPs, the Historical and Current Water Budgets represent Water Year (WY) 2003-2013, where the historical period is WY 2003-2012 and the current year is WY 2013. The Projected Water Budgets reflect conditions through 2070[1] and consider the impacts of climate change and projects and management actions (PMAs). To the extent possible the data sources and methodology used were consistent with those identified by the California Department of Water Resources (DWR) in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the Best Management

[1] The Subbasin GSAs agreed to use actual data from WYs 2014-2017 and assume a repeat of the historical hydrology of 1965-2017 (with the caveat that 1979 would represent the fifth year of the projection and following sequentially the historical water year 1965 would represent the forty-fourth year of the projection) for the years WY 2018-2070.

Commented [A1]: General notes: (1) Urban/M&I components of the Water Budget are not discussed at all in Tables 1 and 2; (2) The Surface Water portion of the Water Budget may benefit by segregation into applied surface water and inflow/outflow/seepage of the surface water flows; (3) if SWP deliveries are used in the Subbasin, reference to those missing from Table 1; (4) Unclear if Tile Drains are dealt with consistently

Commented [A2]: General Comments: (1) Table 2 does not seem to capture the impacts of Climate Change and PMAs, except for with respect to ET and precip.

Practices (BMP) #4-Water Budget.[2] As applicable and available, models and tools (e.g., the Central Valley Hydrologic Model 2 [CVHM2]) were used to support the local sources and assumptions incorporated into the development of the Subbasin Groundwater Water Budget.

(1) Precipitation (Inflow). For the Historical and Current Land Surface Water Budgets, total precipitation across the Subbasin was estimated using either: (1) PRISM: the Precipitation-Elevation Regressions on Independent Slopes Model (PRISM); (2) CIMIS: area-weighted data from the California Irrigation Management Information System (CIMIS) stations located in the Subbasin; and/or (3) data from the National Water Service Station located in Los Banos, CA. Total precipitation was further parsed into effective and non-effective precipitation, as applicable to each GSP area, based on assumptions regarding deep percolation percentages and other losses.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, the 2030 Central Tendency and 2070 Central Tendency climate change factors and guidance provided by DWR were applied to the historical precipitation record to project the impact of climate change on precipitation across the Subbasin. For example, either: (1) the Gridded Statewide Precipitation and Change Factors developed for the Water Storage Investment Program (WSIP) using the Variable Infiltration Capacity (VIC) Macroscale Hydrology Model (DWR, 2018) were applied to the available precipitation data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR Climate Change Technical Advisory Group (CCTAG) were incorporated (DWR CCTAG, 2015).

(2) Applied Water – Groundwater (Inflow). To estimate the volume of applied groundwater for the Historical and Current Land Surface Water Budgets (including both agricultural and municipal & industrial [M&I] pumping, as applicable to each GSP area), the total pumping within the Subbasin was estimated using the following hierarchy of sources, depending upon existing records: (1) Flow meters: volumetric flow meter records from pumping wells; (2) Power bills: electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency); and/or (3) Consumptive use: reported crop acreages and consumptive use data based on either Irrigation Training and Research Center (ITRC)[3] Mapping of Evapotranspiration with Internal Calibration (METRIC) procedure or crop coefficient methodologies (e.g., those provided in the Food and Agricultural Organization of the United States (FAO) Irrigation and Drainage Paper No. 56 (FAO-56) or the ITRC Crop Coefficient data for Zone 14), corrected, as applicable, for applied local and imported surface water. This volume of applied groundwater is consistent with the volume estimated under component (9) Extractions of the Groundwater Water Budget; see below.

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[2] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

[3] California Polytechnic State University, San Luis Obispo

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, the volume of applied groundwater was estimated using various, complimentary methods, including: (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production rates would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record). Climate change impacts and the effects of the planned PMAs are implicitly, rather than explicitly, accounted for (i.e., to the extent that climate change and PMAs increase or decrease the amount of water otherwise available to meet applied water demands, the volume of applied groundwater will be adjusted accordingly).

(3) Surface Water Inflow (Inflow). Surface water serves as an inflow to Subbasin water budget as both applied surface water and as seepage from streams and rivers. To estimate the volume of applied surface water for the Historical and Current Land Surface Water Budgets, the total diversions within the Subbasin over the historical and current water budget time periods were reported using the best available data for each source. Deliveries from the Central Valley Project (CVP), State Water Project (SWP), the San Joaquin River, and other local streams and rivers were compiled from records from the following sources, including, but not limited to: State Water Resources Control Board (SWRCB) diversion reports; United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records; CVP refuge water supply delivery data; and GSA member agency records.

To account for seepage of surface water into the Subbasin from streams and rivers for the Historical and Current Water Budgets, California Data Exchange Center (CDEC) data were used (i.e., by comparing the reductions in measured flow at successive gauging stations after accounting for other diversions), and/or from estimates of seepage losses from certain water bodies from prior water infiltration studies or modeling efforts, as described in the individual GSPs. Seepage from streams and rivers is counted either towards the Groundwater Water Budget directly or towards the Land Surface Water Budget and then, because of the lack of storage capacity in the land surface system and by way of mass balance principles, some or all of this water adds to the Groundwater Water Budget through component (6) Deep Percolation; see below.

For the Projected Land Surface Water Budgets, the volume of applied surface water was estimated as: (1) the records of actual delivery data as it was available for their service areas for WY 2014-2017; and (2) estimates for anticipated future deliveries by WY type for WY 2018-2070, inclusive of climate change considerations to the extent they could be reasonably estimated (i.e., directly modeled based on data provided by DWR and the USBR), or using water year types as a proxy (i.e., future dry year deliveries would reflect historical average dry year deliveries over the historical record). The impacts of planned PMAs on the availability of applied surface water volumes were also incorporated, as applicable. Total inflow to Shasta Lake has a drastic impact on the amount of imported surface water for use in the subbasin. The WSIP model was used to anticipate projected inflow to Shasta Lake and whether or not the water year would be classified as Shasta Critical under the Exchange Contract.

