April 29, 2022

California Department of Water Resources
1416 9th Street
Sacramento, CA 95814

Re: Butte Subbasin Groundwater Sustainability Plan

To whom it may concern:

AquAlliance, the California Sportfishing Protection Alliance, and the California Water Impact Network (hereinafter AquAlliance) submit the following comments and questions on the Butte Subbasin Groundwater Sustainability Plan ("Butte GSP" or "Plan"). There are serious flaws in the Plan that require significant changes to the document, without which the public and policymakers are truly left in the dark and dangerous consequences are obfuscated.

Introduction

The goal of the Sustainable Groundwater Management Act (SGMA) is to sustainably manage groundwater resources for long-term reliability and multiple economic, social, and environmental benefits for current and future beneficial uses based on the best available science (Water Code 113). The people of California have a primary interest in the protection, management, and reasonable beneficial use of the water resources of the state, both surface and underground, and in the integrated management of the state's water resources to meet the state's water management goals. Proper management of groundwater resources will help protect communities, farms, and the environment against prolonged dry periods and climate change, while preserving water supplies for existing and potential beneficial use. Failure to manage groundwater to prevent long-term overdraft infringes on overlying and other proprietary rights to groundwater.

California's Water Code specifically established as state policy that *every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes* (WC 106.3(a)). State agencies, including the California Department of Water Resources (DWR), the State Water Resources Control Board (SWRCB), and the State Department of Public Health, are required to *consider this state policy when revising, adopting, or establishing policies,* *regulations, and grant criteria when those policies, regulations, and criteria are pertinent to the uses of* water (WC 106.3(b)). The Water Code also creates a state policy *that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation* (WC 106). The Groundwater Sustainability Agencies (GSAs) were created by SGMA and are delegated by the state the authority to create and implement a Groundwater Sustainability Plan (GSP), which makes the GSA(s) a political subdivision of the state. Therefore, approval of any SGMA GSP created by a GSA(s) or County Agency, that is then approved by the DWR and the SWRCB, must be consistent with the state policies that protect and prioritize the public's right to safe and available supply of groundwater for all beneficial uses and protect the Public Trust.

Implementation of the SGMA requires the creation of a GSP that provides for the development and reporting of those data necessary to support sustainable groundwater management, including those data that help describe the basin's geology, the short- and long-term trends of the basin's water balance, and other measures of sustainability, and those data necessary to resolve disputes regarding sustainable yield, beneficial uses, and water rights. A presumption inherent in SGMA is that sustainable management of a groundwater basin won't repeat or perpetuate the management errors of the past. The design of the Butte GSP sustainability monitoring program that requires years of declining groundwater levels before an undesirable result can occur suggests that the plan will continue past mismanagement practices. The January 2022 Butte Subbasin[1] Final GSP fails to meet the SGMA goal of water resource sustainability and protection of the water rights of all beneficial users and uses.

These comments on the January 2022 Butte Subbasin Final GSP (Butte GSP) are being provided to support our recommendation that the California Department of Water Resources and the State Water Resources Control Board find that the GSP is incomplete because of multiple deficiencies and the overall failure of the document to comply with the statutory and regulatory requirements of the SGMA and the Water Code. These comments are supplemental to previous October 31, 2021, comments provided on the September 2021 Draft Butte Subbasin GSP, which are attached in Butte Final GSP in Appendix 2.A.2 (pdf pp. 225 to 273). The proposed sustainable management criteria presented in the Butte GSP fail to demonstrate as required by SGMA that the goal of groundwater sustainability is achievable and will occur within 20 years of GSP adoption for: (1) chronic lowering of groundwater levels, (2) reduction of groundwater storage, (3) degraded water quality, (4) inelastic land subsidence, and (5) depletions of interconnected surface waters. The Final Butte GSP fails to protect the beneficial uses for all users of groundwater in the subbasin because of the following:

- The final plan sets the minimum thresholds (MTs) for unreasonable results in the management the groundwater levels at depths that can result in 7% or more of the domestic wells going dry for sustained periods, if not permanently.
- The final plan estimates that sustainable management of the groundwater levels and groundwater storage with the 2070 Climate Change scenario will allow for continued loss in storage of 2,000 acre-feet per year (afy) for the next 50 years, and a maximum cumulative loss during periods of below normal water years of 300,000 acre-feet (af). This loss is in addition to

[1] California Groundwater Basin number 5-021.70, part of the Sacramento Valley Groundwater Basin.

the 186,000 af of storage lost between 2000 and 2018. The estimated maximum cumulative loss during below normal water years is approximately 486,000 af.

- The final plan *margin of operational flexibility* (MOF) for sustainable management, the difference between the depths of the measurable objectives (MOs) and the MTs, is sufficient to allow for a loss in groundwater storage ranging from approximately 555,000 to 943,000 af before an undesirable result can be declared.
- The final plan MOF volume is large enough to hold 56 to 96 years of lost groundwater storage at the average historical rate of -9,800 afy, and 278 to 472 years of storage loss at the average rate of -2,000 afy predicted with the 2070 Climate Change scenario.
- The final plan MOF volume is large enough to allow from 6 to 11 years of continuous groundwater level decline during below normal water years before undesirable results need to be declared.
- The final plan assumes that sustainable management of the subbasin will allow groundwater pumping to increase by 68,300 afy above the 2000-2018 Historical baseline, a 48% increase, with 82% of the increase going to agricultural uses.
- The final plan assumes that sustainable management of the subbasin with the 2070 Climate Change scenario will result in an annual average net stream accretion of -148,500 afy, which is -189,100 afy below the 2000-2018 Historical baseline of 40,600 afy. This is a loss of approximately 89% of the 2000-2018 Historical baseline annual average flow to the streams traversing the subbasin and 466% loss from the overall subbasin baseline net stream accretion.
- The final plan assumes that sustainable management of the subbasin with the 2070 Climate Change scenario will result in an increase in stream seepage losses of 86,000 afy while groundwater pumping increases 68,300 afy, a loss ratio of 126%.
- The final plan assumes that sustainable management of the subbasin with the 2070 Climate Change scenario will result in a decrease in net stream accretion of -189,100 afy while groundwater pumping increases 68,300 afy, a loss ratio of -277%.
- The final plan requires without analysis or justification that before an unreasonable result can occur, the MTs for a sustainability indicator must be continuously and simultaneously exceeded for 24 months at 25% at representative groundwater monitoring wells.
- The final plan requirement for simultaneous, continuous exceedance of the MT at multiple subsidence monuments or representative monitoring wells can result in significant magnitudes and expansive areas of decline in groundwater levels, groundwater storage, water quality, interconnected surface waters, and surface elevations (subsidence) as long as one of the monitored stations in the group doesn't continuously exceed the MT. In other words, there is no limit to decline in the beneficial uses of groundwater if measurements in one of the monitoring stations within a group is above the MT at least once every 24 months.
- The final plan fails to analyze, monitor, or consider the potential impacts to water quality from the proposed allowable changes in groundwater levels and storage, except for one constituent, salinity. Although the final plan calls for coordination in management of water quality with other governmental agencies, the plan doesn't indicate what potential

contaminants of concern are in the Butte subbasin, what associated MTs would be, and what GSP management actions will be taken whenever a water quality impact is identified.

- The final plan sets the rate and expanse of inelastic subsidence that appears to exceed the current conditions while providing no current assessment of the sensitivity of local infrastructure to subsidence.
- The final plan doesn't provide a requirement for frequent monitoring subsidence benchmarks or monitoring of critical infrastructure, but instead leaves the responsibility of subsidence monitoring and analysis to others, with the frequency of reporting dependent on the work schedules and funding of DWR and others.
- The final plan doesn't address how the InSAR subsidence measurements will be utilized or whether the small subsiding areas identified by this technology will be investigated.

The Final Butte GSP Fails to Comply with SGMA and the Water Code.

The following sections provide expanded discussions of the deficiencies listed above regarding how the Butte GSP fails to protect the beneficial uses for all users of groundwater in the subbasin.

1. The Butte GSP sets the MTs for unreasonable results in the management of the groundwater levels at depths that can result in 7% or more of the domestic wells going dry for sustained periods, if not permanently. The MTs for groundwater levels in the 41 Primary Aquifer and 10 Very Deep Aquifer representative monitoring sites' (RMS) wells are set at the shallowest depth below the ground surface (bgs) of two criteria: (1) the depth associated with the 7th percentile (equivalent to 7%) of the "nearby" domestic wells, or (2) 100% of the historical range in measured groundwater levels or 20 feet, whichever is greater, below the observed historic low (Sections 4.3.1.1 and 4.3.1.6, pp. 4-14, 4-15 and 4-20, pdf 213, 214 and 218). The MT calculation methodology then adds a third criterion that if either of the first two criteria results in a depth that is shallower than the observed historic low, then the MT is set at 10 feet deeper than the historic low.

   In response to our comments on the Draft Butte GSP's MT criteria, the Final Butte GSP includes three examples of how to apply these two or three criteria on page 4-15 (pdf 213). While these three examples are helpful in demonstrating the tortuous logic of the Butte GSP's MT selection methodology, the plan still doesn't provide any clear reasoning for why dewatering 7% or more of the domestic wells is a sustainable management practice. The plan just states in the Response to Comments that the MOs and MTs … *are based on local input and balance of local concerns* (Appendix 2.A.2, pdf p. 190). The Butte GSP doesn't state how many domestic wells it's designed to dewater, or whether those domestic well owners have consented to the destruction of their well(s) and the waiver of their rights under Water Codes (WC) Sections 106 and 106.3(a). As we will discuss below, the MT depths selected in the plan will allow for a decline in groundwater levels and a loss in groundwater storage that substantially exceed the historical conditions experienced by the subbasin's domestic wells.

As an illustration of the plan's convoluted MT calculation, the third example on page 4-15 selects an MT at a depth of 10 feet below the historic low (historic low being calculated by subtracting 20 feet from 63 feet). The 10 feet below the historical low value is chosen because the historic low of 43 feet is shallower than the 7% domestic well depth of 45 feet. So, this MT isn't set at the "shallowest" depth, but at a depth deeper than either of the first two criteria, which will likely dewater **more than 7% of the domestic wells** in the "nearby" area. Unfortunately, the Butte GSP doesn't provide statistical data on the depths of "nearby" domestic wells except at the two wells where the MT was set at the 7% depth (AquAlliance Exhibit 1; see wells with IDs B-9 and B-47).

AquAlliance Exhibit 1 is a table that lists all the Butte GSP RMS monitoring wells along with the screened intervals, the zone monitored, the MO and MT depths, various MO-MT depth differences, and MT calculation method. The MT calculation methods for the Primary Aquifer wells are taken from Figure 4-1 (p. 4-17, pdf 215) and from the Very Deep Aquifer wells in Figure 4-3 (p. 4-21, pdf 219). To simplify the discussion of these wells, the leftmost column of the exhibit assigns a well identification label of B-1 through B-57.

2. The Butte GSP also requires that groundwater levels fall below their minimum groundwater elevation thresholds for 24 consecutive months in 25% of the wells before an undesirable result can be declared (Section 4.2.1.2, pp. 4-5 and 4-6, pdf 203 and 204). The plan apparently assumes that harm to the "long-term viability" of beneficial uses and users only occurs when there are 24 continuous months of harm across a broad area of the subbasin. The plan then reasons that:

   If groundwater levels were drawn down below MTs through an extended period of drought during which groundwater extractions were substantially higher than during non-drought periods, the "24 consecutive months or longer" period in the MT definition allows for recovery of water levels over the course of two consecutive winter/springs (seasonal high periods). (See Footnote 33 on p. 4-6, pdf 204.)

   The plan doesn't specify how the 25% of the wells will be selected, whether they can be adjacent, discontinuous, or spread across the subbasin. Can there be more than one 25% group? The monitoring plan does split the groundwater level monitoring network into Primary and Very Deep wells (greater than 700 feet bgs), so that suggests that at least two 25% groups are allowed. The reasoning for selecting the 25% well groups raises several questions:

   - What are the selection criteria for the 11 wells in the Primary monitoring network and 3 Very Deep monitoring network wells? Are they based on the portion of the subbasin being monitored by these wells, how groundwater production in the subbasin is being managed, where sustainability projects are being implemented, when the groundwater levels wells drop below their MT elevations, or some combination of these and other criteria?
   - Can an undesirable result be declared after 24 months of MT exceedance in the Very Deep aquifer, but not be declared for the overlying Primary aquifer?
   - What is the start date of the 24-consecutive-month clock? Does it start on the earliest day that any one of the 25% wells exceeds its MT, on the day the 11th or 3rd well exceeds its MT, or some other intermediate date?

- What happens to the start date of the 24-consecutive-month clock if additional RMN wells exceed their MTs after the clock starts?
- Are these additional wells made part of the existing group or does a new group have to be formed once there are enough additional wells to make another 25% group?
- Does the start date begin anew when a well is added to an existing group?
- If there are multiple 25% MT exceedance groups, how is the determination of an undesirable result made if the exceedance in any one group is less than 24 months, but the combined duration of the exceedance for all groups is greater than 24 months?
- How many 25% MT exceedance groups are possible in each aquifer zone — only one, up to 4, or more?
- Do the wells assigned to a group stay the same forever, or do the wells in a group change when there are fewer 25% of the wells, or the 24-month clock stops?
- Can the areas of the subbasin monitored by multiple 25% groups overlap?
- What happens when the locations of the first 25% group of wells cover a large portion of the subbasin, and then additional MT exceedance wells are clustered around a local pumping depression?
- Why does the MT exceedance need to be continuous in 25% of the monitoring wells for 24 months, when dewatering of a single domestic or small agricultural well can cause significant harm to the user(s) if it occurs repeatedly for only a few months?
- Why is the dewatering of a domestic and/or small agricultural well for less than 24 months considered a beneficially sustainable practice that's in compliance with Water Code Sections 106 and 106.3(a)?
- Why is dewatering of domestic and/or small agricultural wells that might occur cyclically each summer considered a beneficially sustainable practice, and who is benefitting? Certainly not the small landowner.

3. The Butte GSP sets the MT depths for lower groundwater levels to allow … *for adequate flexibility for increased groundwater extractions during drought periods* … (p. 4-15, pdf 213). This drought extraction volume of groundwater is the MOF and is calculated as the depth difference between the MO and the MT. AquAlliance Exhibit 1 lists the MO-MT difference in column G for each monitoring well. The Butte GSP states in Table ES-1 (p. ES-10, pdf 26) that the sustainable yield for the subbasin is 208,500 afy. The plan doesn't state the volume of groundwater stored in the MOF or the amount of groundwater storage lost per foot of groundwater level decline from the MO to the MT depths.