For the Projected Land Surface Water Budgets, the volume of surface water seepage was adjusted, as applicable and available, based on climate change factors provided by DWR. Changes to surface water seepage were directly estimated as a result of PMAs or other program implementation (e.g., the impact on seepage resulting from the San Joaquin River Restoration Program [SJRRP] implemented by the USBR).

(4) Surface Water Outflow (Outflow). As described above, total precipitation was parsed into effective and non-effective precipitation (i.e., the latter being that portion of the total precipitation that cannot be used by the plants because it either runs off or percolates beyond the root zone). Similarly, a portion of the applied water can runoff or deep percolate (typically termed “irrigation inefficiency”). Other surface water outflows (losses) from the Subbasin Land Surface Water Budget include agency-measured or estimated “spills” (i.e., outflow from tile drained fields, canal spills, field runoff, and precipitation runoff) and stream gauge and flow meter readings and data. These collective data sets, sources, and methodologies were used to estimate the historical and current outflows from this component of the Subbasin Land Surface Water Budget.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, the volume of surface water outflows was estimated based on estimates provided by the GSA member agencies (using water year types as a proxy), while those components that may be impacted by climate change (e.g., runoff) were adjusted to reflect changes to precipitation and reference evapotranspiration (ETo). Changes to surface water outflows were directly estimated as a result of PMAs or other program implementation (e.g., water conservation programs to reduce spills) as information was available.

(5) Evapotranspiration (Outflow). The largest outflow for the Historical and Current Land Surface Water Budget is evapotranspiration (consumptive use) by crops. As such, a combination of CIMIS ETo data, crop acreage, and crop coefficient data and methodologies (e.g., ITRC data and methodologies) was utilized to estimate the consumptive use of water in the Subbasin. In addition, direct evaporation from surface water bodies was estimated based on the surface area of the water body and time period it was wetted.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, the 2030 Central Tendency and 2070 Central Tendency climate change factors or guidance provided by DWR were applied to the historical ETo record to project the impact of climate change on ETo across the Subbasin. For example, either: the Gridded Statewide Precipitation and Change Factors developed for the WSIP using the VIC Macroscale Hydrology Model (DWR, 2018) were applied to the available ETo data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR CCTAG (2015) were incorporated.

(6) Deep Percolation (Outflow). For the Historical, Current, and Projected Land Surface Water Budgets, this component is estimated as the sum of the other Outflow components (4 and 5) of the Land Surface Water Budget subtracted from the sum of the Inflow components (1 through 3) and represents the total volume of water that seeps past the root zone and into the Subbasin aquifer(s). This includes applied water seepage, as well as stream seepage (from the San Joaquin River, Delta-Mendota Canal, and California Aqueduct, and other canals), and delivery losses. To the extent that climate change and PMA implementation affects the volumes of components 1 through 5, they are reflected in the resultant outflow component (6) Deep Percolation, which serves as the inflow component (7) Infiltration to the Groundwater Water Budget, see below.

GROUNDWATER WATER BUDGET

Commented [A3]: General Comments: (1) Urban & M&I Uses are not addressed; (2) Table 2 contains some GW outflow components that are not otherwise mentioned in Table 1 (e.g., Flow to Lower Aquifer Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow)

The data sources/methodologies used to estimate the Historical and Current Groundwater Water Budgets are summarized in Table 1 and for the Projected Groundwater Water Budgets in Table 2. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. The time periods are consistent with those used for the Land Surface Water Budgets, and likewise, to the extent possible the data sources and methodology used were consistent with those identified by DWR in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the BMP#4-Water Budget.[4] As identified in Tables 1 and 2, significant data gaps were identified in several of the GSPs on key aspects of the Groundwater Water Budget; additional efforts are on-going to address those data gaps and refine the water budgets as part of the 2025 GSP update. As applicable and available, models and tools (e.g., CVHM2, Westside Subbasin Groundwater Model, and a numerical flow model for the Farmers Water District and Fresno County areas) were used to validate the local sources and support assumptions used to develop the Subbasin Groundwater Water Budget.

(7) Infiltration (Inflow). In all instances, this component of the Groundwater Water Budget is directly linked to the component (6) Deep Percolation of the Land Surface Water Budget. To the extent that climate change is factored into the Historic, Current, and Projected Land Surface Water Budgets, those impacts are reflected in the varying volumes of deep percolation that are assumed to recharge the aquifer system(s) via infiltration.

(8) Lateral Subsurface Flow (Inflow). For the Historical and Current Groundwater Water Budgets, this component is estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

For the Upper Aquifer, lateral inflows were generally estimated using Darcy's Law and estimated aquifer characteristics, or a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries. Mountain front recharge from the Coastal Range was also assumed to provide an additional source of inflow to the Upper Aquifer.

[4] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

To the extent possible, lateral inflows to the Lower Aquifer were estimated, primarily using Darcy's Law and estimated aquifer characteristics, and coarse assumptions regarding contributions of other sources of inflow, or a groundwater flow model, as available. However, this portion of the Groundwater Budget was acknowledged as a significant data gap, which the GSAs are working to address through the collection of additional data, etc.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, this component is generally estimated using historical inflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in inflows as a result of PMAs are directly incorporated, to the extent the information was provided by the GSAs.

(9) Extraction (Outflow). Consistent with the methodology used to estimate component (2) Applied Groundwater of the Historical and Current Land Surface Water Budgets, the total pumping from the Subbasin aquifers was estimated using the following hierarchy of sources depending upon available records: (1) Flow meters: Volumetric flow meter records from pumping wells; (2) Power bills: Electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency and duration of operation); and/or (3) Consumptive use: crop acreages and consumptive use data based on either ITRC-METRIC or crop coefficient methodologies. While the exact distribution of pumping from the Upper and Lower Aquifers is acknowledged as a data gap, total extractions were assumed to be partitioned between the aquifers, with the majority of extractions (80-90%) occurring in the Upper Aquifer.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, the volume of pumped groundwater was estimated using various, complimentary methods, including: (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record). Climate change impacts and the effect of the planned PMAs are implicitly, rather than explicitly accounted for.

(10) Lateral Subsurface Flow (Outflow). For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin, but similarly to component (8) of the Groundwater Water Budget.

For the Upper Aquifer, lateral outflows were generally estimated using Darcy's Law and estimated aquifer characteristics, or a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries.

To the extent possible, lateral outflows to the Lower Aquifer were estimated, primarily using Darcy's Law and estimated aquifer characteristics, or a groundwater flow model, as available. However, this portion of the Groundwater Water Budget was acknowledged as a significant data gap, which the GSAs are working to address through the collection of additional data, etc.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, this component is generally estimated using historical outflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in outflows as a result of PMAs are directly incorporated, to the extent the information was provided by the GSAs.

(11) Flow to Lower Aquifer (Outflow from Upper Aquifer). In instances where there was significant downward flow between the Upper and Lower aquifers, vertical flow was estimated using Darcy's Law, estimated aquifer characteristics, and groundwater gradients. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while water level maps for wet, normal, and dry water year types were prepared to determine the elevation and groundwater gradient. Furthermore, flow to the Lower Aquifer from the Upper Aquifer is acknowledged as a data gap.

(12) Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow (Outflow). In instances where localized shallow groundwater conditions exist or in areas adjacent to surface water, groundwater discharge to the land surface system has been estimated as the remaining groundwater after accounting for all other inflows and outflows (components 7 through 11 and 13).

(13) Change in Storage. For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

For the Upper Aquifer, a sum of the Outflow components (9 through 12) of the Groundwater Water Budget was subtracted from the Inflow components (7 and 8) to assess the change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

For the Lower Aquifer, approaches varied among the GSPs given the significant data gaps, which the GSAs are working to address through the collection of additional data, etc. Change in storage was estimated using measured subsidence as a proxy (i.e., due to compaction caused by inelastic land subsidence), as the difference between inflows and outflows based on modeled results, or as an assumed proportion of overall groundwater change in storage.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the WY 2018-2070 period, the change in storage volumes used in the Historical and Current Water Budgets were averaged by water year type and used throughout the projected water budget period, or were calculated as the difference between inflows and outflows.

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Table 1. Historic and Current Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin Rive Exchar Contrac
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) and California Irrigation Management Information System (CIMIS)	PRISM		PRISM and CIMIS	PRISM and CIMIS	CIMIS
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use	Flow meters	Flow meters, power bills, and consumptive use	Flow meters and consumptive use		Flow mete
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports	Unused	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records	Central Valley Project (CVP) refuge water supply delivery data	USBR CVO and SWRCB diversion reports	USBR CV CDEC whe available, infiltration study use otherwise

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Commented [A3]: SJREC GSP water budget does not mention CIMIS for precipitation; rather it mentions the Los Banos NWS station

Commented [A2]: NorthCentral GSP only mentions CIMIS, not PRISM

Commented [A4]: Should mention consideration of (i.e., subtracting out) applied surface water in this GW consumptive use method

Commented [A6]: NorthCentral GSP mentions urban pumping, quantified with historic data (flow meters)

Commented [A7]: Grassland water budget does not appear to consider the amount of GW demand that is offset by effective precip or applied surface water

Commented [A5]: Same comment as above – mention consideration of applied SW in GW consumptive use method

Commented [A9]: "not applicable; no imported surface water used for irrigation"

Commented [A8]: Aliso GSP it does not say that data from SWRCB was used

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchan Contrac
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation	Unused	Unused	Non-effective precipitation and agency measured spills Where non-effective precipitation is precipitation in excess of evapotranspiration (ET) on uplands and wetlands; all precipitation on developed land; 50% of annual precipitation is effective on agricultural land, 40% of annual precipitation is runoff and 10% is deep percolation on agricultural land	Irrigation efficiency calculation (ET and non-effective precipitation)	Used non-effective precipitation as runoff and measured spills; Flow meter readings
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS; 0.8% reference evapotranspiration (ET_o), applied to estimate of surface area and time facility wetted	Vegetation coefficients and CIMIS				
Land Surface	Outflow	Deep Percolation	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					

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Commented [A10]: Assume this is related to evaporation from open water, but that is not entirely clear as written

Commented [A11]: Aliso GSP and Grasslands GSP: not exactly inflow-outflow. They did detailed calcs for seepage of streams and channels

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchan Contrac
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)	Darcy's equation (groundwater levels and transmissivities)			Darcy's equation (groundwater levels and transmissivities) with exception of Coast Range foothills, where assumed 20% of precipitation	Darcy's equation (groundwater levels and transmissivities)
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer				Assumed 20% of total inflows. Identified data gap that once filled will use same methodology as Upper Aquifer.	
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use	Flow meters and consumptive use. Total extractions split 80% from Upper Aquifer and 20% from Lower Aquifer. Identified data gap to be filled.	Flow met
Groundwater	Outflow	Extraction - Lower Aquifer	Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer					Assumed of total pumping
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)	Darcy's equation (groundwater levels and transmissivities)			Darcy's equation (groundwater levels and transmissivities) with exception of Coast Range foothills, where assumed 20% of precipitation	Darcy's equation (groundwater levels and transmissivities)
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer					

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Commented [A12]: Per Aliso GSP: only total pumping has been calculated and water budgets do not differentiate between upper and lower aquifer contributions

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Commented [A13]: Per Grasslands GSP: Only total pumping is calculated, and the water budgets do not differentiate between upper and lower aquifer contributions

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchan Contrac
Groundwater	Outflow	Flow to Lower Aquifer	Unused – Data gap	Unused	Unused			Darcy's equation (groundw gradients transmissivities)
Groundwater	Outflow	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow	Unused	Unused	Unused	Remaining groundwater after accounting for other inflows and outflows		
Groundwater	Change in Storage	Upper Aquifer	Subsurface inflow - Subsurface outflow, hydrographs and storativity	Inflow - outflow		Inflow ~~-~~ – Outflow, hydrographs and storativity	Hydrographs and storativity	Inflow - Outflow
Groundwater	Change in Storage	Lower Aquifer	Land subsidence as proxy			Land subsidence as proxy	Assumed to be ~~20~~17% of total change in storage	Land subsidenc used as p

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Commented [A14]: Missing flow to lower aquifer and discharge to SW (see Table 2). Need to update for all GSPs.