   An estimate of the volume of groundwater in the MOF can be made by multiplying the average difference of the MO-MT depths by the area of the Butte Subbasin, and the range of specific yield for the aquifers, assuming unconfined conditions. The total area of the Butte Subbasin (DWR Bulletin No. 5-21.70) is 265,000 acres (p. ES-3, pdf 19). Estimates of the specific yield for the Butte Subbasin range from DWR's 5.9% to 7.7% (p. 2-29, pdf 112) to 10% use in the Butte Basin Groundwater Model (Section 3.3 of Appendix 2D, p. 59, pdf 988).

   As an example, for every foot of decline in the average depth of groundwater in the shallow unconfined aquifer zone of the Butte Subbasin, which is less than 200 feet deep, a volume of groundwater ranging from approximately 15,600 to 26,500 acre-feet (af/f) is produced with an average of 21,000 af/f (e.g., 265,000 ac x 5.9% x 1 ft = 15,635 af). Using these parameters with the total average thickness of the MO-MT of 35.6 feet (AquAlliance Exhibit 1, column I), the estimated volume of the MOF ranges from approximately 555,000 af to 943,000 af. The storage volume may be less if the MO-MT difference for the shallow RMS groundwater level wells include both the unconfined and confined aquifers. Unfortunately, the plan doesn't indicate if any of the shallow RMS wells tap confined aquifers, but the Riverbank and Modesto Formation geologic units in the upper 200 feet of the Butte Subbasin are described as having generally unconfined groundwaters (Appendix 2.B.1, pp. 3-12 and 3-13, pdf 397 and 398).

4. AquAlliance Exhibits 2 and 3 are modifications of Groundwater System Water Budget Table 2-8 and Land and Surface Water System Water Budget Table 2-7 with added columns that calculate the difference between the Historical 2000-2018 water budget and the Future 2070 Climate Change water budget. Row 28 in this exhibit lists the change in groundwater storage for the different scenarios. For the Historical period, the annual change in groundwater storage is -9,800 afy (column B). With the 2070 Climate Change scenario the annual change in groundwater storage is a -2,000 afy (column F). This is an improvement in the annual average loss in storage of 7,800 afy (column G, row 28), but the proposed management of the subbasin will still result in a loss in storage of 100,000 af over the next 50 years. The loss in storage is in addition to the approximate 186,000 af lost between 2000 and 2018 (Figure 2-25, p. 2-49, pdf 132; 19 yrs x -9,800 afy = -186,200 af). The total loss in groundwater storage since 2000 with the 2070 Climate Change scenario is predicted to be approximately 286,000 af (186,200 afy + 100,000 afy = 286,200 afy) with the maximum future loss during consecutive below normal water years estimated at up to 486,000 af (Figure 2-44, p. 2-90, pdf 173; 300,000 afy + 186,200 afy = 486,200 afy).

5. The Butte GSP calculates the sustainable yield by subtracting the estimated 2070 Climate Change scenario groundwater storage deficit of 2,000 afy from the 2070 Climate Change scenario pumping rate of 210,500 afy (Section 2.2.3.7 and Table 2-10, p. 2-91, pdf 174). A sustainable yield for the Butte Subbasin is estimated at 208,500 afy. This estimate only considers the groundwater storage deficit; none of the other sustainability indicators were considered. SGMA's definition of sustainable yield doesn't specify that a change in a loss in storage is the only undesirable result that needs to be considered (WC 10721(w)). In particular, the groundwater budget in Table 2-8, AquAlliance Exhibit 2, shows a significant loss in flow in interconnected streams in the future. The Historical baseline net stream flow gains is a positive 40,000 afy (AquAlliance Exhibit 2, row 29, column B). The 2070 Climate Change scenario estimates the stream seepage will increase 94,100 afy (53%) and stream gains from groundwater will decrease 95,000 afy (-43%) (AquAlliance Exhibit 2, rows 11 and 25, columns G and H). **This results in a change in stream flow of -189,100 afy or -466% from the Historical baseline** (AquAlliance Exhibit 2, row 29, columns G and H). This future loss in stream flow occurs with a 68,300 afy increase in groundwater pumping. The ratio of change in net stream flow gains to change in groundwater pumping is approximately -277% (AquAlliance Exhibit 2, rows 21 and 29, columns G and H). A loss in net stream flow that's twice the increase in groundwater pumping should be considered a significant and unreasonable and therefore an undesirable result. The estimate of sustainable yield for the Butte Subbasin must

account for the negative change in interconnected stream flow under the 2070 Climate Change scenario. This would likely require a reduction in the sustainable yield pumping rate.

6. AquAlliance Exhibit 4 is a modification of Figure 2-44 that shows the cumulative changes in Butte Subbasin groundwater storage with the Current and future Climate Change scenarios. Lines have been added that mark the range of slopes of groundwater storage decline during years of consecutive below normal water years, i.e., a drought. These drought changes in storage are estimated for the 2070 Climate Change scenario to range from approximately -75,000 afy to -138,000 afy with an average of -99,250 afy. These drought year declines in groundwater storage are significantly greater than the 2070 Climate Change 50-year average of -2,000 afy by approximately 3,750% to 6,900% (75,000 afy / 2,000 afy = 37.5 = 3,750%). The total loss during these droughts ranges from approximately 250,000 af to 300,000 af. This loss in storage during periods of drought is caused by significant decline in groundwater levels, which likely causes additional losses in the flows in interconnected streams and harm to groundwater dependent ecosystem (GDEs). The large difference between the long-term average annual rate in storage loss and the loss during extended periods of below normal water years suggests that sustainable management of the Butte Subbasin would be better measured by the impacts caused during droughts and how actions of the GSA prevent undesirable results during periods of extended below normal water years to protect all groundwater beneficial uses and users.

7. The Butte GSP estimated the interactions between groundwater systems and surface water features within the Butte Subbasin at a basin scale (Butte Basin Groundwater Model, Section 2.2.2.6.1, pp. 2-54 through 2-61, pdf 137 through 144). The GSP classified the hydraulic connection between streams and rivers as either *gaining or losing* (p. 2-54, pdf 137) depending on the relative elevation of groundwater to the stream. When the water table elevation adjacent to the stream is above the elevation of water in the stream, groundwater can flow into the stream, i.e., *gaining* reach, or accretion. When the water table elevation is below the elevation of the stream, the stream can lose flow to groundwater system, i.e., a *losing* reach. The SGMA regulations introduce two additional criteria for determining an interconnected surface water by requiring … *a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted* (CCR T23, Section 351(o)). The SGMA regulatory definition of an interconnected surface water isn't consistent with the science because it misrepresents the facts on how streams and groundwater interconnect and the fact that interconnection can still occur when there is an unsaturated zone beneath the stream.[2]

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[2] See these articles about how the disconnection of streams and groundwater results in maximum stream flow losses that spread as the groundwater depression enlarges.

Brunner P., Cook P. G., and Simmons C. T., 2009, Hydrogeologic controls on disconnection between surface water and groundwater, Water Resources Research, v. 45, W01422, pgs 1-13. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2008WR006953

Brunner P., Cook P.G. and Simmons C.T., 2011, Disconnected Surface Water and Groundwater: From Theory to Practice, Ground Water, v. 49, no. 4, pgs 460-467. https://libra.unine.ch/Publications/Philip_Brunner/25762

Cook and others, 2010, provide a brief paper that discusses … *the most common misconceptions associated with the term disconnected*. They list the following statements found in scientific literature as being … ***incorrect*** *as general definitions of disconnected rivers (emphasis added):*

- *in a disconnected system, there is no flow between the river and the aquifer,*
- *pumping under a disconnected stream will not affect streamflow,*
- *a river is disconnected if an unsaturated zone separates the river from the aquifer,*
- *a river is disconnected if the water table is below the streambed*

Cook and others note that as … *the groundwater table is lowered sufficiently, an unsaturated zone begins to develop.* As the groundwater level continues to decline, the infiltration rate out of the stream is no longer linearly related to the rate of decline in the water table, the infiltration rate out of the stream transitions from connected to disconnected. With continued decline in the water table, the unsaturated capillary zone beneath the stream no longer intersects the base of the stream, so that further decline in water table no longer affects the infiltration rate, and the pressure head beneath the base of the stream reaches a constant value. At this point the stream is now considered to be disconnected at that location. *The infiltration rate at [the] disconnected [location] will depend on the thickness and hydraulic conductivity of the clogging layer, and the surface water depth.* However, even *[a]t a site that was believed to be disconnected, the streamflow was generally declining*. That is, the stream is losing flow at a constant rate until it becomes dry. A better description of a disconnected stream would be to call it a *losing-disconnected stream*.

It is important to point out that the assertion in SGMA that when there is … *no continuous saturated zone to the underlying aquifer …* [the] stream is no longer an interconnected surface water feature and groundwater pumping can't affect stream flow is scientifically invalid. Cook and others point out that:

Cook P.G., Brunner P., Simmons C.T., Lamontagne S., 2010, What is a Disconnected Stream?, Groundwater 2010, Canberra, October 31, 2010 – November 4, 2010, pg 4.
https://www.researchgate.net/profile/Philip-Brunner/publication/266251504_What_is_a_Disconnected_Stream/links/54dfa2c80cf29666378b9e57/What-is-a-Disconnected-Stream.pdf

Fox G.A. and Durnford D.S., 2003, Unsaturated hyporheic zone flow in stream/aquifer conjunctive systems, Advances in Water Resources, v. 26, pgs. 989-1000.
http://www.geol.lsu.edu/blanford/NATORBF/5%20Modeling%20Papers%20of%20Groundwater%20Flow%20of%20Stream&Aquifer%20Systems/Fox%20et%20al_Water%20Resources_2003.PDF

> *Even though lowering the groundwater table at a specific point under a disconnected system will not increase the infiltration rate directly, it is not correct to assume that additional pumping will not affect a disconnected river on a larger scale. Increased groundwater pumping will result in a widening of the cone of depression, and this can extend the length over which the river is disconnected (Fox and Durnford, 2003).*

A scientifically correct description of groundwater and surface water interactions is critical to understanding the implications for managing the groundwater and surface water resources of the Butte Subbasin, SGMA regulations notwithstanding. The use of a scientifically incorrect assumption about how and where groundwater pumping can affect stream flows to manage the sustainability of a subbasin can result in significant harm to the stream environment, its wildlife and habitats.

Even though a stream is dry at one location, it doesn't mean that it is disconnected from the shallow aquifer system. As groundwater levels decline, the point in the stream where it begins to dry out migrates further downstream. For example, the Butte Subbasin has both gaining, losing and mixed reaches; (see Figure 2-30, p. 2-59, pdf 142). As groundwater levels decline from the MO depths to the MT depths, averaging approximately 37 feet (AquAlliance Exhibit 1), the point in the stream where gaining flow starts will move further westward and downstream, producing greater lengths of losing stream and more loss of flow. Small changes in groundwater elevation can result in long sections of stream transitioning from gaining to losing. For example, for land surface that has a slope of 1 foot of elevation rise to 1500 feet of horizontal distance — a typical slope of the land in the central Butte Subbasin (Figure 2-7, p. 2-20, pdf 83) — every one foot of groundwater decline can cause 1500 feet of downstream migration of the losing-to-gaining transition point. The 37-foot decline below the elevation of the MOs allowed by the MTs could result in the losing-to-gaining transition point moving 55,500 feet down stream, or 10.5 miles, which potentially lengthens the dry section of the stream.

This is a significant impact to the streams in the Butte Subbasin that increases as the groundwater levels decline from the MO elevations causing increases in the length of stream channel that becomes disconnected and possibly dry. The Butte GSP is incorrect in assuming that, when a stream no longer has a continuous saturated zone to the underlying groundwater, actions to manage groundwater levels are no long needed. Declines in groundwater levels can still cause a significant impact on the stream flows. The GSAs' management actions now proposed in the Butte GSP are insufficient to sustainably protect interconnected stream flows and the associated wildlife, habitat, and vegetation.

8. The purpose of the Butte GSP is to establish sustainability by setting goals for … *locally managed sustainable groundwater resources to preserve and enhance the economic viability, social well-being and culture of all Beneficial Uses and Users without experiencing undesirable results* (p. 4-2, pdf 200). To prevent undesirable results from the chronic lowering of groundwater levels, the GSP sets quantitative MTs and MOs for groundwater elevations (p. 4-2, pdf 200). Whenever groundwater levels fall below the MT elevations for 24 consecutive months in 25% of the wells,

an undesirable result occurs in the Butte Subbasin. The MO elevations are set above the MT elevations as *…specific, quantifiable goals for maintaining or improving specified groundwater conditions… to manage sustainability and prevents impacts to all groundwater beneficial uses and users… to maintain the Subbasin's sustainability goal* (p. 4-13, pdf 211). The Butte Subbasin MO elevations *…are the average of the last five years of measured groundwater level data* and are *…generally representative of both drought and recovery conditions within the Subbasin*… (p. 4-15, pdf 214). The elevation difference between the MOs and the MTs is the *margin of operational flexibility* (MOF) that provides an adequate volume of groundwater *…to allow for increased groundwater production during drought years (e.g., 2015) with recovery during normal or wet years* (p. 4-16, pdf 214).

Therefore, the ratio of the volume of groundwater stored in the MOF to the volume of groundwater storage lost during drought years is a measure of how many years of drought can occur before an undesirable result occurs from the lowering of groundwater and loss of groundwater storage.

AquAlliance Exhibit 4 is a modification of Figure 2-44 that shows the estimated cumulative change in storage for different modeled scenarios, with lines added that show the drought rates of storage loss for the 2070 Climate Change scenario. The rate of change in groundwater storage during the simulated 2070 droughts is from -75,000 afy to -138,000 afy with an average of -99,250 afy.

The total volume of groundwater stored in the MOF between the MO and the MT elevations was estimated in Comment No. 3 using low and high specific yield values. The low estimate of MOF volume is approximately 555,000 af and the high is 943,000 af.

Using the maximum rate of drought storage change of -138,000 afy, depletion of the lower MOF volume of 555,000 af would take approximately 4 years of continuous loss (e.g., 555,000 af / 138,000 afy = 4.02 yrs). Depletion for the higher MOF volume would take 7 years. For the average rate of storage loss of -99,250 afy, total depletion of the MOF would take approximately 6 years for the lowest volume and approximately 9 years for the highest volume.