Commented [A15]: Missing flow to lower aquifer and discharge to SW (see Table 2). Need to update for all GSPs.

Commented [A17]: Per Grasslands GSP: inflow/outflow method and specific yield method were both calculated. **"The Inflow/Outflow Method was not used to determine change in storage** because of the limited amount of data available. However, the results of the Specific Yield method were used to inform the use of the Inflow/Outflow method for other water budget parameters."

Commented [A16]: Per Aliso GSP: inflow-outflow and specific yield method - **SY method was preferred** because of added error in the inflow-outflow method. SY method considers SY*change in wl*GSA area

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Table 2. Projected Water Budget Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM), applying climate change factors (CCF)	PRISM, applying CCF [1]	PRISM, applying CCF [1]	PRISM and California Irrigation Management Information System (CIMIS), applying CCF	PRISM and CIMIS, applying CCF	CIMIS, applying CCF
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use	Consumptive use	Consumptive use	Flow meters and consumptive use	Flow meters and consumptive use (where available, balance term where unavailable)	Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports, using water year (WY) types as a proxy	Unused	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO), using WY types as a proxy	Central Valley Project (CVP) refuge water supply delivery data, using WY types as a proxy	USBR CVO and SWRCB diversion reports, using WY types as a proxy	USBR CVO; California Data Exchange Center (CDEC) where available, using WY types as a proxy; Water infiltration stud used otherwise
Land Surface	Inflow	Project Effects	Unused	Unused	Unused	Unused	Estimated Effects of Projects and Management Actions for the spe Flow Category	
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	Unused	Unused	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	
Land Surface	Outflow	Evapotranspiration	Crop evapotranspiration calculated using crop coefficient (K_c) and reference evapotranspiration (ET_o) adjusted for climate change with Hargreaves Samani and PRISM temperature; Canal/reservoir evapotranspiration estimated using historic data adjusted for climate change	Vegetation coefficients and CIMIS				2030 CCF (2014-2045) and 2070 CCF (2046-2070); WY types used as proxy and multiplied by CCF
Land Surface	Outflow	Deep Percolation	Land Surface Inflow - Outflow					
Land Surface	Outflow	Project Effects	Unused	Unused	Unused	Unused	Estimated Effects of Projects and Management Actions for the specified Flow Category	Unused

Commented [A18]: The Alisp GSP does not mention SWRCB as a source of data for applied SW; projected applied SW is "anticipated" to be "a minimum of 10,000 AFY during high flow years" but no basis is provided

Commented [A19]: Should mention used of climate change factors

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy; Landowner based projections of water bank operations	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy, with exception of Coast Range foothills, where assumed 20% of precipitation	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer			Unused	Assumed 20% of total inflows. Identified data gap that once filled will use same methodology as Upper Aquifer.	
Groundwater	Inflow	Project Effects	Estimated Effects of Projects and Management Actions for the specified Flow Category	Unused	Unused	Unused	Estimated Effects of Projects and Management Actions for the specified Flow Category	Unused
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency using WY type as a proxy	~~Flow meters~~Adjusted historical metered data using WY type as a proxy		Adjusted historical metered data ~~Flow meters~~ and consumptive use using WY type as a proxy	Adjusted historical metered data ~~Flow meters~~ and consumptive use using WY type as a proxy	Adjusted historical metered data ~~Flow meters~~ using WY type as a proxy
Groundwater	Outflow	Extraction - Lower Aquifer	Unused	Unused	Unused	Unused		
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy; Landowner based projections of water bank operations	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with exception of Coast Range foothills, where assumed 20% of precipitation	Water level maps for representative year types and transmissivity values. Used water level maps to project; dry = Shasta Critical, Critical and Dry, Normal = above normal, below normal and wet = wet.
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer			Unused	Assumed 20% of total inflows. Identified data gap that once filled will use same methodology as Upper Aquifer.	
Groundwater	Outflow	Flow to Lower Aquifer	Unused	Unused	Unused	Provided by Kenneth D. Smith and Associates - vertical flow using Darcy's equation	Unused	~~Unused~~Reduction of histo estimates based on proje hydraulic gradients
Groundwater	Outflow	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow	Unused	Unused	Unused	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy	Unused	Unused

Commented [A21]: SJREC GSP: The lateral downward flow through the Corcoran Clay is assumed to reduce slightly over time as less pumping from the lower aquifer occurs and reduces the hydraulic gradient between the upper and lower aquifers

Commented [A20]: Is this technically an outflow from the GW system? Flow between aquifer units.