This would allow groundwater levels and storage to decline continuously during at least 6 years of drought and possibly up to 11 years if the Butte GSP 24-month MT exceedance requirement is added before an undesirable result could be declared, causing an average of approximately 600,000 af, and possibly up to 1 million af, of drought storage loss (the MOF volume plus 2 additional years of average loss at -99,250 afy).

Setting the MOF at a volume that would take 6 to 11 continuous years of drought before the MTs are exceeded and an undesirable result must be declared suggests that the MT depths are too deep to be a valid threshold for sustainability and protection of all beneficial uses and users, but are intended to protect only the largest groundwater users with the deepest wells.

9. The analysis in Comment No. 8 regarding how many continuous years of drought can be accommodated by the MOF storage volume before groundwater level and storage decline to an undesirable result violates a basic assumption about the purpose of SGMA. That is, groundwater subbasins that need a GSP because of a medium- to high-priority ranking shouldn't be managed to repeat or perpetuate the errors of the past. The design of the Butte GSP sustainability monitoring program with a MOF storage volume that requires 6-plus years of declining groundwater levels and storage before an undesirable result can occur suggests that the plan will continue past mismanagement practices, which raises several questions:

   - Why is the MOF storage volume set so that, even at the maximum rate of annual storage loss estimated for droughts, it would take a minimum of 6 and possibly up to 9 continuous years of groundwater decline before groundwater levels would exceed the MTs for 24 consecutive months and trigger an undesirable result? Why is maintaining this volume of MOF groundwater storage loss considered a beneficially sustainable management practice as required by SGMA?
   - Doesn't the sustainability criterion requirement for a continuous 24 months of MT exceedance *after* the 4 to 7 years of continuous drought mean that undesirable results for loss in groundwater storage and groundwater levels will probably never be declared in the Butte Subbasin?

10. The sustainable management of groundwater as envisioned by SGMA likely requires that a groundwater storage surplus be maintained to meet the needs of users during droughts and to protect the beneficial uses of streams, wildlife, and GDEs. That is, subbasin management actions should provide sufficient groundwater storage needed to counter the losses from a drought to protect and minimize drought impacts to all beneficial uses and users.

    If a goal of SGMA is the prevention of undesirable results during periods of drought, shouldn't the depth of the MTs be set at a depth caused by declining groundwater levels for a reasonable number of continuous years of drought, after adjusting for any storage surplus created during above normal and wet years? Shouldn't a GSP establish sustainability criteria using a method based on anticipated storage loss during a drought, rather than the arbitrary method of the Butte GSP that set the depths far below the measured historical maximum, which could result in a decade of continuous groundwater level decline, storage loss, and loss of domestic wells before an undesirable result is declared?

    As an example of a drought-based methodology, AquAlliance Exhibit 4 shows the annual loss in groundwater storage that, during the most recent simulated periods of drought lasting more than 3 years, has an average annual loss of approximately -99,250 afy. Using this average rate of annual drought storage loss for 3 years, the average volume of groundwater produced from a foot decline in the shallow aquifer level of 21,000 af/f (see Comment No. 2), a 3-year decline in groundwater level would be of approximately 14 feet (3 yrs x - 99,250 afy) / 21,000 af/f = -14.2 feet). This suggests that the depth of the MTs should be set at 15 feet or less below the MO depth to accommodate future periods of extended drought without causing undesirable impacts to all beneficial uses and users, in particular wells of domestic and small agricultural groundwater users.

It should be remembered that declaration of an undesirable result in the Butte Subbasin as currently planned would occur only after groundwater levels decline for 24 consecutive months below the MT depth. This would allow groundwater levels to decline during a drought lasting 5 years (3 years of drought plus 2 additional years below the MTs) before an undesirable result would be declared, with possibly an additional 10 feet of groundwater level decline and 210,000 af of additional storage loss after the MT depths are reached. Shallower depths for the MTs might be required for protection of interconnected surface waters and GDEs (see Comment No. 9).

Using a drought-based assessment shows that the Butte GSP's method for arbitrarily setting the MT depths below the historical low groundwater level results in an excessive MOF volume that will likely lead to harm to all but the largest groundwater producers with the deepest wells. Why is the arbitrary setting of MTs at greater than historical groundwater depths, which result in excessive volume of MOF groundwater storage, considered a beneficially sustainable management practice? These MTs will harm domestic and small agricultural groundwater users, in opposition to SGMA and Water Code 106.3(b).

11. In addition to groundwater levels having to decline below the MT depth to declare an undesirable result, the Butte GSP threshold for undesirable results for chronic lowering of groundwater levels in the Primary and Very Deep aquifers, reduction of groundwater storage, and degraded water quality requires the groundwater level remain below the MT depth in 25% of the monitoring wells continuously for 24 months[3] (Sections 4.2.1.2 and 4.2.6.4, pp. 4-5 and 4-12, pdf 203 and 210). The 25% monitoring site requirements also apply to inelastic land subsidence monuments, but for this sustainability indicator, the consecutive 24 months of MT exceedance isn't required, possibly because the MT is a 5-year average (Section 4.2.5.4, p. 4-11, pdf 209).

    The Butte GSP doesn't specify the monitoring wells or subsidence monuments in a 25% group; the area covered by a group; whether the wells or monuments in a group need to be adjacent or can be dispersed across the subbasin; whether the wells or monuments in a group can change with the measurements, so that all the wells in the areas of deepest decline are considered together; whether more than one 25% group is allowed; or which wells or monuments could be in more than one group. Instead, the plan only states that … *the 25 percent of the RMS wells below minimum thresholds for 24 consecutive months criterion was estimated to be an indicator of a significant, widespread problem, and thus represented undesirable results* (Section 4.2.1.2, pp. 4-5 and 4-6, pdf 203 and 204).

    The requirement that 25% of the wells must together exceed their MTs for 24 consecutive months may cause rather than prevent the creation of an undesirable result. The MT depths and elevations vary across the subbasin (Tables 4-1 and 4-2, pp. 4-19, 4-20, and 4-22, pdf 217, 218 and

[3] The Undesirable Result description for Depletion of Interconnected Surface Water in Table ES-1 (p. ES-11, pdf 28) conflicts with Section 4.2.6.4 because it fails to include the 24 consecutive month requirement.

222). Therefore, it can be assumed that the wells within any 25% group will have variable MT groundwater depths and elevations. The requirement that all the wells in a group exceed their MTs before declaring an undesirable result will likely produce a decline in groundwater depth across a 25% group area that continues until the lowest of the MTs elevations is passed. This could result in a significant number of domestic wells reaching groundwater levels below their associated MT elevations while the GSAs wait for the last well in the group to exceed its MT. In addition, a seasonal rise in groundwater level above the MT elevation in only one well will stop the undesirable result declaration, but not the impacts to the domestic wells in the 25% group area.

The area covered by a 25% group could be approximately a quarter of the subbasin — approximately 103 square miles, or 66,250 acres — but possibly as much as the entire subbasin, depending on which wells are included in a 25% group. Combining the requirement that all wells in a group exceed their MTs together with the size of the area covered by a 25% group does indeed result in a *"widespread problem."* The size of the problem may become too large and too costly for the Butte GSAs to remedy and will likely require an outside funding source(s) and additional agencies to implement the remedy(ies), such as the state or federal governments. The size and significance of the *problem* would likely be less without the *25% of the-wells-exceed-the-MTs-together-for-24-months* requirement. The ability to remedy any problem would likely be easier and less costly if it occurs sooner. The number of domestic wells being impacted by undesirable declining groundwater levels would likely be less if the problem area is around a single well and doesn't have to include approximately 25% of the subbasin.

12. AquAlliance Exhibit 5 is Butte GSP Figure 4-1 showing the Primary Aquifer RMS well MT values (p. 4-17, pdf 215) with hypothetical boundaries for four 25% well groups added, labeled A to D. This exhibit demonstrates groups of wells that are adjacent rather than dispersed. Assuming all RMS groundwater wells belong to a 25% group, the wells stay in the same group, and the grouping doesn't change with the measurements, then there needs to be an overlap of the 25% group boundaries to create four groups of 11 wells out of a total of 41 wells. These hypothetical groups also demonstrate that the MT depths within a group are highly variable.

    For example, in the center of the subbasin, 25% group labeled B, two adjacent RMS wells along Highway 162 have MT depths of 35 and 54 feet. The 35-foot MT is for well 19N01E35B001M (B-26, CASGEM 23978) with screens from 85 to 135 feet bgs; for State well numbers (see Figure 3-1, p. 3-7, pdf 183) and well B-26 in AquAlliance Exhibit 1 for well details. Also note that this shallow well, B-26, is also part of the Interconnected Surface Water monitoring well network and has a second MT depth of 25 feet bgs for that sustainability indicator. The 54-foot MT is for an intermediate depth well 19N01E27Q001M (B-25, CASGEM 19782) screened from 260 to 280 feet bgs. AquAlliance Exhibits 6 and 7 are hydrographs and histograms of groundwater elevation data from CASGEM for these two wells with the ground surface and MO elevations included. The hydrographs show that groundwater elevations seasonally fluctuate from 2 to 5 feet. The histograms show that 99% of groundwater depths measured in shallow well, B-26, since December 2001 have been less than 10 feet (AquAlliance Exhibit 6B). For the intermediate depth well, B-25, 86% of the groundwater depths have been less than 10 feet since April 1978, and 96%

after 1994 (AquAlliance Exhibit 7B). The depth in the shallow well B-26 exceeded 10 feet twice during the 2012-2015 low in June at 14.71 feet, and August 2015 at 11.83 feet. In the intermediate well, B-25, depth exceeded 10 feet three times during 2012-2015 — May, August, and October 2015 — with the maximum depth at 19 feet bgs in May.

These two wells are less than 1 mile apart, and the middle depth of the screened intervals is approximately 160 vertical feet apart. Historical groundwater level data from CASGEM shows that the depth to groundwater in both wells is typically less than 5 to 10 feet, with the average in recent years less than 5 feet. Historical CASGEM data show that the difference in groundwater elevations between these wells has ranged from -1 to -2 feet, except for the years 2015 and 2021, when the difference ranged from -2 to -3.4 feet (AquAlliance Exhibit 8A). Using the vertical screen difference of 160 feet, the historical vertical groundwater gradient between these two wells ranges from approximately -0.013 to 0.021 (AquAlliance Exhibit 8B). Assuming that these two wells in the center of the subbasin and less than a mile apart are in the same 25% RMS groundwater level monitoring group, the requirement that the MTs in these wells be exceeded together for 24 consecutive months before an undesirable result can occur raises several questions:

- Why wouldn't the groundwater levels in these wells decline at a similar rate under the Butte GSP management actions, when they have in the past?
- Why is the MO set at a 9-foot depth for the intermediate well, B-25, which is 5 feet lower than the MO for the shallow well, B-26, when the historical depths before January 2015 in these wells haven't varied by more than 2 feet? Wouldn't a 4-foot depth MO be a more appropriate average non-drought depth for intermediate well B-25?
- Why are the MT depths for these two wells 19 vertical feet apart when they historically have been less than 2 feet apart?
- Why set the MT depths 19 vertical feet apart when that produces a downward vertical gradient of approximately 12%, or approximately 9 times greater than the historical values (19 ft / 160 ft = 0.119 = 11.9% vs historical 0.013 or 1.3%).
- What subbasin management activities are anticipated that would produce this high vertical gradient for a period of at least 24 consecutive months?
- Assuming that these two wells that are less than 1 mile apart are in the same 25% RMS well group, wouldn't the depth to groundwater in shallower well, B-26, need to be far below its MT to trigger an undesirable result because of the MT depth in well B-25?
- Why is the MT for protection of Interconnected Surface Waters in well B-26 set at 21 feet, 10 feet below the historical maximum, when 99% of the time, including the recent 2012-2015 drought, the depth was less than 10 feet bgs and never exceeded 15 feet?
- Why is the 21-foot MT depth in well B-26 for Interconnected Surface Water protection that far exceeds historical conditions considered a beneficially sustainable management practice?
- How do the GSP management actions required when groundwater levels decline below the ICSW MT depth of 25 feet bgs differ from those when the MT is below 35 feet to protect the subbasin-wide groundwater level sustainability?

13. AquAlliance Exhibit 9 is a modification of Figure 4-5 showing the locations and values of the MT depths to water for the Butte GSP ICSW RMS network with the Well ID numbers from AquAlliance Exhibit 1 added. The Butte GSP ICSW sustainability criterion requires that the MTs be simultaneously exceeded in 3 of the 12 RMS wells, or 25% of the wells, for 24 consecutive months (Table 4-3, p. 4-34, pdf 232 and Section 4.2.6.4, p. 4-12, pdf 210). The Butte GSP doesn't name the ICSW monitoring wells in a 25% group, the area covered by a group, whether the wells in a group need to be adjacent or can be dispersed across the subbasin, whether the wells can be grouped so that all the wells in the areas of deepest decline are considered together, whether more than one 25% group is allowed, whether more than 3 wells can be in a group, or whether the wells in a group can change. The Butte GSP does state that there is a project to add 10 wells to improve monitoring of surface water depletion and GDEs with all 10 of the new shallow wells monitoring GDEs and 7 of the wells added to the ICSW network (Section 5.9.2, p. 5-51, pdf 283 and Figure 5-2,(p. 5-52, pdf 285).

    An issue with the ICSW monitoring network is whether the distribution of the wells will identify the sections of the creeks that will receive the greatest impact from declining groundwater levels. The Butte GSP groundwater budget indicates that streams in the subbasin will experience significant losses in surface water flow with the 2070 Climate Change scenario, averaging -189,000 afy (AquAlliance Exhibit 2, row 29, columns G and H). The plan in Section 2.2.2.6.2 and Table 2-5 (p. 2-62, pdf 145) lists the monthly gains to streamflow from groundwater (accretions) from 2000 to 2018, the Historical baseline. The annual average is 683 cubic feet per second (cfs) with the stream traversing the subbasin receiving an annual average of approximately 293 cfs or 212,000 afy. The estimated 2070 Climate Change decline in surface water flow is a loss of approximately 89% of the 2000-2018 Historical baseline annual average net gains to the streams traversing the subbasin (-189,100 / 212,000 af = -0.892 = -89%) and a 466% loss from the overall subbasin baseline net stream accretion.