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Groundwater	Change in Storage	Upper Aquifer	Subsurface Inflow - Subsurface Outflow	Subsurface Inflow - Subsurface Outflow		Consumptive use of applied water with 80% irrigation efficiency factor	Hydrographs and storativity using WY type as a proxy~~Subsurface Inflow - Subsurface Outflow~~	Subsurface Inflow - Subsurface Outflow
Groundwater	Change in Storage	Lower Aquifer	Unused - Data gap, all composite wells in Aliso Water District; Plans to fill data gap and use same methodology as Upper Aquifer			Land subsidence and WY types used as a proxy	Assumed to be a portion of total change in storage	Land subsidence and WY types used as proxy

[1] For years PRISM data was not available (1965-1980), representative water years from the PRISM data set were selected based on the measured precipitation at CDEC stations MED and MDR

Commented [A22]: Per GSP table 5-18

Sustainable Yield

Though there is a sustainable yield number for the entire Delta-Mendota Subbasin, due to its sprawling nature and the variable conditions that exist across such a large area, the sustainable yield within individual GSAs and even at representative monitoring network sites will vary. Operating within the sustainable yield can eliminate undesirable results and significant and unreasonable impacts across all five sustainability indicators monitored within the Delta-Mendota Subbasin, and help sustainability goals for all indicators.

Maintaining a sustainable yield will help groundwater levels reach measureable objectives (and by proxy interim measureable objectives for interconnected surface water), protecting beneficial uses and users (especially shallow domestic wells), and address reduction in groundwater storage. Maintaining a sustainable yield, especially in the lower aquifer, will also help the Subbasin reach measurable objectives and interim milestones for land subsidence.

Upper Aquifer

The Delta-Mendota Subbasin defines the Sustainable Yield for the Upper Aquifer as the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing Undesirable Results.

It is important to note that the overall groundwater management strategy for the Delta-Mendota Subbasin is to not have water levels decline below historic low water levels. This management strategy is fairly progressive and protective of the beneficial uses and users of groundwater.

The calculation to determine the Sustainable Yield for the Subbasin is defined as:

Upper Aquifer SY = Pumping + Change in Storage + (Outflow – Inflow)

The Technical Working Group determined that a +/- 10% factor should be applied to determine a range for the upper aquifer sustainable yield value. The +/- 10% factor is applied based on the percentage difference between the values from change in storage contour mapping (prepared by Provost & Pritchard) and reported changes in storage from the Subbasin consolidated historic water budgets (WY2003-2012) for the upper aquifer.

The most detailed range for the upper aquifer sustainable yield is calculated using the above formula for both categories of water budgets: projected baseline with climate change factors and projected baseline with climate change factors plus projects and management actions. The 10% factor is applied to the results for both categories. This range aims to demonstrate the Subbasin's upper aquifer sustainable yield without implementing any projects and management actions (low end of range) and how the Subbasin's upper aquifer sustainable yield will be impacted by implementing planned projects and management actions (high end of range).

Sustainable management criteria (Minimum Thresholds and Measurable Objectives) will be the primary indicator governing upper aquifer extractions. The sustainable yield estimates will be updated as part of the five-year GSP review.

Lower Aquifer

Within the Delta-Mendota Subbasin, the distribution of known lower aquifer water level data and extraction volume data are limited and not sufficient to allow for a calculation of lower aquifer sustainable yield. The Technical Working Group therefore look to studies and/or analysis conducted in adjoining subbasins with similar hydrogeologic conditions for consideration in developing a preliminary sustainable yield estimate. A recent study conducted in the adjoining Westside Subbasin was identified and selected for use in developing this preliminary estimate.

The Delta-Mendota Subbasin, in responding to comments from DWR on the initial submittal of the GSP's, has elected to redefine the Sustainable Yield for the Lower Aquifer to be more restrictive. The overall subbasin sustainable yield has been reduced from 250,000 AF down to 75,000 AF. This sustainable yield calculation is coordinated with the sustainability indicators to not cause significant overdraft or inelastic land subsidence.

Commented [JB1]: This number doesn't correlate with the number below (from the W&C updated tech memo #4)

The Lower Aquifer sustainable yield value presented in the original Common Chapter was based on a study conducted in a separate subbasin. That value has been recalculated using subsidence rate data measured at two locations along the Delta-Mendota Canal (DMC) at which subsidence has been observed to be occurring at an accelerated rate relative to other locations in the Subbasin: Pool 8 and Pool 18 of the DMC.

Using the observed subsidence rates measured between 2014 and 2018 at these two locations, the number of years required for subsidence to continue at this rate for 2 feet of subsidence to occur (the revised minimum threshold for inelastic land subsidence for the Subbasin) was estimated. Estimated total Lower Aquifer sustainable yield (e.g., the total volume of Lower Aquifer groundwater that can be extracted across the subbasin before undesirable results, defined as 2 feet of inelastic subsidence) was then calculated by multiplying the number of years of Lower Aquifer pumping to occur before 2 feet of subsidence occurs by the average annual Lower Aquifer change in storage estimated in the Subbasin historic water budget between Water Year 2014 and Water Year 2017.

This methodology resulted in a total estimated Lower Aquifer sustainable yield of 1,303,846 AF using subsidence rates at Pool 8, and 1,130,000 AF using subsidence rates at Pool 18. This correlates to an annual Lower Aquifer sustainable yield over the 20-year implementation window of 65,192 AFY and 56,500 AFY, respectively, or an average annual Lower Aquifer sustainable yield of 60,846 AFY.

The lower aquifer responds drastically different than the upper aquifer. Due to the elastic nature of the upper aquifer subsidence characteristics, it can operate with successive years contributing to the overall average conditions without causing undesirable results. In other words, in the unconfined upper aquifer extractions for one year above the sustainable yield can be offset by a subsequent year with extractions less than the sustainable yield. The lower aquifer, however, cannot rely on averaging extractions above the sustainable yield to meet an average condition. Overdraft in the lower aquifer has the potential to instantly trigger inelastic land subsidence.

The lower aquifer sustainable yield must be managed annually and more importantly site specifically to ensure significant and/or unreasonable land subsidence does not result from the overdraft. The lower aquifer sustainable yield is primarily driven by avoiding an Undesirable Result for land subsidence. The key to stopping subsidence is to reduce or eliminate groundwater extractions from the lower aquifer.

Reduction in Groundwater Storage

To address reduction in groundwater storage, the Delta-Mendota Subbasin proposes to use the same data and methodologies across all six GSP groups/23 GSAs. The methodologies used by the subbasin to calculate reduction in storage will differ based only on the aquifer. For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

Mandatory Annual Reports on GSP implementation require reporting of change in groundwater storage for the prior water year. DWR notes in its incomplete determination for the Delta-Mendota Subbasin that in the Water Year 2020 Annual Report, four methods for the Upper Aquifer and two methods for the Lower Aquifer were identified as being used to calculate change in storage by various GSP groups. As part of the process to address Potential Deficiencies, the six GSP groups coordinated and agreed upon a common methodology for calculating change in storage that will be applied in future Annual Reports, starting for Water Year 2022:

For the Upper Aquifer, the difference in groundwater elevation between the prior and current water year using seasonal high condition contour maps and specific yield estimates.

For the Lower Aquifer, the difference in land surface elevation between the prior and current water year. The GSP groups are working to fill gaps in Lower Aquifer groundwater level monitoring and once complete, change in groundwater storage will be calculated using the same methods as the Upper Aquifer.

As a cross-check against the annual change in storage calculated using the aforementioned methodology, hydrographs at individual representative monitoring locations have, and will continue to be, analyzed and aggregated to confirm the annual calculation.

Minimum thresholds and measureable objectives are also the same across the subbasin and again differ according to aquifer. For Upper Aquifer, the Subbasin will use groundwater levels as a proxy for groundwater storage and use the water level minimum thresholds for groundwater storage limits. Change in land surface elevation based on minimum thresholds for inelastic land subsidence will be the proxy for reduction in lower aquifer groundwater storage.

Commented [JB1]: Need to add the math component.

Table CC-14: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.					
Definition of Significant and Unreasonable	Significant and unreasonable impacts to beneficial uses and users of groundwater are substantially increased costs associated with higher total pumping lift, lowering pumps, drilling deeper wells or otherwise modifying wells to access groundwater, securing alternative water sources, or required mitigation of groundwater dependent ecosystems.					
Sustainability Goal	Maintain groundwater levels that are comparable to existing conditions (historic low conditions as of Water Year 2016) in order to continue meeting the demand of beneficial uses and users of groundwater and prevent a trend of decreasing groundwater levels. The Delta-Mendota Subbasin will continue ~~S~~successful and ongoing coordination with neighboring Subbasins to address chronic lowering of groundwater levels caused by pumping outside of the Subbasin.					
Minimum Threshold	The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the historical seasonal low at more than 50% of representative monitoring sites in a GSP area. The historic seasonal low is a fixed elevation at each site, based on available groundwater level data prior to the end of Water Year 2016. To account for future year-to-year variations in hydrology, compliance with the fixed historic seasonal low threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Shorter-term ("acute") groundwater elevation thresholds will also be established at each representative monitoring site by 2025 using a coordinated methodology. Acute thresholds will be established at levels that are intended to avoid short-term undesirable results, particularly for domestic water wells, groundwater dependent ecosystems, and interconnected surface waters where present in the Upper Aquifer, and for subsidence in the Lower Aquifer. Each year, both the historic seasonal low and the acute groundwater elevation thresholds will apply, whichever is more protective. Groundwater levels are measured as water surface elevation ("WSE"). Each GSP area includes multiple representative monitoring sites ("RMS") to which the minimum threshold applies. Examples are provided below, but see Table XX for more detailed information. For any RMS without data prior to Water Year 2016, Minimum Thresholds and acute thresholds will be established using the aforementioned methodologies and~~on~~ the data ~~set~~ resulting from the first five years of monitoring following Water Year 2016 or following construction of the well.					
	Upper Aquifer: Aliso RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Upper Aquifer: Farmers RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Upper Aquifer: Fresno RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Upper Aquifer: Grassland RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Upper Aquifer: Northern & Central RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Upper Aquifer: SJREC RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD
	Lower Aquifer: Aliso RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Lower Aquifer: Farmers RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Lower Aquifer: Fresno RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Lower Aquifer: Grassland RMS data for the lower aquifer does not exist due to minimal historical pumping. RMS targets to be established by 2025.	Lower Aquifer: N&C RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD	Lower Aquifer: SJREC RMS X Seasonal Low Water Level: __ WSE Acute Threshold: TBD

DELTA-MENDOTA SGMA

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Measurable Objective and 5-Year Interim Milestones

Measurable Objective:
Maintain seasonal high groundwater levels at an elevation that is at or above the Water Year 2015 seasonal high at more than 50% of representative monitoring sites in a GSP area. The Water Year 2015 seasonal high is a fixed elevation at each site, based on available groundwater level data. If data are unavailable for Water Year 2015 at a representative monitoring site, either a Water Year 2014 or Water Year 2016 Seasonal High will be used. To account for future year-to-year variations in hydrology, compliance with the fixed seasonal high threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation ("WSE"). Each GSP area includes multiple representative monitoring sites ("RMS") to which the measurable objective applies. Examples are provided below, but see Table XX for more detailed information.

For any RMS without data prior to Water Year 2016, Measurable Objectives will be established using the aforementioned methodology and~~on~~ the data ~~set~~ resulting from the first five years of monitoring following Water Year 2016 or following the construction of the well.