    The Butte GSP doesn't clearly indicate where the 189,000 afy loss in streamflow will occur. Figure 2-30 (p. 2-59, pdf 142) shows that most of the streams traversing the subbasin are gaining groundwater, so it's likely that they will be very susceptible to losing streamflow when groundwater levels decline to the MT depths. Identifying where these losses might occur is critical to protecting the interconnected streams and sustainably managing the subbasin. To that end, there are issues with how the ICSW RMS network will work to ensure sustainability and protect the beneficial uses and users of interconnected streams and GDEs.

    For example, two of the wells shown in AquAlliance Exhibit 9 near the center of the subbasin adjacent to Highway 162, labeled B-26 and B-56, are an example of one issue with the ICSW monitoring network. What is the criterion for including a ICSW well in a 25% group? One of these two wells, B-26, was previously discussed in Comment No. 9 because it has two MT depths that are 10 feet apart, at 25 and 35 feet bgs (AquAlliance Exhibit 1). The second ICSW well, B-56, has an MT depth of 26 feet bgs. These two ICSW wells are adjacent to two different streams, Butte Creek and Little Dry Creek (see Figure 2-10, p. 2-5, pdf 88). The logical choice for a third well in the 25% group would be the well along the same streams, such as B-37 to the north that's between these two creeks. Well B-37 has an MT of 24 feet bgs, which is consistent with the other two wells, so there isn't the problem of having groundwater levels decline until the maximum MT depth is exceeded before declaring an undesirable result. However, there are other problems with making the ICSW monitoring well groups.

- What group of three wells does well B-57 to the northwest belong to? Can it be included with the other three wells to make a group of 4 wells?
- Well B-57 is adjacent to Little Dry Creek, but the MT depth is 44 feet, which creates the *waiting for exceedance of the maximum dept*h problem if it's combined in a group with the other three wells, because there's a 20-foot MT depth difference.
- Can these two northern ICSW monitoring wells be effective at identifying when and where streamflow is being lost when they are 6 to 12 miles away from wells B-26 and B-56?
- Well B-57 is too far away from the other 9 ICSW monitoring wells and not associated with any of their streams, so why would it be grouped with those wells? Note that the proposed additional 10 monitoring wells don't solve this issue (see Figure 3-6, p. 3-22, pdf 198).
- The three wells in the southeast — B-23, B-54, and B-55 — are a logical group. But to what group should well B-19 belong? Again, can there be 4 or more wells in a group? If there are 4+ wells in a group, do all wells have to exceed their MTs or just 3 wells? See Comment No. 2 for discussion of other issues related to additional wells in a group and the timing of the 24-month clock.
- The *waiting for exceedance of the maximum dept*h problem is also an issue with the southeastern group of wells because the MT depth difference is at least 9 feet and possibly up to 20 feet, if B-19 is included.
- Well B-19 is distant from any other ICSW monitoring well and the 10 additional monitoring wells don't solve this issue. Well B-19 is closest to well B-26, but that creates the *waiting for exceedance of the maximum dept*h problem with a 14-foot MT depth difference.
- Well B-19 could be grouped with wells B-16 and B-17 to the west, but those wells monitor different surface water features, and the group would have an 11-foot *waiting for exceedance of the maximum dept*h problem.
- Well B-19 could have to wait for the proposed 3 new wells to the southwest, but then it would be a 4th well and the 39-foot MT depth might create a *waiting for exceedance of the maximum dept*h problem.
- Another logical grouping of three ICSW monitoring wells is B-16, B-29 and B-30, which are west of Angel Slough, but they also have the *waiting for the maximum dept*h problem with a MT depth difference of 18 feet.
- If a group is made of well B-29, B-16 and B-30, then what group is B-17 assigned to, or is it a 4th well?
- Do the 3 wells in a group have to be adjacent and/or monitor the same water feature?
- If the 3 wells in a group can monitor difference water features, how does that ensure timely protection of each feature, or does that just ensure that they will fail together? Why is a monitoring protocol that produces mutual failure considered a beneficially sustainable management practice?

All of these questions raise doubts about the efficacy of the Butte GSP ICSW monitoring well network at identifying and protecting the beneficial uses and users of surface waters. The Butte Subbasin covers approximately 265,000 acres (p. ES-3, pdf 19). The requirement that 25% of the ICSW wells need to exceed their MT depths for 24 consecutive months may result in a significant impact to surface water flows over a significant area. In the above example of the four central subbasin ICSW wells, the distance between the monitoring points could allow long sections up to several miles of stream to be dewatered before the required three wells would exceed the MTs and trigger an undesirable result.

The Butte GSP ICSW RMS network needs to be revised and expanded to allow for effective and protective monitoring of the subbasin surface water features, so that measurements protect the beneficial uses and users, especially in those the sections of streams where future losses are anticipated. The location of ICSW monitoring wells should be linked to portions of the streams where the habitat is most sensitive and maintaining flows is critical for the survival of fisheries and the habitats of other wildlife and GDEs. The ICSW monitoring wells should also be linked to actual surface water flow measurements to validate that the MT depths are protective of instream flows.

14. The water balance in the Butte GSP assumes that with the 2070 Climate Change scenario the management of the subbasin will result in an increase in groundwater production of 68,300 afy, (AquAlliance Exhibit 2, rows 21, column G). This increase in pumping will occur with a decrease in groundwater discharging to surface water, and a change in net stream accretion, of -189,000 afy (AquAlliance Exhibit 2, row 29, column G), or 466% below the 2000-2018 baseline of 40,600 afy (row 29, columns H and B). The loss in net stream accretion occurs because of an increase in seepage from streams with climate change of 86,000 afy (row 10, column G) and a reduction in groundwater discharging to the streams of -95,000 afy (row 25, column G). This is a ratio of future stream seepage to increased groundwater pumping of 126% (86,000 afy / 68,300 afy = 1.26 = 126%). This is also a ratio of future net loss in stream accretion to increased groundwater pumping of approximately 277% (AquAlliance Exhibit 2, row 30, column G). This decline in future streamflow that significantly exceeds the increase in groundwater production raises several questions the issue of whether the proposed Butte GSP will sustainably manage the subbasin:

  - Why is a loss ratio of 126% from an increase in stream seepage loss caused by an increase in groundwater pumping considered a beneficially sustainable management practice? Shouldn't this increase in seepage that exceeds the increase in pumping be considered an ecological tipping point that produces an undesirable result to interconnected surface waters and an impact to the Public Trust?

  - Why is a loss ratio of -277% from a decrease in net stream accretion of -189,100 afy caused by an increase in groundwater pumping considered a beneficially sustainable management practice? Shouldn't this decrease in stream flow from increased pumping also be considered an ecological tipping point and an undesirable result to interconnected surface waters and an impact to the Public Trust?

- The historical net stream accretion, 40,600 afy (row 298, column B), occurred with groundwater pumping of 142,200 afy (row 21, column B), a ratio of net accretion to pumping of approximately 29% (row 30, column B). With the 2070 Climate Change scenario, the management plan estimates that the net stream accretion will be -148,500 afy (row 29, column F), for an approximate 466% decrease in groundwater discharging to surface waters over the 2000-2018 Historical baseline (row 29, column H). Why is this reduction in net stream accretion considered a beneficially sustainable management practice? Shouldn't a decrease in stream flows that's significantly greater than the increase in groundwater production be considered an ecological tipping point that causes an undesirable result to interconnected surface waters and an impact to the Public Trust?

15. The Butte GSP fails to analyze, monitor, or consider the potential impacts to water quality caused by the allowable changes in groundwater levels and groundwater storage, except for one constituent, salinity (Sections 3.4 and 4.2.4, pp. 3-11 to 3-15 and 4-9 to 4-10, pdf 187 to 191 and 206 to 208). Salinity is considered a contaminant of concern because of the potential for saline and brackish connate groundwater in the older sediments that underlie the freshwater aquifer system. There is the potential for saline/brackish fluid to migrate upward in areas of sediment doming, along faults, and from over pumping of deeper freshwater aquifers (Sections 2.2.1.7.1, 2.2.1.7.2 and 2.2.1.8.2, pp. 2-25, 2-29 and 2-30, pdf 108, 112 and 113). Another potential source of saline water contamination is the improperly orphaned or abandoned gas wells scattered across the Sacramento Valley.[4]

    The Butte GSP proposes to participate in a Sutter Buttes Water Quality Interbasin Working Group with a goal and objective to find funding for studies to improve the knowledge of the hydrogeology and water quality of the Butte, Sutter, Yolo, North Yuba, and South Yuba subbasins. *It is expected that groundwater studies identified by the interbasin working group would be grant funded and implemented by research entities, such as USGS or DWR. If projects are identified to protect or improve groundwater quality, they would be led and implemented by local entities such as the counties, agricultural water districts and agencies, municipalities, and other public water suppliers using a variety of funding sources, including grants and loans* (Section 6.1.2.2, p. 6-4 and 6-5, pdf 312 and 313). The Butte GSP doesn't make any specific commitment to conduct these important studies unless outside funding is obtained (Figure 6-2, p. 6-12, pdf 320).

    Although the Butte GSP calls for coordination in management of water quality with other governmental agencies, the plan doesn't indicate what the MOs or MTs are for all the potential contaminants of concern in the Butte Subbasin, or what GSP management actions will be taken whenever a water quality impact is identified.

[4] See California Council on Science and Technology, November 2018, https://ccst.us/reports/orphan-wells-in-california/publications/

What is the role of the GSAs in protecting water quality for all beneficial uses and users? In particular, the protection of domestic water supply must be the primary concern for managing the subbasin. SGMA empowers the GSAs with the authority to control pumping rates and locations throughout the subbasin to protect all beneficial uses and users, an authority over groundwater resources that other regulatory agencies don't possess.

The Butte GSP should provide a concise description of what projects and management actions the GSAs will be taking to prevent degradation of the subbasin water quality for all potential contaminants of concern and how the GSAs will remedy any degradation that occurs.

16. The Butte GSP sets the MO and MT rates for inelastic subsidence at 0.25 feet per 5 years (ft/5-yrs), and 0.50 ft/5-yrs, respectively (Table ES-2 and Sections 4.2.5 and 4.3.5, pp. 4-10 and 4-11, 4-27 and 4-28; pdf 208, 209, 225 and 228). The MO for subsidence is approximately 769% greater than the current subsidence rate of less than 0.0325 ft/5-yrs (p. 4-27, pdf 225), and the MT is approximately 1,538% greater. In the discussion of the historical and recent subsidence rates, Table 2-4 (p. 2-53, pdf 136) shows the difference between the Sacramento Valley GSP monument subsidence measurements and the InSAR measurements, which is significant. **The InSAR annual rate of land elevation decline is approximately 1,400% more than what is being measured at the GPS monuments** (-0.125- ft/y / -.009 ft/yr = 13.9 = 1,390%). The discussion also notes that the InSAR measurements show the greatest changes in land surface elevation occurring in small areas or "pockets," and not broad areas. The InSAR 2015-2019 cumulative rate of land elevation decline in "pocket" areas of the subbasin is already near the MT value of -0.50 ft/5-yrs (Figure 2-27, p. 5-55, pdf 139).

    Even though the plan acknowledges that subsidence in the Butte Subbasin currently occurs in small areas, the subsidence monitoring network requires that 25% of the subsidence monuments, 8 of 31, exceed the MT before an undesirable result can occur. The plan doesn't specifically state the minimum duration of the MT exceedance, but the 5-year averaging subsidence rates for the MO and MT suggests a 5-year running average is required. AquAlliance Exhibit 10 is a composite of Figures 2-26 and 2-27 that shows the InSAR data overlain by the GPS monuments. This exhibit shows that the broad area of subsidence in the southeastern portion of the subbasin with up to -0.25 ft of land surface decline has 6 GPS monuments. This subsiding area is approximately 15 miles by 6 miles, approximately 57,000 acres, yet the size still doesn't have enough area to enclose 25% of the GPS monuments. There are several other GPS monuments along the periphery, but it's unclear which of them, if any, should be included with the other six. The Butte GSP doesn't discuss how the InSAR measured "pockets" of subsidence that exceed the MT will be evaluated or whether they can trigger an undesirable result. The plan doesn't provide the frequency of subsidence monitoring or reporting, but instead is dependent on the work performed by DWR and NASA's Jet Propulsion Lab. The Butte GSP subsidence monitoring network raises several issues:

    - What are the criteria for selecting the GPS monuments to be in a 25% group and are the InSAR data a factor in making a group?

- Why does the area of subsidence have to extend across large areas of the subbasin before any management actions are implemented? Can't subsidence in the small pocket areas cause damage to critical structures?
- Why are the pocket areas of greatest subsidence identified by InSAR not being investigated already to determine if localized subsidence is causing or will cause structural damage, such as a localized sinkhole that might enlarge with time?
- Will an assessment be made of the critical structures in the subbasin to determine their current condition and the amount of subsidence that they can tolerate before there's structural damage? Will there be regular inspections of these structures?
- Why isn't settlement-caused damage to an individual bridge and/or home considered significant?
- Why shouldn't the omission of the InSAR measurements as a subsidence indicator be considered a violation of the SGMA requirement to use the "best available science" (WC 113, CCR Title 23 Sections 351(h), 351(i), 354.16(e), 354.44(c), and 355.4(b)(1))?
- What management actions and projects will be implemented to stop or mitigate subsidence? Table 5-3 doesn't list preventing subsidence as having an expected direct benefit from the Butte GSP management actions and projects (p. 5-8, pdf 240).
- Why are the subsidence MO and MT values far greater than the current condition? This seems to be designed to allow a reduction in the groundwater sustainability of the subbasin.
- Why are the Butte GSP's plan potential increases in the areas and rates of subsidence over the current conditions considered a beneficially sustainable management practice?

The Butte GSP needs to provide additional information and reasoning on:

- Why won't MO and MT values that are significantly greater than the existing subsidence reduce the sustainability of the subbasin?
- Why does 25% of the subbasin need to be in significant subsidence before an undesirable result is identified and management actions need to be taken?
- Why does subsidence need to be averaged over 5 years if structural damage is occurring in less time?
- When will identification of critical infrastructure in the Butte Subbasin occur and by whom, including inspection of their current condition? A determination of the amount of settlement that critical infrastructure can tolerate without damage must be included.
- A schedule for required periodic critical structure inspections, including the agencies that conduct these inspections.
- A schedule for required periodic subsidence GPS monument monitoring by DWR and/or others, including a permanent source of funding.
- How will the InSAR measurements be used to assess subbasin-wide and pocket areas of subsidence and in the determination of an undesirable result?
- A schedule for required collection and analysis of InSAR measurements.
- Identification of a constant source(s) of funding for periodic collection and analysis of subsidence data that includes a commitment by the GSA to provide the needed funds regardless of the contributions from outside sources.