Upper Aquifer: Aliso RMS X Seasonal High Water Level: __ WSE	Upper Aquifer: Farmers RMS X Seasonal High Water Level: __ WSE	Upper Aquifer: Fresno RMS X Seasonal High Water Level: __ WSE	Upper Aquifer: Grassland RMS X Seasonal High Water Level: __ WSE	Upper Aquifer: Northern & Central RMS X Seasonal High Water Level: __ WSE	Upper Aquifer: SJREC RMS X Seasonal High Water Level: __ WSE
Lower Aquifer: Aliso RMS X Seasonal High Water Level: __ WSE	Lower Aquifer: Farmers RMS X Seasonal High Water Level: __ WSE	Lower Aquifer: Fresno RMS X Seasonal High Water Level: __ WSE	Lower Aquifer: Grassland RMS data for the Lower Aquifer does not exist due to minimal historical pumping. RMS targets to be established by 2025.	Lower Aquifer: N&C RMS X Seasonal High Water Level: __ WSE	Lower Aquifer: SJREC RMS X Seasonal High Water Level: __ WSE

Year 5: Gather data and complete the establishment of seasonal low and seasonal high elevations at representative monitoring sites in the Lower Aquifer for the Grassland GSP area. Develop a coordinated methodology and complete the establishment of acute groundwater elevation thresholds. Identify chronic lowering of groundwater levels caused by pumping outside the Subbasin.

Year 10: Maintain groundwater levels at Measurable Objectives. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

Year 15: Maintain groundwater levels at Measurable Objectives. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

Table CC-15: Delta-Mendota Subbasin SMC for Reduction in Groundwater Storage

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.					
Definition of Significant and Unreasonable	A significant and unreasonable impact to beneficial uses and users of groundwater is insufficient water storage to maintain beneficial uses and natural resource areas in the Subbasin, including the conjunctive use of groundwater.					
Sustainability Goal	Maintain historic groundwater storage volumes in order to continue meeting the demand of beneficial uses and users of groundwater and to provide a 3-year drought buffer. Minimize reductions in groundwater storage during extended dry periods. Work with neighboring Subbasins to address reduction in groundwater storage caused by pumping outside of the Subbasin.					
Minimum Threshold	For the Upper Aquifer, as a reasonable proxy for an individual groundwater storage threshold, maintain groundwater levels in accordance with the minimum threshold set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, as a reasonable proxy, utilize change in land surface elevation in accordance with the minimum thresholds set for Inelastic Land Subsidence as the reduction in groundwater storage that would cause undesirable results, which is up to XX acre-feet of storage loss attributable to groundwater extraction in the Subbasin.					
Measurable Objective and 5-Year Interim Milestones	**Measurable Objective**: For the Upper Aquifer, maintain groundwater levels in accordance with the measurable objectives set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, ~~maintain~~ minimize loss of groundwater storage caused by inelastic land subsidence.~~groundwater levels in a manner such that the reduction in groundwater storage that would cause undesirable results is up to XX acre-feet of storage loss attributable to groundwater extraction in the Subbasin.~~ **Year 5:** Maintain groundwater levels in accordance with the measurable objectives. Identify reduction in groundwater storage caused by pumping outside the Subbasin. **Year 10:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.					

Commented [LD1]: Please confirm that this is correct.

LA Sustainable Yield to be calculated as multiplier on Lower Aquifer change in storage from Subbasin water budget.

Commented [JM2R1]: Yes. The change in storage is about 1.1 MAF and the narrative around this criteria needs to articulate the math that was done.

Commented [LD3]: Modify to be consistent with MT

DELTA-MENDOTA SGMA

WOODARD & CURRAN

Table CC-17: Delta-Mendota Subbasin SMC for Land Subsidence

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.					
Definition of Significant and Unreasonable	Significant and unreasonable damage to conveyance capacity from inelastic land subsidence is structural damage that creates an unmitigated and unmanageable reduction of design capacity or freeboard. Significant and unreasonable impacts to natural resource areas from inelastic land subsidence are unmitigated decreases in the ability to flood or drain such areas by gravity. Significant and unreasonable threats to public health and safety from inelastic land subsidence are those that cause an unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges.					
Sustainability Goal	Minimize inelastic land subsidence by ramping down allowable subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040. Work with neighboring Subbasins to address inelastic land subsidence caused by groundwater extraction outside of the Subbasin.					
Minimum Threshold	At representative monitoring sites, the change in ground surface elevation that would cause undesirable results is up to 2 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin. Prevent subsidence caused by groundwater extractions in the Delta-Mendota Subbasin that exceeds corrective design standards or established triggers for critical infrastructure including the Delta-Mendota Canal, California Aqueduct, and Sack Dam.					
Measurable Objective and 5-Year Interim Milestones	**Measurable Objective**: Minimize inelastic land subsidence attributable to groundwater extraction within the Subbasin, with no additional subsidence after 2040. **Year 5:** Interim goal of no more than 1 foot of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the first 5-year period of SGMA implementation. Gather data and complete the selection or establishment of representative monitoring sites ("RMS") for land subsidence, with particular attention to the locations of critical infrastructure in the Subbasin, and in coordination with the Bureau of Reclamation and Department of Water Resources. Determine the relative proportion of subsidence caused by groundwater extraction within and outside the Subbasin for each RMS. Where subsidence is caused by pumping outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 10:** Interim goal of no more than 0.5 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the second 5-year period of SGMA implementation, for a cumulative total of 1.5 feet in the first 10 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Interim goal of no more than 0.25 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the third 5-year period of SGMA implementation, for a cumulative total of 1.75 feet in the first 15 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.					