Conclusion

By its own admission, the Butte GSP is bent on pursuing long-held plans by some local water districts, DWR, and the U.S. Bureau of Reclamation to expand conjunctive use through groundwater manipulation, artificial recharge, and potential dam reoperation that will harm the people and environment of the GSA and surrounding region. The draft Plan will not lead to sustainability as required by SGMA, but will allow major groundwater fluctuations, significant well losses, and cost burdens on harmed groundwater dependent farms, homes, and businesses. This was predicted in 2016: "This potential conflict will become acute in the likely scenario where artificial recharge inhibits natural recharge so that it is difficult, if not impossible, to determine the relative quantity of each. Given explicit provisions in the Act and statewide policy favoring storing surface water underground it is not difficult to envision a privately-controlled GSA systematically drawing down percolated groundwater to create storage space in the basin, and then replenishing the basin with imported water, with little consideration of the ability for overlying users to access the basin or the long-term health of the surrounding ecosystem." [5]

For all the reasons discussed in our comments on the Butte Subbasin draft and here on the final GSP, the Plan fails to meet SGMA's goal of water resource sustainability and protection of the water rights of all beneficial users and uses. In accordance with legal requirements to protect the Public Trust, the Plan also fails. It also appears that the GSP will foist the responsibility to demonstrate damage from undesirable results on the unsuspecting public, creating an impossible burden for all but the large water districts with deep pockets. Therefore, the Plan must be rejected by DWR and the SWRCB.

Respectfully submitted,

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[5] Keats, Adam et al., 2016. *Not All Water Stored Underground is Groundwater: Aquifer Privatization and California's 2014 Groundwater Sustainable Management Act*. Footnote: *2014 Act, § 10720.1(g) (It is the intent of the Legislature "[t]o increase groundwater storage and remove impediments to recharge.").* pp. 98-99.

Exhibit 1

Modified Table of Butte Final GSP Groundwater Level and Water Quality Monitoring Wells

	A	B	C	D	E	F	G	H	I	J
Well ID	State Well Number	CASGEM Number	Screened Interval[1] (ft bgs)	Monitored Zone	Measureable Objective Depth (ft bgs)	Minimum Threshold Depth (ft bgs)	MO - MT Difference (feet)	MT Calculation Method	MO - MT Difference Shallow Zone < 200 (ft bgs)	MO - MT Difference ICSW (feet)
B-1	17N01E06D001M	25513	110-500*	Intermediate	6	35	29	-20 feet	--	--
B-2	17N01E10A001M	16951	66-110	Very Shallow	17	42	25	-20 feet	25	--
B-3	17N01E17F001M	33031	130-150	Shallow	7	34	27	-20 feet	27	--
B-4	17N01E24A003M	24326	700-790	Very Deep	700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
					3	30	27	100% Historic	--	--
B-5	17N01E24A006M	24328	45-55	Very Shallow	6	29	23	-20 feet	23	--
B-6	17N01W10A001M	25258	770 to 800*	Very Deep	700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
B-7	17N01W10A004M	24660	88-98	Very Shallow	5	38	33	-20 feet	33	--
B-8	17N01W27A003M	24981	160-170	Shallow	14	43	29	-20 feet	29	--
B-9	17N02E14A001M	33033	70-102	Very Shallow	15	56	41	Shallowest 7%	41	--
B-10	17N02E14H001M	16956	60-102	Very Shallow	23	53	30	-10 feet	30	--
B-11	17N03E08K002M	33037	0-0	Very Shallow	13	38	25	-20 feet	25	--
B-12	18N01E13A002M	34015	80-317	Intermediate	12	65	53	100% Historic	--	--
B-13	18N01E15D002M	16376	56-112	Very Shallow	7	79	72	100% Historic	72	--
B-14	18N01E35L001M	25777	816-836	Very Deep	700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
					1	36	35	100% Historic	--	--
B-15	18N01W02E003M	25507	110-120	Shallow	19	60	41	100% Historic	41	--
B-16	18N01W14B001M	16377	59-173*	Shallow	26	73	47	100% Historic	47	--
				ICSW	26	48	22	-10 feet	--	22
B-17	18N01W17G001M	40068	48-108	Very Shallow	21	52	31	100% Historic	31	--
				ICSW	21	37	16	-10 feet	--	16
B-18	18N01W22L001M	16378	76-124*	Shallow	17	57	40	100% Historic	40	--
B-19	18N02E16F001M	16382	20-60	Very Shallow	13	39	26	-10 feet	26	--
				ICSW	13	39	26		--	26
B-20	18N02E25M001M	16383	61-220	Shallow	18	58	40	100% Historic	40	--
B-21	18N03E08B003M	32764	156-463	Intermediate	29	59	30	-10 feet	--	--
B-22	18N03E18F001M	16916	100-220*	Shallow	14	44	30	100% Historic	30	--
B-23	18N03E21G001M	16917	0-0	Very Shallow	31	50	19	-10 feet	19	--
				ICSW	31	50	19		--	19
B-24	19N01E09Q001M	19780	140-200	Shallow	11	45	34	100% Historic	34	--
B-25	19N01E27Q001M	19782	260-280	Intermediate	9	54	45	100% Historic	--	--
B-26	19N01E35B001M	23978	85-135*	Shallow	4	35	31	-20 feet	31	--
				ICSW	4	25	21	-10 feet	--	21
B-27	19N01E35B002M	25778	930-950	Very Deep	700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
					-1	30	31	100% Historic	--	--
B-28	19N01W15D002M	50096	250-295*	Intermediate	25	54	29	-20 feet	--	--
B-29	19N01W22D007M	24498	80-90	Very Shallow	20	54	34	100% Historic	34	--
				ICSW	20	40	20	-10 feet		20
B-30	19N01W27R001M	19786	68-108	Very Shallow	33	86	53	100% Historic	53	--
				ICSW	33	55	22	-10 feet	--	22
B-31	1901W28 Red 27	58373	120-140	Shallow	700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
B-32	19N02E07K004M	24324	140-150	Shallow	5	35	30	-20 feet	30	--
B-33	19N02E13Q001M	23979	130-210*	Shallow	5	32	27	-20 feet	27	--
B-34	19N02E13Q003M	24321	670-680	Very Deep	700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
					5	27	22	100% Historic	--	--
B-35	19N03E05N002M	34319	27-48[2]	Very Shallow	37	98	61	100% Historic	61	--
B-36	20N01E18L003M	23981	100-110	Very Shallow	5	28	23	-20 feet	23	--
B-37	20N01E35C001M	16135	49.5-92	Very Shallow	6	34	28	-20 feet	28	--
				ICSW	6	24	18	-10 feet	--	18
B-38	20N01W11N002M	24713	84-170	Shallow	22	54	32	100% Historic	32	--
B-39	20N02E15H001M	16151	170-180	Shallow	44	103	59	100% Historic?	59	--
B-40	20N02E16P001M	16285	0-0	Intermediate	30	116	86	100% Historic	--	--
B-41	20N02E28N001M	35611	160-277	Intermediate	12	49	37	100% Historic	--	--
B-42	21N01E08K002M	19253	19.2-181.2	Very Shallow	49	109	60	100% Historic	60	--
B-43	21N01W11A002M	24975	125-185*	Shallow	15	38	23	-20 feet	23	--
B-44	21N01W13J003M	48992	355-385	Intermediate	25	70	45	100% Historic	--	--
B-45	21N01W23J001M	19739	0-0	Very Shallow	23	67	44	100% Historic	44	--
B-46	21N01W35K002M	21221	75-135	Shallow	18	41	23	-20 feet	23	--
B-47	22N01E32E004M	19363	85-160	Shallow	39	73	34	Shallowest 7%	34	--
B-48	17N01W10A001M	25258	770-800*	Very Deep	10	60	50	100% Historic	--	--
B-49	18N01W02E001M	25506	719-729	Very Deep	11	59	48	100% Historic	--	--
B-50	19N01W22D004M	24496	780-790	Very Deep	12	47	35	100% Historic	--	--
B-51	20N01E18L001M	16131	767-894*	Very Deep	11	62	51	100% Historic	--	--
					700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
B-52	21N01W11A001M	24974	810-1280*	Very Deep	22	55	33	100% Historic	--	--
B-53	21N01W13J001M	48990	780-820	Very Deep	26	62	36	100% Historic	--	--
					700 µs/cm	900 µs/cm	200 µs/cm	--	--	--
B-54	17N03E05C003M	16962	Unknown	ICSW	28	59	31	-10 feet	--	31
B-55	17N03E16N001M	33038	48-478	ICSW	22	50	28	-10 feet	--	28
B-56	18N01E05D002M	52595	120-240	ICSW	8	26	18	-10 feet	--	18
B-57	20N02E15H002M	33574	55-65	ICSW	23	44	21	-10 feet	--	21
		Number and Percent of Zone Monitoring GW Level	ICSW	12, 22%	Average MO-MT Difference, feet					
			Very Shallow	17, 31%	All Primary Wells		37.3		ICSW Wells	21.9
			Shallow	16, 30%	All Very Deep Wells		36.8	Well < 200 ft	35.6	
			Intermediate	8, 15%						
			Very Deep	10, 19%						

CASGEM ID = California Statewide Groundwater Elevation Monitoring Identification Code

ft = feet   bgs = below ground surface

1 - * Indicates multiple screened intervals, see Table 4-1 and 4-2 for details on intervals

2 - CASGEM states that well is open hole from 48 to 180 ft

Exhibit 2

Butte Final GSP Table 2-8 Modified - Water Budget Summary: Groundwater System.

Table 2-8 Historical versus 2070 Future

	A	B	C	D	E	F	G	H
	Component	Historical 2000-2018 (AFY)	Current 1971 - 2018 + 2004-05 (AFY)	Future, No Climate Change (AFY)	Future, 2030 Climate Change (AFY)	Future, 2070 Climate Change (AFY)	Historical vs 2070 Climate Change (AFY)	Historical vs 2070 Climate Change (%)
	Inflows							
1	**Subsurface Inflows**	**103,100**	110,700	105,400	105,700	**104,200**	**1,100**	**1.07%**
2	*Colusa Subbasin*	*17,100*	*15,500*	*15,500*	*16,400*	*17,300*	200	1.17%
3	*Sutter Subbasin*	*6,600*	*5,300*	*5,300*	*5,400*	*5,500*	-1,100	-16.67%
4	*Vina Subbasin*	*65,400*	*75,100*	*70,800*	*69,500*	*66,600*	1,200	1.83%
5	*Wyandotte Creek Subbasin*	*14,000*	*14,800*	*13,700*	*14,400*	*14,900*	900	6.43%
6	**Deep Percolation**	**265,800**	268,000	268,000	269,700	**269,600**	**3,800**	**1.43%**
7	*Precipitation*	*83,900*	*89,500*	*89,300*	*89,200*	*89,000*	5,100	6.08%
8	*Applied Surface Water*	*146,400*	*139,500*	*139,400*	*132,100*	*132,100*	-14,300	-9.77%
9	*Applied Groundwater*	*35,500*	*39,100*	*39,300*	*48,400*	*48,400*	12,900	36.34%
10	**Seepage**	**277,200**	355,400	356,300	361,000	**363,200**	**86,000**	**31.02%**
11	*Streams*	***177,900***	*260,500*	*261,400*	*268,900*	***272,000***	**94,100**	52.89%
12	*Lakes*	*26,400*	*26,400*	*26,400*	*26,400*	*26,400*	0	0.00%
13	*Canals and Drains*	*72,900*	*68,500*	*68,500*	*65,700*	*64,800*	-8,100	-11.11%
14	***Total Inflow***	***646,100***	*734,100*	*729,700*	*736,400*	***737,000***	**90,900**	**14.07%**
15	*Outflows*							
16	**Subsurface Outflows**	**112,800**	113,300	113,000	111,200	**112,200**	**-600**	**-0.53%**
17	*Colusa Subbasin*	*34,800*	*31,900*	*31,900*	*31,300*	*30,800*	-4,000	-11.49%
18	*Sutter Subbasin*	*34,200*	*42,200*	*42,200*	*41,300*	*41,800*	7,600	22.22%
19	*Vina Subbasin*	*28,600*	*25,900*	*25,500*	*25,800*	*26,600*	-2,000	-6.99%
20	*Wyandotte Creek Subbasin*	*15,200*	*13,300*	*13,300*	*12,900*	*13,000*	-2,200	-14.47%
21	**Groundwater Pumping**	**142,200**	162,800	162,600	189,400	**210,500**	**68,300**	**48.03%**
22	*Agricultural*	*114,800*	*130,300*	*129,900*	*152,200*	*170,700*	55,900	48.69%
23	*Urban and Industrial*	*2,300*	*1,800*	*2,000*	*2,000*	*2,000*	-300	-13.04%
24	*Managed Wetlands*	*25,100*	*30,700*	*30,700*	*35,200*	*37,800*	12,700	50.60%
25	**Stream Gains from Groundwater**	**218,500**	154,800	152,700	137,200	**123,500**	**-95,000**	**-43.48%**
26	**Western Boundary Net Outflows**	**182,400**	304,400	302,700	300,100	**292,800**	**110,400**	**60.53%**
27	***Total Outflow***	***655,900***	*735,300*	*731,000*	*737,900*	***739,000***	83,100	12.67%
28	***Change in Storage (Inflow - Outflow)***	***-9,800***	*-1,200*	*-1,300*	*-1,500*	***-2,000***	**7,800**	**-79.59%**
29	***Net Stream Flow Gains (Accretion - Seepage)***	***40,600***	*-105,700*	*-108,700*	*-131,700*	***-148,500***	***-189,100***	**-465.76%**
30	***Net Stream Flow Gains / GW Pumping***	***28.6%***	*-64.9%*	*-66.9%*	*-69.5%*	***-70.5%***	***-276.9%***	

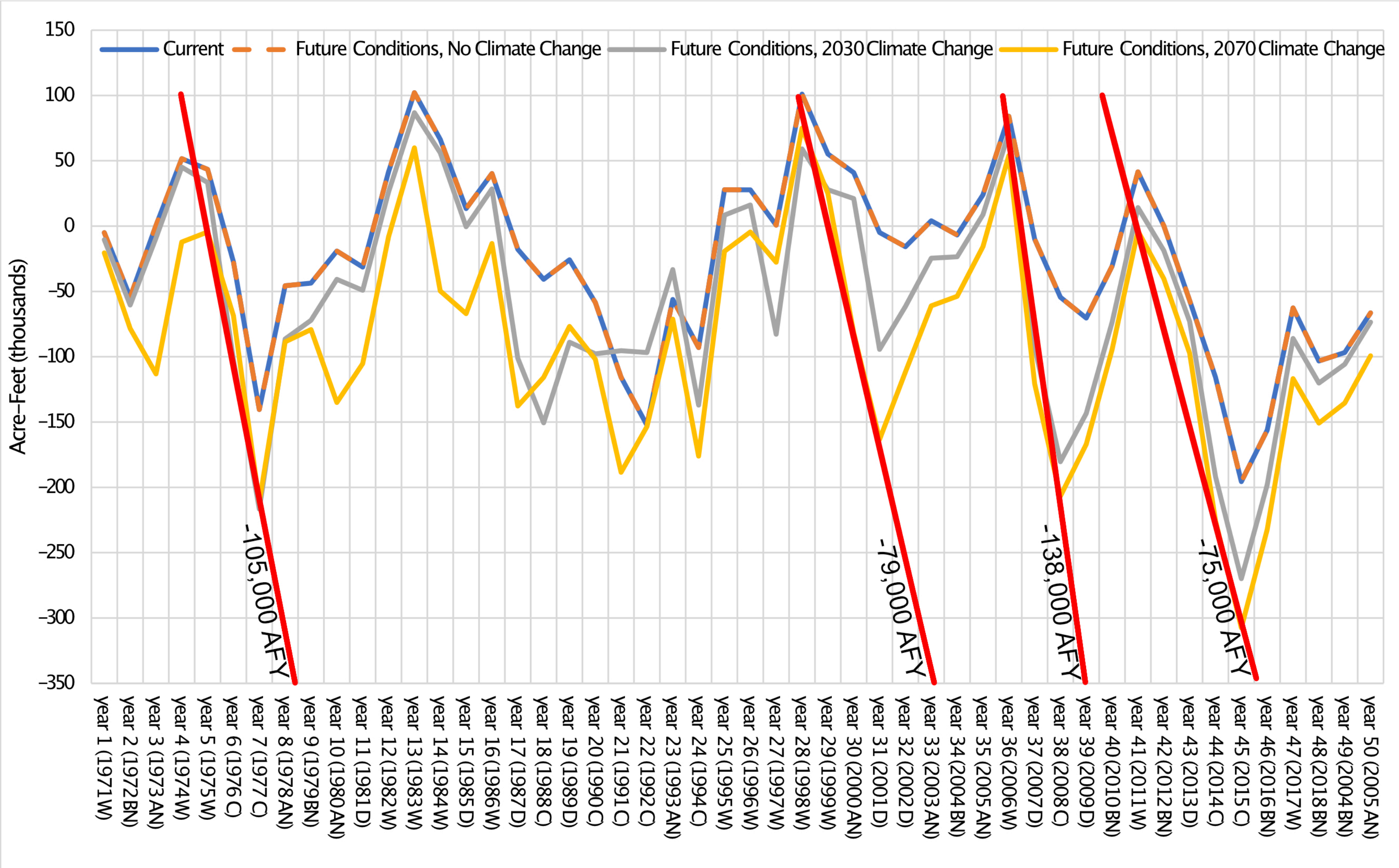
Exhibit 3

Butte Final GSP Table 2-7 Modified - Water Budget Summary: Land and Surface Water System.

Table 2-7 Historical versus 2070 Future

	A	B	C	D	E	F	G	H
	Component	**Historical 2000-2018 (AFY)**	**Current 1971 - 2018 + 2004-05 (AFY)**	**Future, No Climate Change (AFY)**	**Future, 2030 Climate Change (AFY)**	**Future, 2070 Climate Change (AFY)**	**Historical - 2070 Climate Change (AFY)**	**Historical - 2070 Climate Change (%)**
	Inflows							
1	**Surface Water Inflows**	**1,926,800**	1,926,500	1,931,200	1,913,900	**1,922,200**	**-4,600**	**-0.24%**
2	*Outside Diversions*	*823,300*	*740,000*	*740,000*	*711,300*	*703,400*	-119,900	-14.56%
3	*Sacramento River Diversions*	*113,500*	*97,500*	*97,500*	*96,600*	*96,300*	-17,200	-15.15%
4	*Little Chico Creek*	*25,600*	*29,500*	*29,600*	*31,200*	*32,500*	6,900	26.95%
5	*Butte Creek*	*247,900*	*269,800*	*269,800*	*289,400*	*301,300*	53,400	21.54%
6	*Little Dry Creek*	*8,100*	*10,700*	*10,700*	*11,500*	*12,300*	4,200	51.85%
7	*Dry Creek*	*24,700*	*25,800*	*25,800*	*27,500*	*29,300*	4,600	18.62%
8	*Precipitation Runoff from Upslope Lands*	*60,500*	*61,700*	*64,100*	*69,000*	*75,200*	14,700	24.30%
9	*Applied Water Return Flows from Upslope*	*21,600*	*17,400*	*18,300*	*17,600*	*17,400*	-4,200	-19.44%
10	*Other Inflows from Boundary Streams*	*574,100*	*646,300*	*647,600*	*634,200*	*629,700*	55,600	9.68%
11	**Precipitation**	**501,000**	525,900	525,900	546,900	**561,300**	**60,300**	**12.04%**
12	**Groundwater Pumping**	**142,200**	162,800	162,600	189,400	**210,500**	**68,300**	**48.03%**
13	*Agricultural*	*114,800*	*130,300*	*129,900*	*152,200*	*170,700*	55,900	48.69%
14	*Managed Wetlands*	*25,100*	*30,700*	*30,700*	*35,200*	*37,800*	12,700	50.60%
15	**Stream Gains from Groundwater**	**218,500**	154,800	152,700	137,200	**123,500**	**-95,000**	**-43.48%**
16	***Total Inflow***	***2,788,600***	*2,770,000*	*2,772,400*	*2,787,400*	***2,817,500***	**28,900**	**1.04%**
	Outflows							
17	**Evapotranspiration**	**816,100**	822,700	822,100	836,500	**862,800**	**46,700**	**5.72%**
18	*Agricultural*	*606,200*	*627,000*	*626,200*	*640,300*	*665,800*	59,600	9.83%
19	*Urban and Industrial*	*8,300*	*7,400*	*7,800*	*8,000*	*8,200*	-100	-1.20%
20	*Managed Wetlands*	*87,600*	*78,000*	*78,000*	*80,700*	*82,100*	-5,500	-6.28%
21	*Native Vegetation*	*34,000*	*35,400*	*35,300*	*36,300*	*36,600*	2,600	7.65%
22	*Canal Evaporation*	*79,900*	*74,800*	*74,800*	*71,200*	*70,200*	-9,700	-12.14%
23	**Deep Percolation**	**265,800**	268,000	268,000	269,700	**269,600**	**3,800**	**1.43%**
24	*Precipitation*	*83,900*	*89,500*	*89,300*	*89,200*	*89,000*	5,100	6.08%
25	*Applied Surface Water*	*146,400*	*139,500*	*139,400*	*132,100*	*132,100*	-14,300	-9.77%
26	*Applied Groundwater*	*35,500*	*39,100*	*39,300*	*48,400*	*48,400*	12,900	36.34%
27	**Seepage**	**277,200**	355,400	356,300	361,000	**363,200**	**86,000**	**31.02%**
28	*Streams*	*177,900*	*260,500*	*261,400*	*268,900*	*272,000*	94,100	52.89%
29	*Lakes*	*26,400*	*26,400*	*26,400*	*26,400*	*26,400*	0	0.00%
30	*Canals and Drains*	*72,900*	*68,500*	*68,500*	*65,700*	*64,800*	-8,100	-11.11%
31	**Surface Water Outflows**	**1,429,400**	1,324,100	1,326,200	1,320,400	**1,322,300**	**-107,100**	**-7.49%**
32	*Precipitation Runoff*	*33,300*	*37,000*	*37,100*	*39,700*	*42,000*	8,700	26.13%
33	*Applied Surface Water Return Flows*	*47,900*	*65,800*	*65,700*	*56,200*	*51,400*	3,500	7.31%
34	*Applied Groundwater Return Flows*	*8,200*	*12,700*	*12,700*	*12,500*	*13,200*	5,000	60.98%
35	*Streams*	*1,309,600*	*1,178,400*	*1,180,500*	*1,181,800*	*1,185,600*	-124,000	-9.47%
36	*Butte Creek Diversions to Sutter Subbasin*	*30,500*	*30,100*	*30,100*	*30,100*	*30,100*	-400	-1.31%
37	***Total Outflow***	***2,788,500***	*2,770,200*	*2,772,600*	*2,787,600*	***2,817,800***	**29,300**	**1.05%**
38	***Change in Storage (Inflow - Outflow)***	***100***	*-200*	*-200*	*-200*	***-300***	**-400**	**-400.00%**
39	***Net Stream Flow Gains (Accretion - Seepage)***	***40,600***	*-105,700*	*-108,700*	*-131,700*	***-148,500***	***-189,100***	**-465.76%**
40	***Net Stream Flow Gains / GW Pumping***	**28.6%**	**-64.9%**	**-66.9%**	**-69.5%**	**-70.5%**	**-276.9%**	

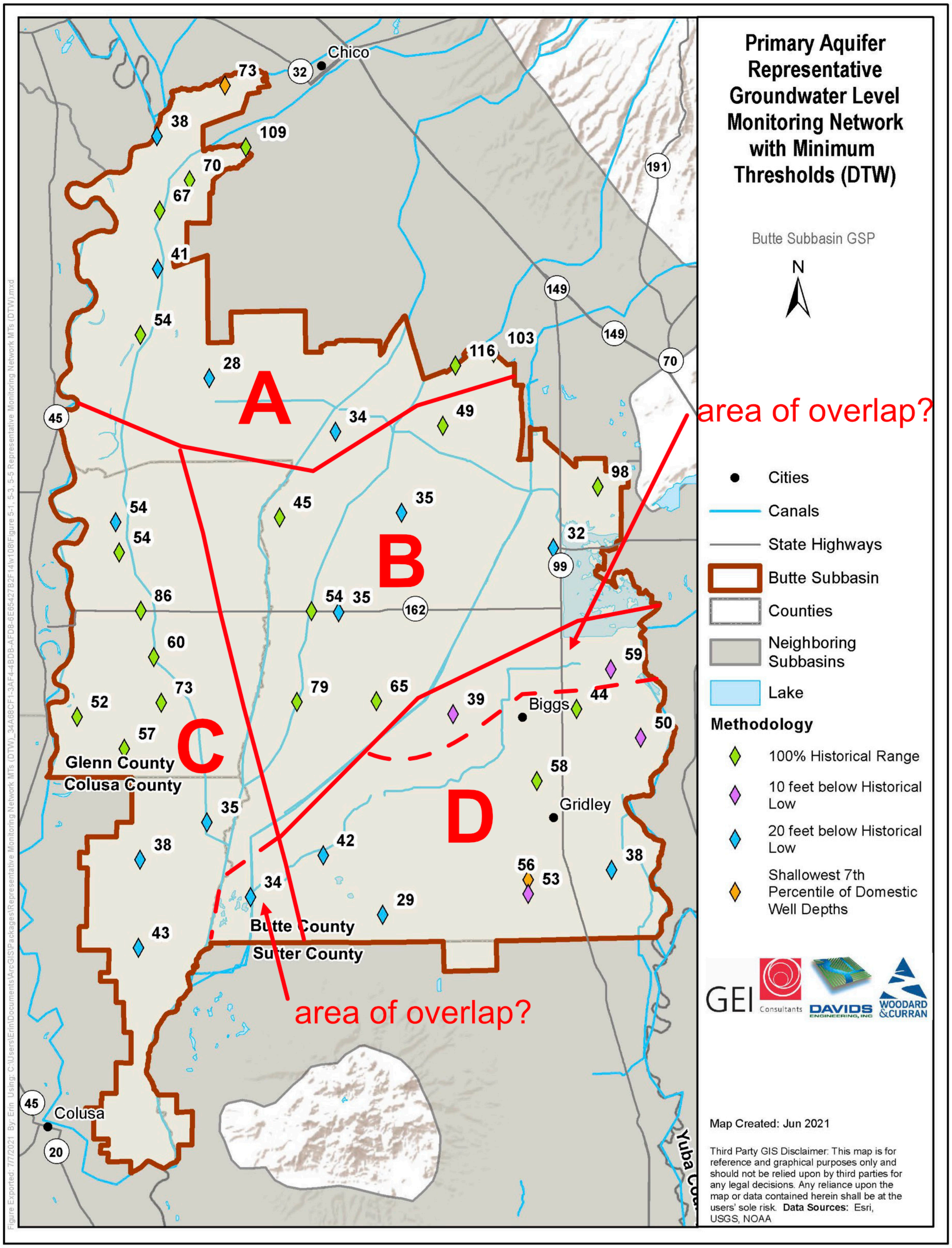
Exhibit 4



Modified **Figure 2-44.Cumulative Change in Groundwater Storage for Current and Future Conditions Baseline Scenarios.**

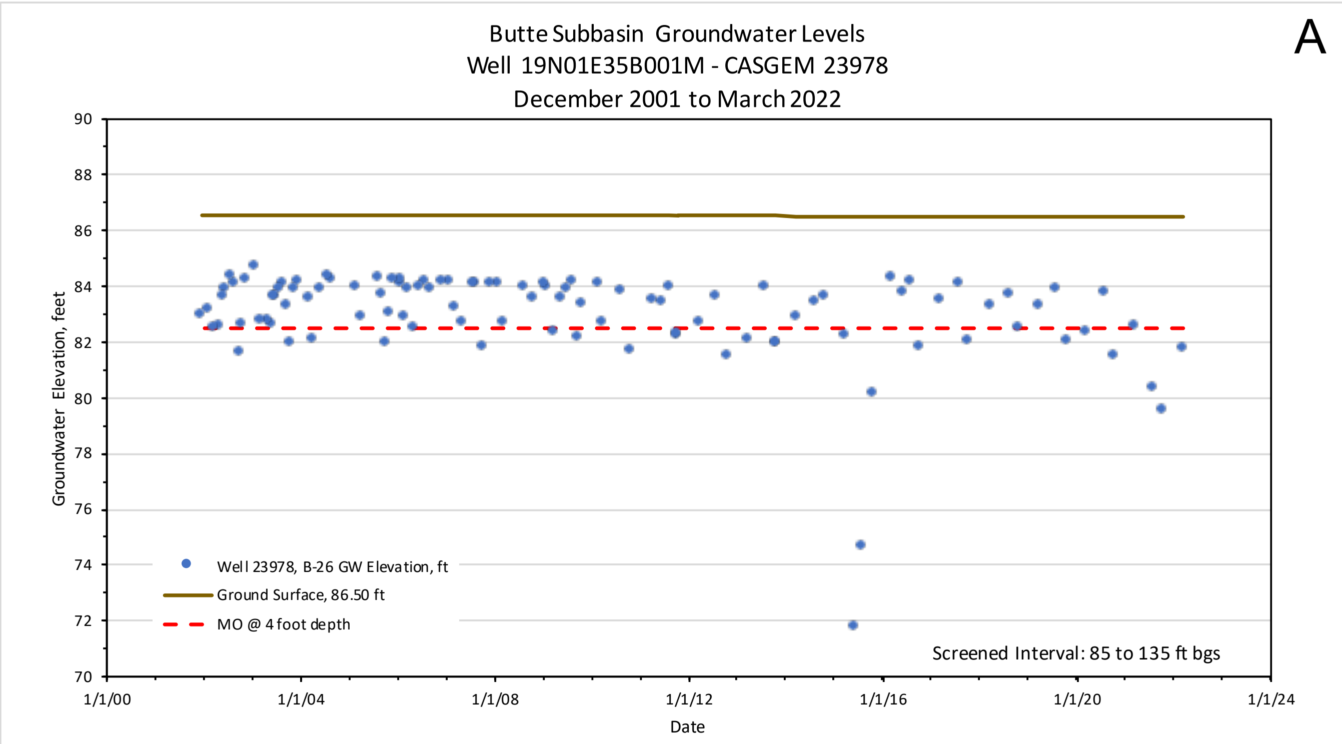
Lines show range of slopes of annual average groundwater change in storage during future 2070 Climate Change scenario droughts.

Exhibit 5



Modified *Figure 4-1: Primary Aquifer Representative Groundwater Level Monitoring Network with MTs (DTW)*
with boundaries of hypothetical groups of 25% drawn.

Exhibit 6


A
Butte Subbasin Groundwater Levels
Well 19N01E35B001M - CASGEM 23978
December 2001 to March 2022
Groundwater Elevation, feet
90
88
86
84
82
80
78
76
74
72
70
Well 23978, B-26 GW Elevation, ft
Ground Surface, 86.50 ft
MO @ 4 foot depth
Screened Interval: 85 to 135 ft bgs
1/1/00
1/1/04
1/1/08
1/1/12
1/1/16
1/1/20
1/1/24
Date

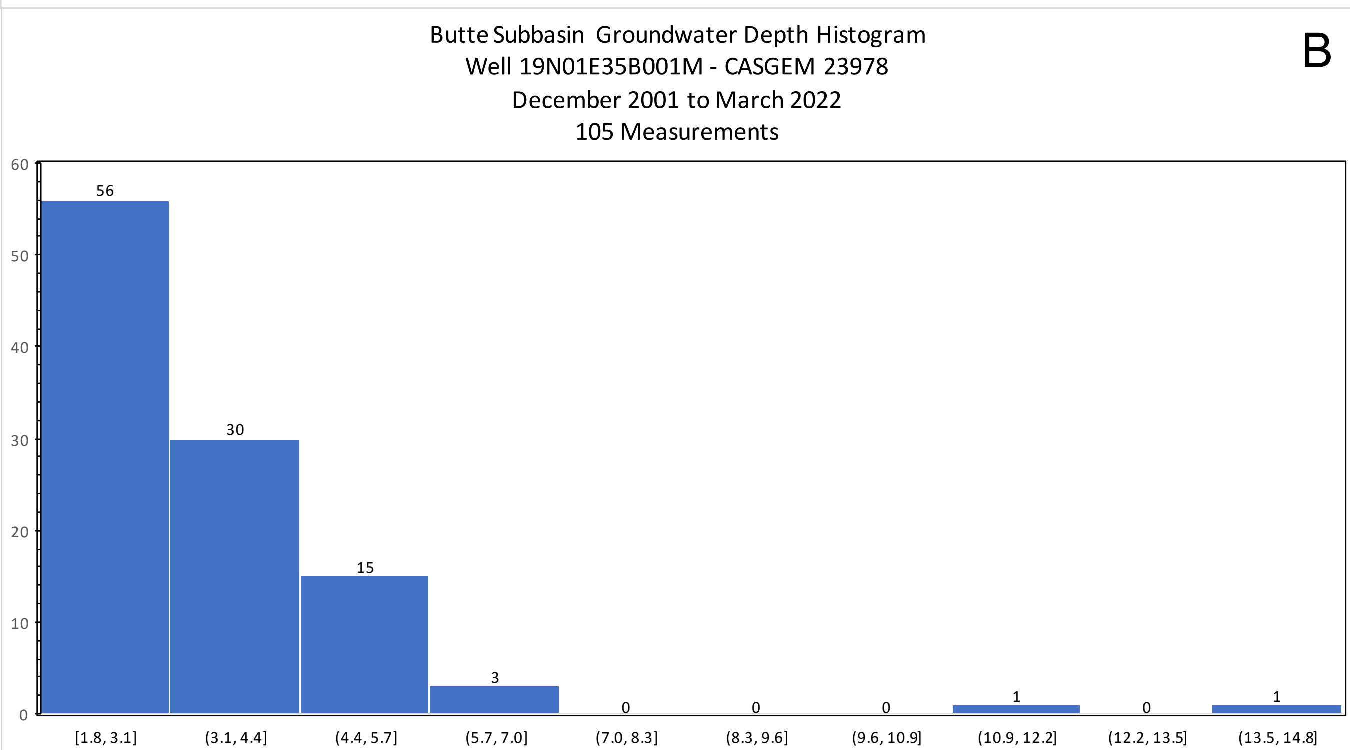
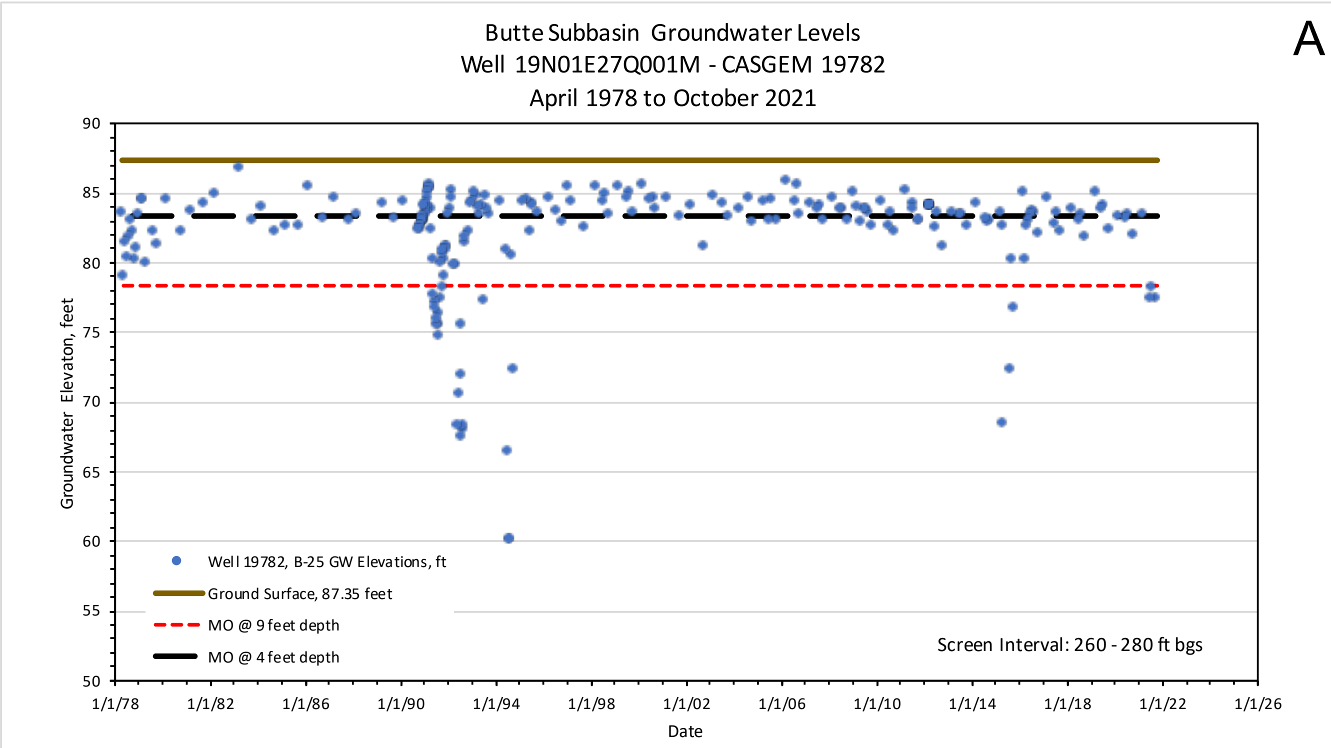

B
Butte Subbasin Groundwater Depth Histogram
Well 19N01E35B001M - CASGEM 23978
December 2001 to March 2022
105 Measurements
60
50
40
30
20
10
0
56
30
15
3
0
0
0
1
0
1
[1.8, 3.1]
(3.1, 4.4]
(4.4, 5.7]
(5.7, 7.0]
(7.0, 8.3]
(8.3, 9.6]
(9.6, 10.9]
(10.9, 12.2]
(12.2, 13.5]
(13.5, 14.8]

Exhibit 7


A
Butte Subbasin Groundwater Levels
Well 19N01E27Q001M - CASGEM 19782
April 1978 to October 2021
Groundwater Elevaton, feet
90
85
80
75
70
65
60
55
50
Well 19782, B-25 GW Elevations, ft
Ground Surface, 87.35 feet
MO @ 9 feet depth
MO @ 4 feet depth
Screen Interval: 260 - 280 ft bgs
1/1/78
1/1/82
1/1/86
1/1/90
1/1/94
1/1/98
1/1/02
1/1/06
1/1/10
1/1/14
1/1/18
1/1/22
1/1/26
Date

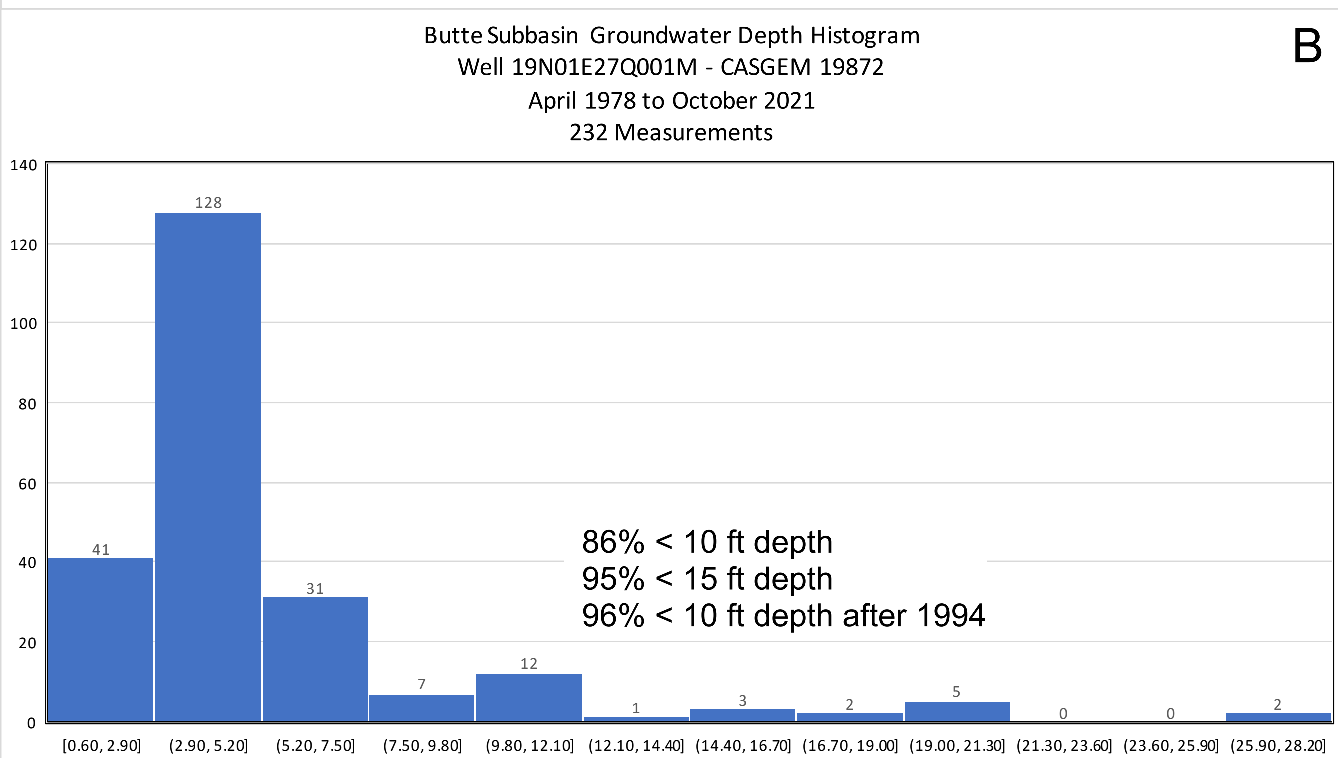
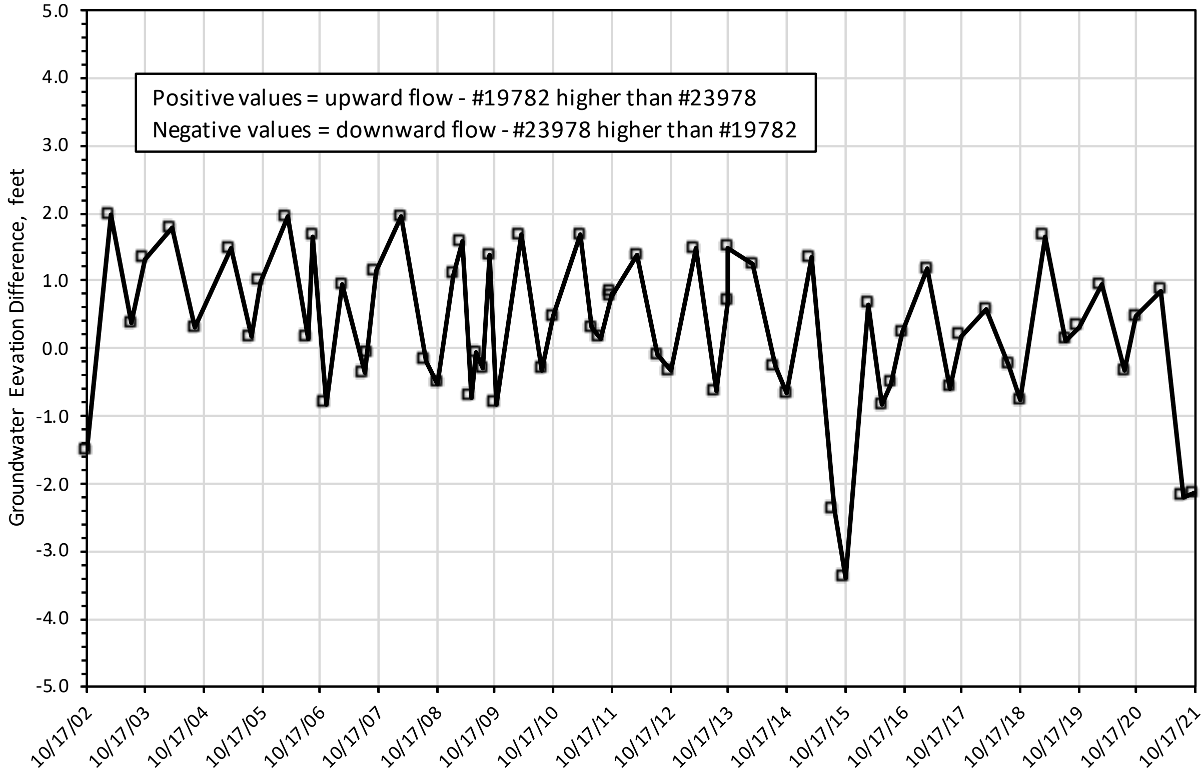

B
Butte Subbasin Groundwater Depth Histogram
Well 19N01E27Q001M - CASGEM 19872
April 1978 to October 2021
232 Measurements
140
120
100
80
60
40
20
0
41
128
31
7
12
1
3
2
5
0
0
2
[0.60, 2.90]
(2.90, 5.20]
(5.20, 7.50]
(7.50, 9.80]
(9.80, 12.10]
(12.10, 14.40]
(14.40, 16.70]
(16.70, 19.00]
(19.00, 21.30]
(21.30, 23.60]
(23.60, 25.90]
(25.90, 28.20]
86% < 10 ft depth
95% < 15 ft depth
96% < 10 ft depth after 1994

Exhibit 8

Butte GSP Primary Aquifer Monitoring Wells
CASGEM Wells Nos. 19782 and 23978
Historical Groundwater Elevation Difference



Butte GSP Primary Aquifer Monitoring Wells
CASGEM Wells Nos. 19782 and 23978
Historical Groundwater Vertical Gradient

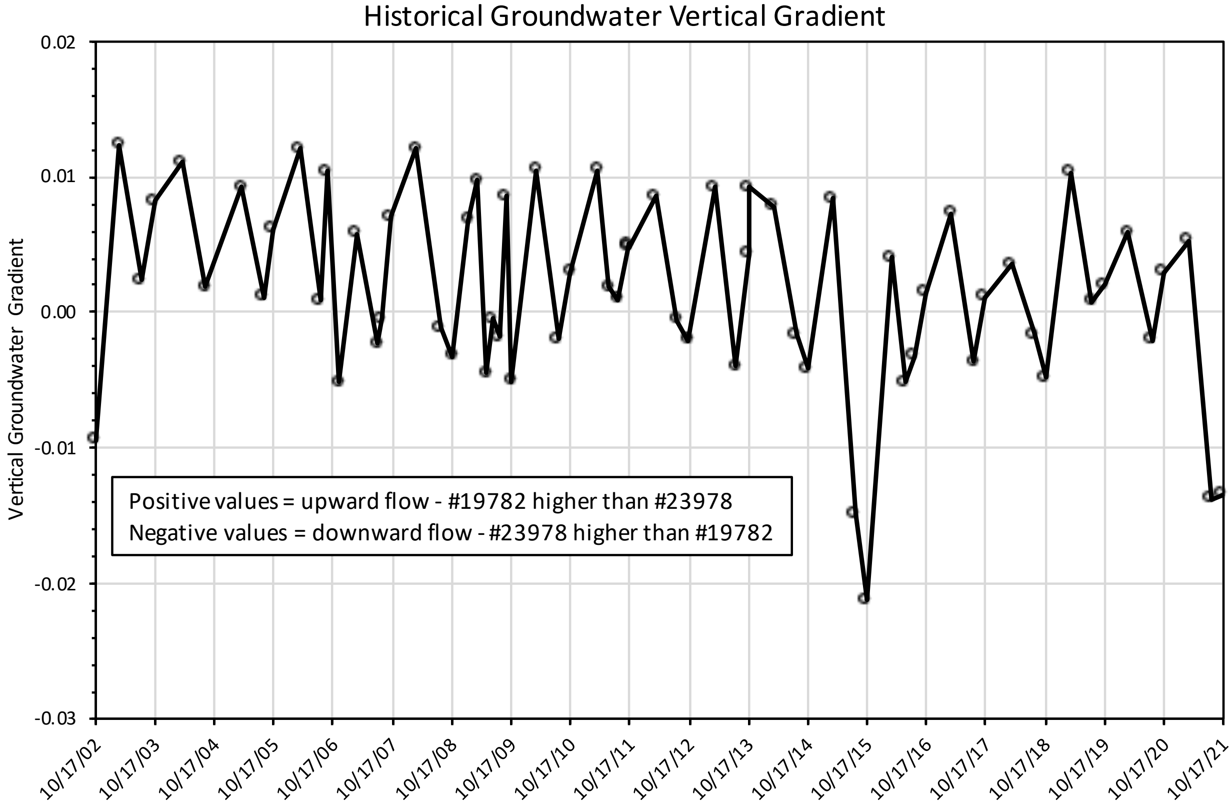
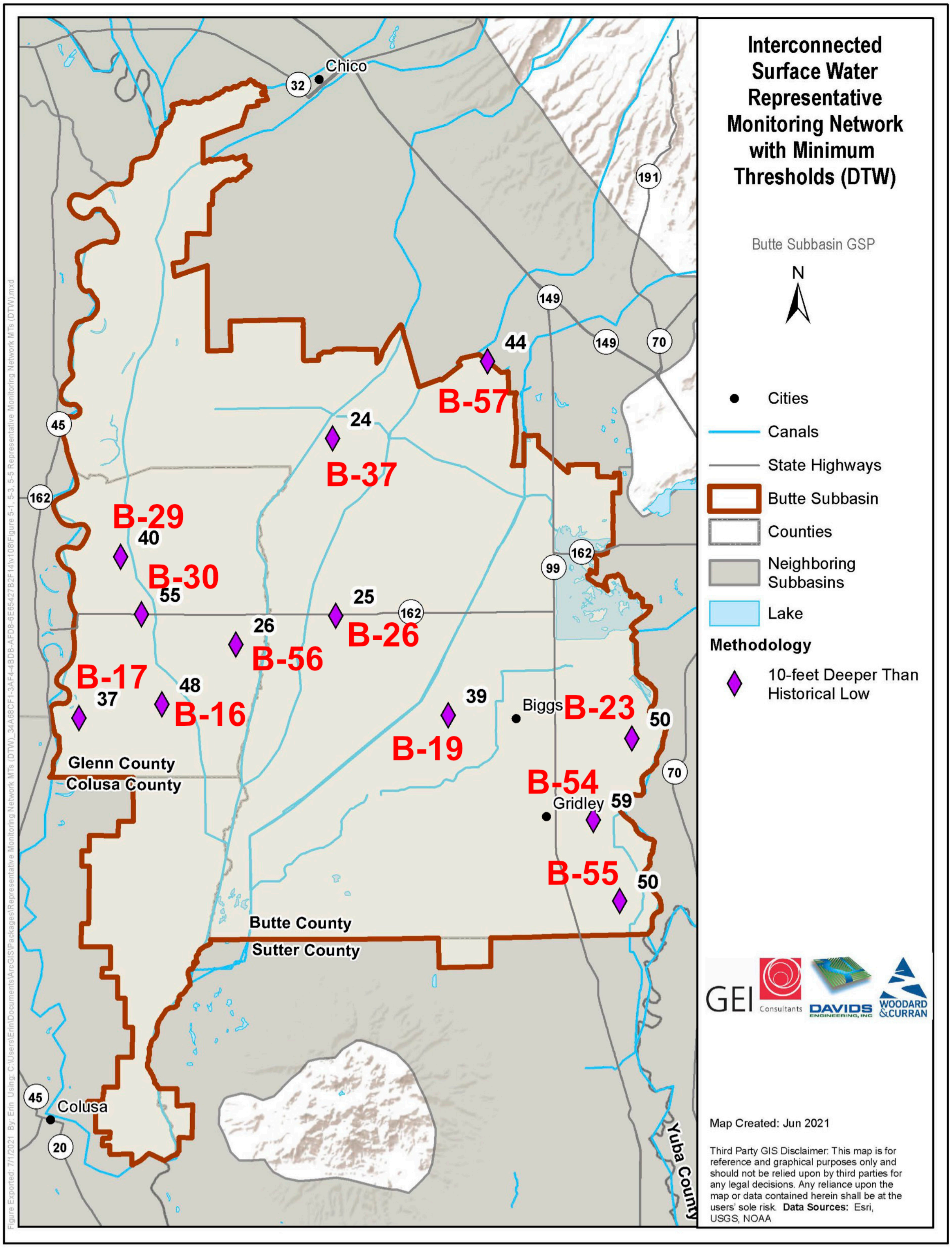


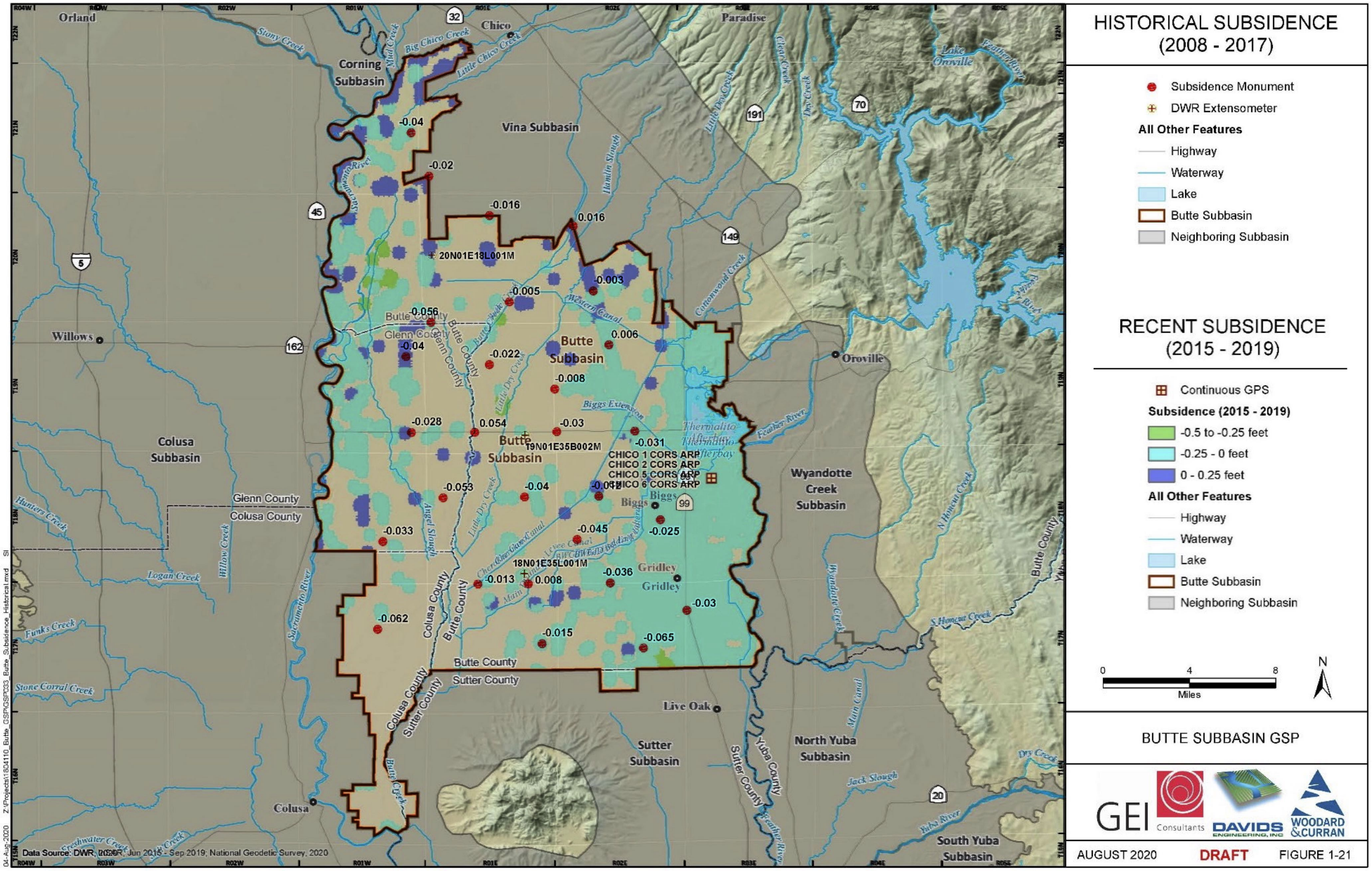
Exhibit 9



Modified *Figure 4-5: Interconnected Surface Water Representative Monitoring Network with MTs (DTW)*

B-26 ICSW Well ID from AquAlliance Exhibit 1

Exhibit 10



Modified Figure 2-26. Historical Subsidence in the Butte Subbasin (2008 – 2017)
with Figure 2-27. Recent Subsidence in the Butte Subbasin (2015-2019)