RESOLUTION NO. ______

RESOLUTION ADOPTING THE AMENDED [NORTHERN & CENTRAL DELTA-MENDOTA REGION] GROUNDWATER SUSTAINABILITY PLAN

A. **WHEREAS,** in August 2014, the California Legislature passed, and in September 2014 the Governor signed, legislation creating the Sustainable Groundwater Management Act ("SGMA") "to provide local groundwater sustainability agencies with the authority and technical and financial assistance necessary to sustainably manage groundwater" (Wat. Code, § 10720, (d)); and

B. **WHEREAS**, SGMA requires sustainable management through the development of groundwater sustainability plans ("GSPs"), which can be a single plan developed by one or more groundwater sustainability agencies ("GSAs") or multiple coordinated plans within a basin or subbasin (Wat. Code, § 10727); and

C. **WHEREAS**, SGMA requires a GSP to be developed and implemented to manage groundwater in all basins designated by the Department of Water Resources ("DWR") as medium or high priority, including the Delta-Mendota Subbasin (basin number 5-22.07); and

D. **WHEREAS,** the [Central Delta-Mendota] GSA was formed to be an exclusive GSA for a portion of the Delta-Mendota Subbasin, and is composed of the following member agencies: [Eagle Field Water District, a California water district; the County of Fresno, a political subdivision of the State of California; Fresno Slough Water District, a California water district; County of Merced, a political subdivision of the State of California; Mercy Springs Water District, a California water district; Pacheco Water District, a California water district; Panoche Water District, a California water district; San Luis Water District, a California water district; Santa Nella County Water District, a California County water district; and Tranquillity Irrigation District, a California irrigation district] (individually, a "Party" and in the plural or collectively, the "Parties"); and

E. **WHEREAS, [**pursuant to its Joint Powers Agreement entered into by the Parties in August of 2019, the Central Delta-Mendota GSA is governed by a Board of Directors consisting of one representative from each of the Parties (the "Board of Directors")]; and

F. **WHEREAS**, the [Central Delta-Mendota] GSA has the authority to draft, adopt, amend, and implement a GSP (Wat. Code, § 10725 *et seq.*; § 10728.4); and

G. **WHEREAS**, [the Central Delta-Mendota GSA is a member of the Northern and Central Delta-Mendota Regions Group formed for the purpose of developing a GSP and coordinating sustainable groundwater management in the Northern and Central Regions of the Delta-Mendota Subbasin] (Wat. Code, § 10723.6(i)); and

H. **WHEREAS**, the San Luis & Delta-Mendota Water Authority ("SLDMWA") submitted an Initial Notification to DWR on behalf of the members of [the Northern and Central

Delta-Mendota Regions] to jointly develop a single GSP for the Northern and Central Regions of the Delta-Mendota Subbasin on [January 5, 2018]; and

I. **WHEREAS**, other GSAs in the Delta-Mendota Subbasin prepared separate GSPs for other regions of the Delta-Mendota Subbasin for a total of six GSPs covering the entire Delta-Mendota Subbasin (each, a "GSP Group"); and

J. **WHEREAS**, the GSAs from all six GSP Groups entered into a Coordination Agreement effective December 12, 2018 (the "Coordination Agreement") to comply with SGMA and ensure that the multiple GSPs within the Delta-Mendota Subbasin would be developed and implemented utilizing the same methodologies and assumptions, that the elements of the GSPs are appropriately coordinated to support sustainable management, and to show how the multiple GSPs will achieve the sustainability goal for the Subbasin. The Coordination Agreement also established a Coordination Committee composed of representatives from each GSP Group, outlined information sharing obligations, procedures for resolving conflicts, and designated the SLDMWA as the Plan Manager for the Delta-Mendota Subbasin; and

K. **WHEREAS**, SGMA states that a GSA "may adopt or amend a [GSP] after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment" (Wat. Code, § 10728.4); and

L. **WHEREAS,** all the GSAs comprising the [Northern and Central] Regions of the Delta-Mendota Subbasin coordinated to develop the [Northern & Central Delta-Mendota Region GSP ("N-C DM GSP")], which was adopted by the [Central Delta-Mendota] GSA after a public hearing and 90-day notification to the affected city and counties on [January 6, 2020]; and

M. **WHEREAS**, the Plan Manager submitted the [N-C DM GSP] and the Coordination Agreement to DWR on [January 23, 2020]; and

N. **WHEREAS**, on January 21, 2022, DWR completed its review of all the GSPs in the Delta-Mendota Subbasin and released a letter determining that the GSPs for the Delta-Mendota Subbasin as a whole were "Incomplete" and identified deficiencies and corrective actions for the GSAs in the Delta-Mendota Subbasin to take. Amended or modified GSPs addressing the corrective actions from each GSP Group must be submitted to DWR by July 20, 2022; and

O. **WHEREAS**, on March 15, 2022, the Plan Manager transmitted the 90-Day Notice to affected cities and counties notifying them of the [Northern and Central Region GSAs'] intent to adopt an amended [N-C DM GSP] at one or more public hearings to be scheduled not earlier than June 22, 2022, and inviting consultation with the affected cities and counties; and

P. **WHEREAS,** all the GSAs comprising the [Northern and Central] Regions of the Delta-Mendota Subbasin and the Coordination Committee have, in order to address the deficiencies and to effect the corrective actions identified by DWR, continued to coordinate to develop the draft of the amended [N-C DM GSP ("Amended N-C DM GSP")] and publicly released the draft [Amended N-C DM GSP] on [June 20, 2022]; and

Q. **WHEREAS,** on [June 20, 2022], the GSAs comprising the [Northern and Central Regions] of the Delta-Mendota Subbasin recommended each of its members adopt the final draft Amended [N-C DM GSP] for their respective jurisdiction.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of [the Central Delta-Mendota GSA] finds as follows:

1. After a public hearing, the [Central Delta-Mendota] GSA hereby approves and adopts the final draft Amended [N-C DM GSP], dated June 20, 2022, in substantially the form presented, subject to such modifications as the executing officer shall approve, said execution to provide conclusive proof of approval of any such modifications.

2. The [Central Delta-Mendota GSA] authorizes the SLDMWA, its consultants, and the Plan Manager to take such other actions as may be reasonably necessary to submit the [Amended N-C DM GSP] to DWR by July 20, 2022, and implement the purpose of this Resolution.

PASSED, APPROVED, AND ADOPTED this [7th day of July], 2022 by the following vote:

AYES:
NAYS:
ABSTAIN:
ABSENT:

____
____________________, Chairman

Attest:

____
________________, Secretary

____
Date: