Slough. Finally, a bedrock block in the southwest portion of the management area beneath Chalfant Valley and Laws is present at relatively shallow depth and probably acts as a barrier to regional north-south groundwater flow (Hollett, 1991). The geologic structures of porous alluvium under tuff, north-south trending faults, and shallow bedrock act in concert to direct regional groundwater flow from Tri-Valley to Fish Slough.

Studies of groundwater geochemistry also indicate a Tri-Valley connection to Fish Slough. Zdon et al. (2019) concluded that water discharged in Fish slough is a mixture sourced from the northeast (Tri-Valley), north (Benton Hot Springs and Adobe Valley) and northwest (Volcanic Tablelands) based on geochemical data. Adobe Valley is a less likely source area because of intervening bedrock between the valley and Fish Slough, but a connection cannot be ruled out. The authors note that the Fish Slough Northeast Spring shows the strongest geochemical signature for Tri-Valley area waters, whereas the other springs were more of a mixture of all sources. The source areas identified are consistent with those expected from hydrogeologic conditions present in the basin.

Finally, groundwater level data also support the Tri-Valley connection to Fish Slough. Groundwater information is sparse for Adobe Valley to the north but the available data indicate long-term water level declines on the order of 0 - 0.3 ft/yr (SGMA data viewer). These rates are lower than the 0.5 - 1.9 ft/yr declines observed in the Tri-Valley area and indicate that water level declines in Tri-Valley are a more significant contributor to the water level declines observed in Fish Slough. The differences in rates of decline between Fish Slough and Tri-Valley can be explained by 1) change in aquifer conditions and 2) distance from pumping centers. The Tri-Valley aquifer system is primarily unconfined and driven by elevation gradients, whereas the Fish Slough Aquifer system is primarily confined and driven by pressure gradients. Since drawdown is a function of time and distance from pumping, the fact that Fish Slough is located further from the pumping centered in Tri-Valley means that drawdown is expected to be lower for the same time period compared to wells located within Tri-Valley.

Explanation contained in this response was added to the GSP Section 2.2.1.6, Hydrologeologic Framework for clarification.

Additional Reference:

Stevens, C. H., Stone, P., & Blakely, R. J. (2013). Structural Evolution of the East Sierra Valley System (Owens Valley and Vicinity), California: A Geologic and Geophysical Synthesis. *Geosciences*, *3*(2), 176-15.

Dr. Holly Alpert

OVGA Public Review Draft Comments

Note: Dr. Alpert submitted comments inserted into the pdf of the Public Review Draft GSP. For brevity, the entire draft GSP is not reproduced here. Comments were extracted from the submitted pdf.

Many of the comments included typographical or grammatical corrections.

Response: See General Comment #1.

ES1: An overall comment is that it's sometimes unclear where the non-adjudicated portion of the basin is being discussed vs. the entire basin. I might suggest qualifying all mentions of the non-adjudicated portion as GSP, just so it's very clear.

Response: see General Comment # 2: The GSP only applies to a portion of the Basin but the hydrogeological conceptual model and water balance included the entire basin. Clarifying text was added at several locations in the Final GSP.

ES 1.3: RE estimated cost of $436,665. Seems awfully low, even after seeing the breakdown.

Response: This is the best estimate based on staff/contractor hours and current rates to complete the Management Actions and administrative tasks included in the plan and the estimated cost of groundwater model development (approximately $310,775).

ES 2.1 But will LA work with OVGA??

Response: See General Comment # 2

ES 2.2.3: This section is clearly written by a different author from the previous sections and in general is not as clear. Suggest giving a heavy edit.

Response: See General Comment #1.

Best practices would suggest using more than one climate model – an ensemble.

Response: This scenario was recommended by DWR and since it assumes no actions will be implemented to alter CO_2 emissions, it is the most conservative or approximately worst case scenario.

E S 3.4.1 The January 1, 2015 water level was chosen as Management Objective. Why this date? Seems arbitrary. Should be based on some hydrologic milestone rather than a political milestone.

Response: The clarifying text below was added to the referenced paragraph:

> *If undesirable results before 2015 are present (e.g. water levels in Tri-Valley declining since the 1980's), the GSP must set measurable objectives to maintain or improve upon conditions occurring in 2015 (DWR, 2017). The GSP may, but is not required, to address undesirable conditions that occurred before January 1, 2015 (SGMA § 10727.2(b4)).*

ES 3.4.3: Maybe it's mentioned elsewhere, but it seems like a discussion of LADWP's desire to pump from under the lakebed is warranted.

Response: This is discussed at greater length in the body of the GSP (e.g. Section 2.1.3.1.7), but LADWP has not completed their analyses to design the project and no final project description or monitoring program has been made public to fully consider in the GSP.

ES 3.4.3: This is alluded to elsewhere, but there are real water quality concerns on the east side of the lakebed, which is seen in the well that supplies Keeler.

Response: The referenced sentence was clarified in the Final GSP that water quality is primarily good on the north, south, and west sides of the lake.

> *Groundwater quality in and under the Owens Lake is generally poor due to evaporative concentration of solutes; however, water quality north, south, and west of the perimeter of the lakebed is generally good due to recharge from the Sierra Nevada.*

Philip Anaya

OVGA Public Review Draft Comments

Aaron Steinwald
Director
Owens Valley Groundwater Authority

Philip E Anaya
2348 Longview Dr
Bishop , Ca. 93514
Novemebr 8, 2021

Dear Dr. Steinwald ,

As one of many initial longtime public participants in the Owens Valley Groundwater

Authority (OVGA) please consider these comments regarding the Draft Groundwater Sustainability Plan (GSP) . Without a doubt there has been considerable efforts made, there has been considerable dollars and hours spent to arrive at the formation of the GSP but we need a more robust Plan. SGMA in the Owens Basin was envisioned to provide sustainability to the groundwater operations and infrastructure in the Basin. A large portion of the Basin has been treated "as Adjudicated" in SGMA even though it is technically not Adjudicated as many other Basins in California are. The Basin has been divided into a so called Adjudicated / Non Adjudicated areas which is at the core of difficulty of achieving sustainability in the Basin. The Adjudicated portion of the Basin is owned by the DWP and subject to the Long Term Water Agreement (LTWA) management with Inyo County. There are also other entities referred to as the MOU parties who have standing in the LTWA. The Draft GSP fails to adequately address the issues of a divided Basin. The Boundary is an immense issue for sustainability of the Basin as it is a line drawn on the map yet it is a boundary that is hydrologically linked. The Non Adjudicated portion of the Basin is and has been subjected to undesirable results and the emphasis of the GSP should be focused on operational management of the boundary. In the Draft GSP however that management is left to the failed aspects of the LTWA. In the drought years of 2013 and 2014 we have had the events and the lessons in West Bishop of the loss of more than 3 dozen domestic wells. This was due to a number of reasons . Drought, DWP Production wells on the north side of Barlow Lane, (the Boundary of a Adjudicated / Non Adjudicated portion of the Basin) the operational mismanagement of the surface flow recharge system of the Bishop Creek Water Association Ditch system (BCWA) that allowed the Ditches to go dry. This was later studied by Dr. Harrington, the past head of the Inyo County Water Department and affirmed by the State of California DWR as the source of local aquifer

(water table) that was diminished by the operations of the DWP in 2013 and then repeated in 2014 all not addressed by the LTWA. That the Draft GSP relies on the LTWA to manage the Boundary is inexplicable. Not only does the Draft GSP fail to mention these events and find a resolution of a cooperative management with an uncooperative LADWP there is nothing mentioned of a Plan in the future to seek an agreement with DWP to adequately manage sustainable Groundwater across the "Boundary". Also there is a failing to formally seek additional future projects for surface flow recharge in the Draft document. These issues are at the core of sustainability for the Owens Basin and until there is a management of the Boundary, beneficial surface flow management for recharge there is not a lot of hope for SGMA in the Owens Basin. The LADWP historically has made difficulties worse in the Basin. There is little oversight of their responsibilities. The positive steps towards sustainability made in the Basin have all been accomplished in the Courts and stymied by political considerations. The DWR was correct in its initial Medium Priority in the Basin and was correct in an initial Draft High Priority. Through some political call at the State level to reduce it back to the current Low Priority the Basin has been abandoned by DWR, The State's generous grant to fund the GSP which the OVGA decided to voluntarily go forward with, is money down the drain without sustainable management of the "Boundary". While seeking a agreement with the DWP is a formidable task non the less under the future Projects section it should be included along with projects for surface flow recharge of Non Adjudicated local aquifers.

Thank You for your consideration , Philip Anaya

Response: The hydrologic changes and management that occurred in West Bishop in 2013 were widely reported. The suggestion to include in the GSP a project to acquire and manage surface water in West Bishop in the area managed by the Bishop Creek Water Association has been offered at several meetings of the OVGA, but the Board has not directed staff to include such projects in the GSP. The feasibility of acquiring surface water rights for recharge, reservoir storage costs, and acquiring staff to manage surface water (and asking the Basin residents to fund) would be considerable obstacles. The Owens Valley and Owens Lake Management Areas are not in overdraft and all surface water recharge is used in Tri-Valley Management Area. Regarding the remainder of the comment see General Response #2.

Geri Bassett

OVGA Public Review Draft Comments

Comments on OVGA GSP Public Review Draft

Pg. 22 - ES 3.2.1 Tri-Valley Management Area, middle of second paragraph

"Based on available geologic, hydrologic, and geochemical evidence, pumping in the management area is the cause of declining water levels and spring flow in Fish Slough."

What data is this statement based on?

Response: See General Comment #6

'The magnitude of overdraft and the pumping effect on spring flow, however, are poorly quantified."

The comment is made repeatedly in this document that there is insufficient data for an accurate water model in the Tri-Valley/Fish Slough area, yet the OVGA/GSP continues to make assumptions based on the inadequate data and then management plans based on their assumptions.

Response: See General Comments #5 and #6. There is sufficient data to identify a problem exists but not enough to implement a solution.

P. 38 - ES 4.4 Project #4, second paragraph, second line

"Insufficient information exists for the OVGA (or another agency) to design a program to manage pumping to ensure the SMC for water levels in the valleys and spring flow are achieved. It is not feasible or reasonable for the residents and agricultural producers in the Tri-Valley communities to make immediate or drastic reductions in pumping without economic and social hardship or without potentially impacting air quality. "

How do these statements correlate to the proposed management action of developing a pumping program, as mentioned in section 4.5.3, page 288?

Response: The referenced management action to develop a pumping program is contingent upon and would occur after the implementation of Management Action #3 to increase the monitoring program to characterize water levels at more locations in the Tri-Valley and after Management Action #4 to develop a groundwater model for the Tri-Valley Management Area. Management Actions #3 and #4 are necessary to make informed management decisions to address the chronically declining water levels throughout the Management Area. This stepwise process is deemed a more prudent approach than implementing management immediately.

P. 50 and various places in document and appendices -

Tri-Valley Groundwater Management District is labeled as Tri-Valley Water Management District or Tri-Valley Groundwater Management. The correct name or abbreviation should be used throughout the document.

See General Comment #1. The District is abbreviated TVGMD throughout the Final GSP.

P. 74 - last paragraph

"LTWA and each agency shall make any data or information pertaining to conditions in the Basin available."

According to the OVGA at numerous meetings, LADWP is not providing requested data. If that is so, LADWP is in violation of the LTWA. Is this being pursued by ICWD?

Response: LADWP regularly provides extensive monitoring datasets to Inyo County. LADWP has not provided numerical groundwater models developed by their consultants for portions of the Basin. The ICWD continues discussions with LADWP staff regarding sharing the groundwater models.

P. 99 - table 2-5, Stakeholder Workshops - says there is a meeting scheduled on December 16, 2021.

Is that a typo?

P. 132 - last comment date is listed as 3/11/12.

Response: These typos were corrected in the Final GSP.

P. 144 - last 3 lines of first paragraph

512 surveys mailed and 41 responses received.

I don't consider an 8% response to be a successful outreach. Even though there is limited internet access in the Tri-Valley area, a zoom meeting, as was done in the other 2 management areas could have been done.

Response: The Tri-Valley area was provided a higher level of outreach than the other management areas through a survey mailed directly to every resident with return postage and a presentation specific to the management area during the GSP comment period on October 20, 2021. In contrast, the other stakeholder workshops to discuss Management Actions on October 6 and October 13, 2021, were not specific for geographic regions of the Basin and no direct mailers were sent to other valley residents where internet connectivity exists. At the general stakeholder meetings, the Undesirable Results and Sustainable Management Criteria for specific geographic areas were presented. For the Tri-Valley area, these proposed standards were discussed at the TVGMD public meeting on December 16, 2020. Finally, the OVGA cannot force Tri-Valley residents to participate or return the surveys, and the return rate should not be used as a measurement of success. The OVGA's commitment was to ensure multiple methods of participation were available, especially for disadvantaged populations, which is why the cost and expense of mailers with return postage was undertaken.

Section 2.1.9.3 discusses the difficulty in outreach in Tri-Valley and Sections 2.1.9.5 and 4.4 include another possible OVGA project:

Tri-Valley Survey: Add a groundwater management public education campaign concurrent with groundwater model development in the Tri-Valley to help Tri-Valley residents understand the situation and become more directly involved in groundwater management decisions that will affect their livelihoods.

P. 210 - last paragraph, third to last line

"identified the Tri-Valley area as one of the potential water sources for Fish Slough, which was supported by geochemical analysis by Zdon et al. (2019)."

> What are the other water sources for Fish Slough and what percentage comes from each of them?

Response: See General Comment #6: Zdon et al., (2019) did not determine the percentage of spring water arising from various recharge sources. Pertinent conclusions from Zdon et al., (2019) were:

> *"Northeast Spring is from a regional water source, deriving part of its water from the alluvial Tri-Valley groundwater system."*

> *"Northwest and BLM Springs are regionally derived and are a possible mixture of more sodic sources to the north (Adobe Valley and Benton Hot Springs area) and northwest (Volcanic Tablelands), mixing with Fish Slough Northeast Spring/Tri-Valley water."*

> *"These results have identified additional source areas contributing to spring flow in the Fish Slough area, including connections to the regional aquifer systems. The connections to the regional aquifer systems explain how regional water withdrawals in the area have resulted in the decline of spring flow in the Fish Slough area over time."*

The only source water area for the springs and the regional aquifer system upgradient from Fish Slough with significant pumping and similar water level trends as wells near the sampled springs was also recognized by Zdon et al., (2019):

> *"Future groundwater development and management in the region should be cognizant of the potential hydraulic connection between the basin-fill aquifer in the southern Hammil–northern Chalfant valleys and Fish Slough."*

P. 218 - second paragraph

"The Tri-Valley Management Area was determined to have low ecological value because:

(1) it supports a relatively small number of special-status species and ecological communities, (2) contains no designated critical habitat for federally listed species, (3) supports few species that are directly dependent on groundwater (two mollusks), and (4) includes few species or ecological communities that are vulnerable to changes in groundwater conditions. Additional groundwater and vegetation mapping and monitoring is necessary to assess the susceptibility of the GDE in Tri-Valley to pumping management."

Again, more justification for developing a groundwater model for the Tri-Valley.

Response: That is correct. Additional revisions to the GDE map may accompany groundwater model development or may be a future project of the OVGA (see Sections 2.1.9.5 and 4.5.3)

P. 223, table 2-10 - the 4th column, second row Is 84,00 supposed to be 8,400 or 84,000?

Response: Typographical error corrected to read $84,000

P. 227 - last paragraph of 2.2.3.3

"However, based on monitoring well data and a comparison of recharge and discharge, the Tri Valley management area appears to be in overdraft. A groundwater model is needed before making action plans.

This statement should be added to many of the triggers or notes sections of the Tri- Valley Management Areas action plans in Table 4.1.

Response: comment noted. The statement applies to proposed actions in the Tri-Valley Management Area.

P. 230 - section 2.2.4.1, last sentence of first paragraph

"While the amounts of groundwater discharging into Fish Slough are poorly quantified, existing evidence suggests a large portion comes from the Tri-Valley area (Jayko & Fatooh, 2010; Zdon et al., 2019)."

Define "large".

Response: Unfortunately, neither cited study quantified the relative sources for the discharge in Fish Slough (which is difficult to quantify without a groundwater or geochemistry model) but relied on the multiple lines of evidence (geology, hydrology, and geochemistry) that suggest most or a significant portion of the recharge arises in Tri-Valley. Also see General Comment #5.

P. 237 - section 3.2.1, middle of second paragraph

"Based on available geologic, hydrologic, and geochemical evidence, pumping in management area in excess of recharge is the cause of lowering water levels."

How can this be said until a groundwater model is completed?

Response: See General Comment # 5. The evidence is sufficient to develop a conceptual model of the groundwater system, e.g. water balance, aquifer properties (thickness, conductivity) and arrangement (depth, lateral extent). The conceptual model would form the basis of the design of a numerical groundwater model which would collect all available data and be calibrated to measured water levels and discharges. A numerical model can run alternate pumping/recharge scenarios to assess how the aquifer system functions under differing management scenarios.

P. 238 - first sentence of second paragraph

"Severe pumping overdraft (which does not presently exist) could cause land subsidence"

Define "severe". It has already been stated that the Tri-Valley is in overdraft and that pumping is the cause. How "severe" does overdraft need to be to warrant OVGA imposing a pumping plan on the Tri-Valley?

Response: This sentence was reworded in the Final GSP for clarity:

Severe pumping overdraft resulting in land subsidence (which does not presently exist) could cause general infrastructure damage or migration of lower quality deeper groundwater requiring treatment or loss of potable water, but these are unlikely to occur at the current rate of groundwater level decline.

P. 251 - second paragraph, third line

"Since there have been no reported significant and undesirable results directly related to decreased water levels in Benton, Hammil, or Chalfant valleys of the date of this Plan,"

How can this statement be made when this report also says that decreased water levels from too much pumping are causing problems in Fish Slough?

Response: The sentence specifically is referring to effects in the three valleys. Spring declines have been noted but have not exceeded the threshold chosen (0.1 cfs) to represent significant and undesirable results at the time the GSP was prepared.

Third paragraph

"Achieving the 20-year measurable objective will require either increasing recharge into the aquifer or decreasing pumping."

Why, when there are "no reported significant and undesirable results... " as stated above and in other areas of this document?

Response: Significant and unreasonable results are represented by the Minimum Threshold values. The Management Objective was set to the water level on January 1, 2015. Water levels are currently below the Objective and declining. The sentence was revised for clarity:

Achieving the 20-year measurable objective to correct the observed long-term decline will require either increasing recharge into the aquifer or decreasing pumping.

Uncertainty in the water budget and the lack of a numerical groundwater flow model for the area prevents an accurate assessment of how much groundwater pumping in Tri-Valley would need to be reduced to achieve the measurable objectives.

The Tri-Valley groundwater model needs to be done before other actions are taken.

Response: Some actions like Management Actions #1: Well Registration, #2: Well permit review, and #3: Increase Monitoring can and should occur before completion of a groundwater model. Developing a specific pumping plan to correct chronic lowering of water levels should be informed by and rely on a groundwater model.

P. 275 section 4., first paragraph, seventh line

"An additional consideration in developing this list of Management Actions and Projects was to not place an undue financial or regulatory burden on local residents recognizing that compliance with SGMA is voluntary for the OVGA."

How does "undue financial or regulatory burden" correlate with the proposed pumping plan for Tri-Valley?

Response: The Basin is low priority and the OVGA committed in Section 1.2, Fund 1: The OVGA recognizes its duty to Basin residents, and future generations to ensure that financial resources are used effectively and responsibly to promote sustainable groundwater conditions. The OVGA is committed to carefully and prudently use funds to fully comply with SGMA and to avoid expanding beyond the scope of SGMA in a manner that might create undue costs to Beneficial Users.

P. 278, section 4.2, first paragraph, last sentence

"Permits for such wells will be reviewed primarily to acquire information to update the database and ensure the use and production of the well is correctly cataloged as *de minimis.*"

How is a well going to be determined as being de minimis in the case of wells used only for domestic use but on property over 1 or 2 acres? Will the property owner need to install a water meter to show that they are a de minimis user?

Response: That can be estimated on a case-by-case basis from remote sensing to detect if the green acreage or landscaping is unusually large.

P. 299, section 5.1, first sentence

"Implementation of all or parts of this GSP are at the discretion of the OVGA as long as the Basin remains ranked as low priority."

If the basin is still low, OVGA shouldn't be able to implement any of this plan.

Response: Comment noted. The Legislature encourages and authorizes low priority basins to be managed under a GSP, but it is voluntary. The OVGA can implement the GSP once adopted (CWC §10725(a)) within the GSA jurisdiction.

Management Plans - if the basin is re-rated to medium or high priority and there are no grants to pay for any of the management plans/actions, who pays for them? Does each management area have to pay for the plans/actions in their area?

Response: The OVGA is responsible for covering costs of implementing the GSP and has several options to do so: 1) member contributions similar to the current funding mechanism, 2) assessing fixed fees or fees based on extraction quantity on local pumpers in the GSP area, 3) assessing property related fees or taxes, 4) issue general obligation bonds, or 5) some combination of the above. It is assumed the OVGA will attempt to acquire grants when possible for projects in the Basin, but such funding is not secure. The budget to July 2022 has been adopted, and the OVGA will rely on existing funds (Section 1.3.2). The Joint Powers Agreement contains a provision that one or more members of the OVGA may choose to be designated as the member that bears all costs of implementing the GSP in a particular management area above the typical baseline (e.g. administration) costs to implement the GSP.

Big Pine Paiute Tribe of the Owens Valley

OVGA Public Review Draft Comments

Big Pine Paiute Tribe of the Owens Valley

Big Pine Paiute Reservation

P.O. Box 700 · 825 South Main Street · Big Pine, CA 93513 (760) 938-2003 · fax (760) 938-2942 www.bigpinepaiute.org

L'eaux Stewart Tribal Chairperson

November 5, 2021

Owens Valley Groundwater Authority c/o Inyo County Water Department 135 S. Jackson Street
Independence, CA 93526
[submitted electronically]

Dear Owens Valley Groundwater Authority Board:

Subject: Comments on draft Groundwater Sustainability Plan

The Big Pine Paiute Tribe of the Owens Valley ("Tribe") is committed to the protection of water and the environment in the eastern Sierra. The Tribe has been following California's efforts to sustainably manage its groundwater resources since before the state legislature approved the Sustainable Groundwater Management Act ("SGMA") in 2014. The Owens Valley Groundwater Authority was created to guide the development of plans to ensure the sustainability of Owens Valley groundwater as informed by local people. On September 23, 2021, the draft Owens Valley Groundwater Basin Groundwater Sustainability Plan Public Review Draft ("draft GSP") was released for public comment. In the Tribe's view, the draft GSP is not reflective of the needs and concerns of the valley's residents, and it will not protect the environment.

SGMA offered hope for the Owens Valley Groundwater Basin: It offered hope that local people, including tribes, might work together to take a serious look at our water situation and plan the appropriate steps to protect the water now and for future generations. Our valley has been subject to more than a century of dewatering by the City of Los Angeles Department of Water and Power ("LADWP"). Once-flourishing meadows, springs, and wetlands have been sucked dry by groundwater pumping which LADWP has been pursuing relentlessly for more than 50 years. With its control of water and land, LADWP has controlled the socio-economics of the valley. LADWP makes decisions about the Owens Valley environment for the purpose of protecting its interests while serving utility customers: Los Angeles decision -makers are not accountable to citizens of Owens Valley. LADWP has prevailed due to lack of state laws prohibiting such gross exploitation.

SGMA, though long overdue, is an opportunity to right some of the oppressive wrongs in Owens Valley.

Overall Comment

The Tribe has reviewed the draft GSP, and in the Tribe's view, this plan should not be submitted to the state of California as the GSP for the Owens Valley Groundwater Basin. The Owens Valley Groundwater Authority ("OVGA") is not required to submit a GSP, because the state has classified the Owens Valley Groundwater Basin as a low Priority basin. It would be better for people of Owens Valley to take more time to develop a protective plan that truly considers current conditions and future needs as opposed to hurrying to submit a plan that, if implemented, allows continued, unregulated water gathering by LADWP but harms our citizens, environment and economy. If the draft GSP is adopted by the OVGA and submitted, it will: set a low bar for

groundwater sustainability which is not protective of our precious water resources; cost money to implement; impose new regulations on a handful of people in our rural area; potentially adversely affect the valley's economy by stifling development; not be proactive in terms of finding solutions when groundwater becomes unavailable (as is likely given current LADWP pumping coupled with the changing climate); and overall be a waste of time and resources which truly should be applied to dealing with Inyo/LA Water Agreement issues. If the OVGA believes that by not adopting the GSP we lose the opportunity to more fully monitor conditions in the groundwater basin, then the OVGA is being fooled. There is ample financial assistance currently provided to Inyo County (by LADWP) to do this work for parts of the basin in Inyo County. There is no harm in the OVGA acknowledging that staff and the consultants (paid mostly by state grant funding) fulfilled the need to draft a plan; however, OVGA must recognize the size of as well as the issues unique to our complicated groundwater basin, then regard this draft GSP as a starting point for working toward better planning and management for the basin.

Response: The OVGA intends to comply with SGMA deadlines for submitting the GSP and also to comply with Proposition 1 grant agreement requirements. As the primary deliverable for the grant, DWR expects the OVGA to adopt and submit a Final GSP to DWR before the date specified by SGMA. However, submitting the GSP by the deadline does not preclude further development or refinement of the GSP to address issues of concern, and the GSP must be reviewed every five years.

One important reason the draft GSP fails us is because Inyo County and LADWP worked together to lobby state lawmakers into exempting from SGMA the lands within the Owens Valley Groundwater Basin that are subject to the Inyo/LA Water Agreement[1] This questionable act, which was performed outside of public scrutiny, crippled our ability as locals to develop a meaningful groundwater management plan.[2] SGMA grants local Groundwater Sustainability Agencies ("GSAs ") the authority to regulate pumping. However, due to the exemption in SGMA for Inyo County in which the LADWP lands subject to the Water Agreement are treated as adjudicated, the OVGA cannot regulate LADWP pumping. LADWP pumping accounts for the vast majority of groundwater pumping in the groundwater basin and is in need of regulation. At this time, there is no point in focusing on the non LADWP pumping in Owens Valley. The OVGA should take the time to change the law and assert the authority to which we California citizens in the eastern Sierra would be entitled under SGMA.

Response: See General Comment #2. Changing the statue that define LADWP lands as adjudicated and regulating pumping on lands under the Long-Term Water Agreement (LTWA) are outside the scope of this GSP even though the Tribe disagrees. The Tribe's disagreement is acknowledged, but outside the requirements for the GSP. We agree that non-LADWP pumping in much of the Owens Valley is not making the Basin unsustainable.

Specific Comments should OVGA proceed with this draft GSP

<u>There is no Goal</u>. Note that the draft GSP does not have a clearly-stated goal. There is a section for the goal, but it is presented as a list of things to do. After reading the draft GSP, it would appear a goal is to keep things as they are now. What this means is to allow continuation of conditions in the basin that have been degraded due to LADWP activities and permit no further development in the future. Should there be some local undertaking which might benefit the local people, environment, and economy, such as to create or restore a wetland, expand local agriculture, or even build a golf course, this GSP would impose significant constraints. According to SGMA, the local people were supposed to develop the goal, but there is no agreed- upon, locally-generated groundwater management goal in the draft GSP.

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1 referred to in the draft GSP as the Long-Term Water Agreement, LTWA.

2 See Inyo County Board of Supervisors materials for their August 19, 2014, meeting. Tribal staff can provide documentation upon request.

Response: SGMA (CWC §10721) requires the GSP include a sustainability goal defined as "..*the existence and implementation of one or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield."*

The stated goal of the GSP is provided in Section 1.2: *The sustainability goal of the OVGA is to monitor and manage the Basin by implementing a groundwater monitoring network and database and by adopting management actions that fairly consider the needs of and protect the groundwater resources for all beneficial users in the Basin.*

With regard to comments concerning impacts to the Basin caused by LADWP, see General Comment #2

No Local's Definition of Sustainability. The draft GSP is misleading when it says that the Owens Valley Groundwater Basin is being managed "sustainably." Similar to the above comment, local people are supposed to define sustainability for the groundwater basin, but that did not happen here. In places, the draft GSP uses the bare minimum definition of sustainability as described by the state in SGMA. In other places it rationalizes that the basin is sustainable based on the basin being classified as Low Priority (due to omission of LADWP activities) and on the draft GSP's presentation of recharge and discharge values. SGMA presented a list of rather extreme conditions that must be avoided in order for a basin to qualify as minimally sustainable. Certainly, we do not want those things to happen in Owens Valley, but the draft GSP misses the opportunity to raise the bar and protect groundwater dependent ecosystems, Fish Slough, Owens Lake, local agriculture, and more.

Response: The Basin Ranking includes criteria related to groundwater conditions and trends, but also criteria related to basin size, groundwater reliance, population, well density etc. that are related to the geography of the Basin. The wording in the GSP was revised to remove inferences between sustainability and basin ranking (e.g. see Section 1.2 and elsewhere).

None of Owens Valley is Adjudicated and this is Unfair to the Tribe. The draft GSP must systematically alter its use of the word "adjudicated" when it refers to LADWP areas managed according to the Water Agreement. There is no adjudication in the Owens Valley Groundwater Basin! The entire basin is "non-adjudicated," but this term is used to apply to the non-LADWP lands; that is, the areas for which the OVGA is responsible. With SGMA as written, the LADWP lands are "treated as adjudicated," so the language must be changed throughout the document to reflect this. In fact, it would be better to change it to "Water Agreement area" or "Exempt from SGMA area." Unfortunately, that still leaves the problem of the term, "non-adjudicated" which is used throughout the draft GSP to refer to non LADWP areas. The term non-adjudicated applies to the entire basin, not just the areas over which the OVGA has jurisdiction. Language is important. A reader reading on nearly every page of the draft GSP that LADWP lands are adjudicated may soon believe they are. The Tribe in particular suffers the consequences of this unfair language. When a watershed is adjudicated, water rights are supposed to be settled, and that absolutely has not happened for the tribes in the groundwater basin. Please do not characterize the Owens Valley Groundwater Basin as adjudicated,

Response: General Comment #3.

There Must be a Plan to Coordinate with LADWP. The draft GSP needs to clearly present a plan for the OVGA coordination with LADWP because LADWP activities directly affect a majority of the region to which the draft GSP applies. The draft GSP is set up to cast as the problem valley citizens or communities that use water when LADWP is the problem. The GSP must include the steps the OVGA will take to accomplish this coordination and list what must be mutually understood, if not managed. This would include wellfield pumping, surface water conveyances, irrigation, and other LADWP operations. At nearly every opportunity during the years leading to the draft GSP, the Tribe and members of the public brought up this important problem, and now that the draft GSP is released, it is realized that the problem was not adequately addressed. The OVGA cannot ignore that the Owens Valley Groundwater Basin is one interconnected groundwater basin. Failure to coordinate with LADWP places undue burden on water users within the GSP area. When something goes awry, such as a local person's well goes dry or there is subsidence, the OVGA as the regulatory authority can hold the local person, Community Service District, City of Bishop, etc., responsible and not the true culprit. It is unfortunate to see that the draft GSP appears to rely on Inyo County and LADWP to make things right according to terms of the Water Agreement when an incident occurs, and incidents will occur. For decades, the Tribe and public have seen significant struggles between the county and LADWP when an issue is raised, because the process outlined in the Water Agreement for resolving disputes is not effective. It allows: an impasse to persist, involvement by lawyers, no punitive actions (because no fault is found), and final outcomes in which the victim still loses at least part of the case.

Response: Coordination with LADWP cannot include mutual management (with the OVGA) of wellfield pumping, surface water conveyances, irrigation, or other LADWP operations. Those activities on LADWP lands are subject to provisions of the LTWA and thus exempt from SGMA. This GSP contemplates its monitoring program will detect cross-boundary impacts on the GSP area from LADWP's pumping activities and will allow the OVGA to coordinate with LADWP in mitigating any such effects, and/or with the LTWA parties to help enforce relevant LTWA provisions that protect the environment and private well owners in a manner consistent with this GSP. Also refer to General Comment #2.

Degradation Caused by LADWP Must Not be Condoned. The Tribe finds it unacceptable that the draft GSP as written condones, or "grandfathers-in" damage to the hydrology, environment and economy caused by LADWP pumping. To remedy this, the GSP should truly explain the reasons for groundwater fluctuations in the basin (it's not just "drought"), then adjust thresholds and management objectives to manage for shallower conditions throughout the basin. Managing this way will of course take coordination with LADWP so see the above comment. The Water Agreement calls for water management to maintain conditions that existed in the mid 1980s; that period is the baseline for the Water Agreement. Heavy pumping occurred 1987-1990 by LADWP, and water tables and vegetation conditions in some parts of the valley never fully recovered from that pumping, yet LADWP continues to pump. The hydrograph shown for V016B on p. 185 of the draft GSP is a good example of the effects of this pumping then subsequent lack of full recovery of the water table. In Owens Valley, we see depressed water levels and degraded vegetation conditions characterized by less meadow, fewer trees, more shrubs, and more weeds than during the baseline period. The draft GSP ignores this reality and uses the 2012-2016 period as a new baseline. It is unfair for the preparers of the draft GSP to turn a blind eye on Water Agreement goals--goals the local people demanded as a *minimum--and* interject a new baseline with lower water-levels and degraded vegetation conditions, then hide behind SGMA to condone it in the draft GSP. The draft GSP sets "minimum thresholds" and "measureable *[sic]* objectives" that hold the future to no better than these now-less-than-acceptable conditions. Some of the proposed water table management depths are clearly too deep to support groundwater dependent grasses as noted for monitoring wells located in or near what used to be meadows. The OVGA should not be sending this message to LADWP or the state of California that the damage done to date is acceptable; clearly it is not acceptable to some locals, including the Tribe.

Below are some specific examples showing how the basin is not protected by criteria in the draft GSP. Proposed GSP monitoring well T574 is a good example of grandfathering-in LADWP's depletion of groundwater and degraded vegetation conditions to define a new baseline. This monitoring well is located on LADWP land in the Laws area, near permanent monitoring site Laws 3, which is a place where the subsurface is capable of a high degree of capillarity (upward movement of groundwater to the plant root zone). The depth to groundwater in the mid 1980s for TS74 was about 10 feet, which is shallow enough to support meadow in the vicinity, and occasionally since the mid 1980s, the water table has risen to the 10- foot range. The draft GSP sets the TS74 minimum threshold at 20 feet, which is the bottom of this monitoring well. The water table cannot be accurately measured if it drops below 20 feet: no one will know where it is if this happens. The draft GSP sets the measurable objective at 16 feet. This is too deep for meadow, but it is something LADWP could probably maintain with status quo pumping in Laws. To maintain baseline vegetation conditions over the long term, the measurable objective should be no deeper than the 10-foot depth, but the draft GSP sets it at 16 feet! Choosing this deeper level accepts LADWP degradation of the Laws area and sends a message that this not only is acceptable but also is consistent with a definition of sustainability. This is not fair to those of us who depend on Inyo County and LADWP to manage according to Water Agreement goals. The draft GSP management approach would permanently compromise ecological conditions in Laws and be in conflict with the Water Agreement.

Proposed monitoring well T809, located near permanent monitoring site Independence Oak 1, north of Independence Creek and the town, is another example of grandfathering-in conditions degraded by LADWP since the start of the Water Agreement. T809 was installed after the mid 1980s baseline, but it was placed in what was an alkali meadow. To reasonably support meadow, the groundwater should be managed to stay within 8 feet of the surface. The draft GSP sets the minimum threshold for this monitoring well at 19 feet and the measurable objective is 13 feet. This is too deep to sustain Water Agreement baseline ecological conditions.

Response: The monitoring wells and vegetation discussed in this comment are located on LADWP lands which are exempt from SGMA. The wells are included as the monitoring point nearest to lands subject to the GSP in that portion of the Basin. The Management Objective is to maintain average water levels of 2001-2010 and not drop below the Minimum Thresholds. Vegetation near T809 and T574 is monitored annually by the Inyo/Los Angeles Technical Group and presented in the ICWD annual reports (www.inyowater.org/reports). Since 2001, perennial vegetation cover has been at or above the LTWA baseline levels in 14 of 20 years near T809 and in 19 years near T574 (the area near T574 burned in 2002). Near 809T, cover fluctuates above and below baseline but the trend over time is stable. Perennial grass cover has been at or above baseline in all years near T809 and 17 years near T574. Vegetation declines during the 2012-2016 drought coinciding with period that Minimum Thresholds for water levels were derived were small and temporary.

Proposed monitoring well V299, which is located on the Big Pine Paiute Reservation, is another example of grandfathering-in groundwater levels depressed by LADWP pumping. This LADWP well is located on a Tribal member's assignment which is not a meadow. The water table beneath the Reservation is deep, and it is kept depressed by LADWP pumping in the Big Pine area . The draft GSP sets the minimum threshold for V299 at a depth deeper than the well can measure! According to data on the ovga.us website, V299 is dry at about 97 feet, but the draft GSP sets the minimum threshold at 109 feet. The management objective is set at 96 feet. Normally a well selected for long-term monitoring should be capable of providing good data over a range of conditions, but to set monitoring criteria at the extreme end of a monitoring well is questionable if not outrageous. V299 was installed in the late 1920s and when installed the water table was much shallower, in the 40-foot range. By the time the Reservation was established, water levels had dropped to the 60-foot range, and with LADWP pumping in the 1970s, levels dropped further to 80- to 90- foot depths. This significant decline without noteworthy recovery anywhere near where water levels were historically is the result of LADWP pumping in Big Pine.

Response: There was an error in the database for a dry well read in V299. The Minimum Threshold for this well in Table 3-5 has been revised to 3909' (101' depth from r.p.) consistent with the procedure to set thresholds in other representative monitoring wells.

Insist on Zero Subsidence. The OVGA should absolutely not allow any land subsidence due to groundwater pumping. Language in the draft GSP should set the target at zero for subsidence due to pumping. In addition to damaging infrastructure, subsidence indicates that aquifers have shrunk and thus are unable to store as much water should a big runoff year occur, and this condition is often permanent. We do not need to subject the Owens Valley Groundwater Basin to this risk; this is something the OVGA and GSP can manage to completely avoid. Setting an arbitrary allowable change (as the draft GSP does) is disingenuous because it is unlikely anyone can stop subsidence at some arbitrary change, and we know it is practically impossible to reverse subsidence.

Response: It is a common misperception that aquifer storage is impacted by small levels of subsidence. The effects generally occur in the fine-textured layers separating aquifers at depth and aquifer storage is unaffected.

The measurable objective for land subsidence has been set to less than 0.07 ft (0.84 inches), the vertical resolution of the remotely sensed inteferometric synthetic-aperture radar (InSAR) data provided by DWR (TRE Altamira, 2021; Towill, 2021). This value represents maximum instrument sensitivity. This value for the objective was chosen because no subsidence has been observed in Basin and the goal is to maintain those conditions.

The minimum threshold of 0.3 ft (3.6 inches) of subsidence measured by InSAR has been proposed as less than significant and reasonable. The minimum thresholds for subsidence are based on the variability in repeat measurements at permanent GSP stations reflecting elevation changes caused by factors other than subsidence (approximately 1.6 inches). If this amount of subsidence is observed, it is approximately the smallest value likely not due to noise or some other cause (see Appendix 8)

No LADWP Pumping at Owens Lake. The OVGA should not permit pumping under or near Owens Lake, as has been proposed by LADWP to control dust. Owens Lake is not the property of LADWP, and they have already done the lake and thus southern valley excessive ecological harm. There is no amount of pumping LADWP could do which would not be a threat to springs and seeps in the area, private wells, subsidence, and vegetation on dunes. The threat of LADWP pumping at the lake may be remedied by the OVGA insisting on no pumping and incorporating this objective into the GSP.

Response: The Owens Lake is owned and managed by the State Lands Commission (SLC), and LADWP operations on state lands is conducted under a lease with the SLC. SGMA "*…does not authorize a local agency to impose any requirement on the state or any agency, department, or officer of the state. State* *agencies and departments shall work cooperatively with a local agency on a voluntary basis*" (CWC §10726.8(d)). The OVGA cannot simply forbid pumping on state owned lands as requested. State agencies, however, are required to "*…consider the policies of* [SGMA], *and any groundwater sustainability plans adopted pursuant to* [SGMA], *when revising or adopting policies, regulations, or criteria, or when issuing orders or determinations, where pertinent*" (CWC §10720.9). This GSP sets sustainable management criteria in test wells surrounding the lake and proposes that the OVGA actively participate in the working group and coordinate with state and local agencies with land management responsibilities to ensure this management area is managed sustainably to avoid undesirable results (GSP Section 4.5.1).

Too Few Management Areas. The draft GSP oversimplifies the groundwater basin by splitting it into three management areas. There are volumes of data on the basin with enough information to permit management on a finer scale, especially in the Owens Valley Management Area. Lumping Round Valley with Bishop, Big Pine, and also Lone Pine is simply not reasonable.

Response: The spatial distribution of the varying geologic, hydrologic, and groundwater quality conditions was used to divide the basin into separate management areas to allow for development of SMCs that take into account varying hydrogeologic conditions. Further subdivision of the basin into smaller units is not warranted based on hydrogeologic criteria or necessary to facilitate implementation of the GSP to maintain conditions or improve conditions where necessary.

The GSP Must Work to Manage Groundwater Recharge. The Tribe questions why the draft GSP does not propose a plan to work with others in the basin to manage aquifer recharge. To truly manage groundwater, it is obviously useful to manage not just what is taken out, but also what goes in, the recharge. There is nothing in the plan talking about how OVGA will work with the other land management agencies to direct flows in canals or ditches or perform water-spreading in order to help meet the needs of the OVGA area (the non LADWP area) of the basin. If the OVGA fails to address management of recharge in the GSP, then LADWP will continue to control recharge and make it work to LADWP's advantage which could deprive or harm other parts of the basin.

Response: This comment has been offered at several meetings of the OVGA, but the Board has not directed staff to include such projects in the GSP. The feasibility of acquiring surface water rights for recharge, reservoir storage costs, and acquiring staff to manage surface water (and asking the Basin residents to fund) would be considerable obstacles. Overdraft conditions do not exist in the Owens Valley or Owens Lake Management Areas and all surface runoff is used within Tri-Valley.

OVGA Needs Independent Staff. The Tribe views it as a conflict for Inyo County Water Department staff members to also serve as staff to the OVGA. Already there are conflicts in which it confuses the public and perhaps the staff itself as to which "hat" a staff person is wearing at a meeting. Should the OVGA proceed with the GSP, the OVGA needs to recruit its own workers so it can function without having staff that also is supposed to work on different goals and objectives as called for in the Water Agreement or on other water- related projects.

Response: This comment is not germane to the contents of the GSP.

Errors in draft GSP. The draft GSP (including appendices) has typos, redundancies, and a few more significant mistakes. It is an unnecessarily cumbersome document. For example, information on the three management areas is presented in a leap-frog manner throughout the document. Should someone care to read about the plans, for example, for Tri-Valley only, the person must skip here and there and read redundant fill material. Section headings are not always helpful.

Response: See General Comment #1.

ovga.us website. The OVGA should work to ensure that data on the ovga.us website is up to date and then it should continue to work to improve this information and keep these data publicly accessible.

Response: Section 2.1.2 states:

The Inyo County Water Department plans to use OVGA database as a repository for LADWP data for their daily operations in the future, and therefore it is anticipated to be updated regularly as additional data are collected and become available for import. The OVGA will determine the timing of the acquisition of data to update the database from other sources as funding and the scope of the GSP implementation in a low priority basin requires. The OVGA will also determine whether to require reporting of missing data collected by pumpers or to implement additional monitoring programs to fill identified data gaps (see Section 4, below).

In conclusion, the Tribe respectfully requests the OVGA hold onto the draft GSP and continue to work on preparing a more protective plan for the Owens Valley Groundwater Basin. The draft GSP is not capable of managing the Owens Valley Groundwater Basin in a truly sustainable manner that protects our water now and into the future. Please consider the Tribe's comments.

Sincerely,

ORIGINAL pdf signed by L'eaux Stewart

L'eaux Stewart, Tribal Chairperson

Note: The Tribe's Environmental Director, Sara J. Manning, Ph.D., contributed to these comments. Dr. Manning is an expert on Owens Valley ecology, groundwater pumping, and water issues

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

OVGA Public Review Draft Comments

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State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Inland Deserts Region
3602 Inland Empire Boulevard, Suite C-220
Ontario, CA 91764
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

November 1, 2021

Sent via email

Dr. Aaron Steinwand
Owens Valley Groundwater Authority Executive Manager
P.O. Box 337
135 S. Jackson Street
Independence, CA 93526
asteinwand@inyocounty.us

Subject: California Department of Fish and Wildlife Comments on the Draft Owens Valley Groundwater Authority Groundwater Sustainability Plan

Dear Dr. Steinwand:

The California Department of Fish and Wildlife (CDFW) appreciates the opportunity to comment on the Owens Valley Groundwater Authority (OVGA) Draft Groundwater Sustainability Plan (GSP) prepared in accordance with the Sustainable Groundwater Management Act (SGMA) statutory and regulatory requirements. The Draft GSP describes the Owens Valley groundwater basin which includes the Owens Valley, Owens Lake and the Fish Slough and Tri-Valley Management Area (Basin), develops quantifiable management objectives that account for the interests of beneficial groundwater uses and users, and identifies a group of management actions that will maintain sustainable conditions in the Basin for 20 years after GSP adoption. The Draft GSP also contains steps a Groundwater Sustainability Agency (GSA) could undertake to manage groundwater pumping in the Basin to address declining water levels in a portion of the Basin.

CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish & G. Code, §§ 711.7 and 1802). CDFW has an interest in the sustainable management of groundwater, as many sensitive ecosystems, species, and public trust resources depend on groundwater and interconnected surface waters, including ecosystems on CDFW-owned and managed lands.

COMMENTS AND RECOMMENDATIONS

Pursuant to 23 CCR §354.16, GSPs are required to provide a description of current and historical groundwater conditions within the Basin. As part of that requirement (23 CCR

§354.16 (a)(1 & 2), the GSP must provide groundwater level elevation contour maps depicting the groundwater table or potentiometric surface associated with current seasonal highs and seasonal lows and hydrographs depicting hydraulic gradients within or between

principal aquifers. The Draft GSP does not provide groundwater elevation contour maps for recent and current groundwater conditions or hydrographs depicting hydraulic gradients between aquifers for the management areas discussed within the Draft GSP.

Response. Although the current network of monitoring wells is sufficient to characterize large-scale, basin-wide trends, the network does not contain enough wells to produce groundwater contours at smaller scales in the Tri-Valley/Fish Slough management area. This lack of spatial coverage is identified as a data gap in the GSP with proposed management actions to close the gap. Hydrographs for monitoring wells in Tri-Valley were included in Appendix 3.

General groundwater contour maps for the Owens Valley Management Area will be added in Appendix 7. Hydrographs from selected multiple completion wells or clusters showing the generally upward gradient in the Basin from deeper to shallower aquifers are provided in Appendix 7, and the GSP will be revised to direct the reader to these data. Please note that many of the wells in Table 3-6, water levels and management objectives are given as height above ground surface reflecting the generally upward gradients and artesian conditions in the southern part of the basin. Section 2.2.2.1 was revised to convey the information in this response.

CDFW acknowledges that the GSP indicates (Chapter 4) that it will develop and implement projects within the designated management areas to address these data gaps and will update the plan as additional groundwater level data sets are obtained. As part of this process, CDFW recommends that the OVGA develop a more robust groundwater elevation monitoring network which includes the construction of dedicated multiple completion monitoring wells capable of better characterizing groundwater trends and gradients (vertical gradients) within or between principal aquifer units located in each of respective management area described in the GSP document.

As briefly discussed above, the Draft GSP provides a good discussion in Chapter 4 regarding proposed projects and management actions needed to better characterize groundwater conditions within management areas. More specifically, CDFW agrees that the actions listed regarding the Tri-Valley Management Area are needed and warranted. Additionally, CDFW agrees that a Tri-Valley Management Area groundwater model is needed to better characterize groundwater conditions and their connection to Fish Slough. CDFW believes that utilizing existing well structures within the Tri-Valley Management Area is beneficial in developing a better understanding of groundwater conditions where wells are located within the Basin; however, there is a discernable data gap in existing well coverage where additional information is needed to define the connection between Fish Slough and the Tri-Valley aquifer system.

CDFW believes that strategically placed, depth-specific, multi-completion monitoring wells are needed to adequately define the connection between Fish Slough and the Tri-Valley aquifer system. CDFW recently completed a hydrogeological characterization of Fish Slough and the Tri-Valley area and prepared a Groundwater Monitoring Plan that provides recommendations for additional monitoring well structures and locations to assist in characterizing the interaction between Fish Slough and the Tri-Valley aquifer system.

This document can be provided upon request to assist the GSA if needed. CDFW acknowledges that the Draft GSP identifies, within Chapter 4, the need for additional monitoring wells within the management area to assist in characterizing groundwater conditions; however, the Draft GSP does not provide a discussion regarding potential locations and depths of these monitoring structures or the benefits of their installation.

CDFW recommends that the Final GSP include a discussion regarding the benefits of multiple completion monitoring wells, the types of data sets they can provide (e.g., depth, specific water level/water quality data, characterization of vertical gradients, etc.), and identify proposed locations within the Tri-Valley management area where these structures would provide the most beneficial information (i.e., the connection between Fish Slough and the Tri-Valley aquifer system).

Response: The OVGA may consider the need to install multiple completion or other monitoring wells after the proposed management action to increase monitoring relying on voluntary monitoring using private wells is implemented. The OVGA recognizes the potential benefit of information from the proposed locations and may seek funding for additional monitoring wells if Management Action #3 is insufficient to address this data gap. .

CDFW also offers the following corrections and requests for clarification.

<u>Page 22, ES 3.2.1</u>

- "*The steady water table decline is concerning, but it is unlikely that the undesirable results related to sustainable yield or available groundwater storage will be exceeded or that a decreased ability to maintain status quo pumping during droughts based on storage constraints will occur during the GSP implementation*."

  CDFW does not agree that status quo pumping is compatible with protection of groundwater dependent ecosystems

Response: The sentence in question does not pertain to status quo pumping effects on GDEs. The sentence states that status quo pumping wouldn't be impacted by a depletion of storage, i.e. the Basin storage is adequate to allow for that continued beneficial use. Whether status quo pumping can continue without affecting GDEs is a separate Sustainability Indicator addressed elsewhere in the GSP.

- *"Severe pumping overdraft (which does not presently exist) could cause land subsidence resulting in general infrastructure damage or migration of lower quality deeper groundwater requiring treatment or loss of potable water, but these are* *unlikely to occur at the current rate of groundwater level decline*."

CDFW does not agree with the conclusion that pumping overdraft does not exist in the Basin.

Response: This sentence in this section and elsewhere in the GSP was reworded as shown below:

"*Severe pumping overdraft resulting in land subsidence (which does not presently exist) could cause general infrastructure damage or migration of lower quality deeper groundwater requiring treatment or loss of potable water, but these are unlikely to occur at the current rate of groundwater level decline.*"

Page 25, ES 3.3.1

- "*The CDFW monitor and manage the spring flow for the benefit of the listed species and habitat*".

  CDFW presently does not monitor any spring flow. All gauges are operated by the City of Los Angeles. Inyo County maintains pressure transducers in the monitoring wells and provides data to CDFW upon request.

Response: This correction was made in this section and elsewhere in the GSP with the sentence below.

LADWP monitors and CDFW manages the flow downstream of the spring for the benefit of the listed species and habitat"

- "*The minimum threshold represents the minimum flow rate that is necessary to allow management of flows to maintain current habitat conditions according to the CDFW*".

  CDFW recommends that the methodology to arrive at the threshold is noted, or a citation provided so that the source can be tracked down more specifically in the future.

Response: See General Comment #4

Page 30 ES 3.4.3

- "*As long as groundwater demand does not significantly increase or groundwater inflows do not significantly decrease, maintaining current groundwater levels will keep the management area in a sustainable condition*."

  CDFW requests clarification on whether this statement considered the Los Angeles Department of Water and Power test well pumping for dust mitigation.

Response; LADWP has not proposed a final pumping project description or monitoring plan, but the GSP statement is accurate as long as the conditional clause "as long as groundwater demand does not significantly increase…" remains true. This pertains to any future LADWP project that could result in failure to maintain measurable objectives. The GSP recommends the OVGA remain engaged with the Owens Lake Groundwater Development Program stakeholder process to ensure a possible pumping project is consistent with the GSP (Section 4.5.1).

CDFW appreciates the opportunity to provide comments on the OVGA Draft GSP. Questions regarding this letter or further coordination should be directed to Rose Banks, Environmental Scientist, at (760) 218-0022 or Rose.Banks@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Alisa Ellsworth
84FBB8273E4C480...

Alisa Ellsworth
Environmental Program Manager

cc: California Department of Fish and Wildlife
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CALIFORNIA NATIVE PLANT SOCIETY, BRISTLECONE CHAPTER

OVGA Public Review Draft Comments

Bristlecone Chapter of the California Native Plant Society
PO Box 364, Bishop, CA 93515

November 8, 2021

Owens Valley Groundwater Authority Board
Via email: lpiper@inyocounty.us

Re: OVGA Groundwater Sustainability Plan

Dear Board Members,

The Bristlecone Chapter of California Native Plant Society appreciates the opportunity to comment on the draft Groundwater Sustainability Plan (GSP) for the Owens Valley Groundwater Basin (Basin). We recognize the Division of Water Resources (DWR) has designated the Owens Valley as a low priority basin under the Sustainable Groundwater Management Act (SGMA). Under SGMA, the Owens Valley Groundwater Authority (OVGA) is therefore not required to develop a GSP. We are therefore very grateful that the OVGA chose to go through the demanding process of developing the GSP.

The California Native Plant Society (CNPS) is a non-profit organization working to protect California's native plant heritage and preserve it for future generations. Our nearly 10,000 members are professionals and volunteers who work to promote native plant conservation through 33 chapters statewide. Our local CNPS Bristlecone Chapter has members from Inyo and Mono counties, as well as throughout California.

Our organization is concerned with the conservation of California native plants and their habitats, and we have interest in the goals set forth in the OVGA mission statement: *The Owens Valley Groundwater Authority safeguards the sustainability of the Owens Valley Groundwater Basin through locally tailored management of groundwater resources to protect and sustain the environment, local residents and communities, agriculture, and the economy.* Below is our assessment of portions of the GSP that bearing on native plant species and their habitats.

I. Sensitive plant species and natural communities

Our chapter was pleased to see the attention given to sensitive plant species and natural communities within the Basin detailed in the draft GSP. These are documented in Appendix 9, Owens Valley GDE Assessment authored by Stillwater Sciences and summarized in Tables 3.1-3 and 3.1-4 of Appendix 9. We caution that while CNDDB data may represent a portion of the best information available for special status species, other sources and future research may reveal new occurrences, which unfortunately are often subject to multi-year CNDDB backlogs.

Bristlecone Chapter of the California Native Plant Society
PO Box 364, Bishop, CA 93515

We intend to reach out to ICWD and local CDFW staff to inquire about a process for our chapter to report new sensitive species occurrences for inclusion in relevant map updates. We appreciate the incorporation of local expertise and ground-truthing provided by ICWD in regards to phreatophytic species. We support additional remote sensing efforts, especially when informed by an appropriate level of field verifications. Overall, the information in the draft GSP provides an encouraging view of the Basin outside of the lands and groundwater resources covered by the Long Term Water Agreement (LTWA). Many springs and groundwater-dependent ecosystems (GDEs) appear to thrive within the Basin.

II. Groundwater Declines in Tri Valley and Fish Slough

Although the Basin has been classified as low priority by DWR, the northern part of the Basin within the management areas of Tri-Valley and Fish Slough have seen declines in groundwater levels. Of real concern is the Fish Slough area, with its populations of special status species, including eight plant species (Appendix 9). Hydrologists believe Tri Valley groundwater feeds into Fish Slough based on water chemistry, but that there is no hydrological connection between Tri Valley and the Laws area within the LTWA. However, there is uncertainty about the interconnectedness of these aquifers.

Response: There is evidence for hydrologic connection between Fish Slough and the western Laws/Five Bridges area. Spring water exiting Fish Slough is a recharge source in Laws. Also, similar aquifer materials are found below the Bishop tuff, but the presence of faults and leaky confining layers limits the effect of Laws or Bishop pumping extending into Fish Slough. Variations in LADWP pumping through history are not strongly reflected in water level trends in Fish Slough which more closely resemble water level trends in Tri-Valley. It is possible for an effect from LADWP pumping to propagate north into Fish Slough, however. Any pumping impacts from LADWP wells are subject to the LTWA overall goal to avoid “other significant effects” (See General Comment #2) and must be managed to avoid affecting Fish Slough.

The Owens Valley has lost many springs and seeps within the area covered by the LTWA. In arid landscapes like the Eastern Sierra, the springs once lost or degraded are very difficult to recover. The Bristlecone Chapter recognizes the value placed on Fish Slough by OVGA Board Members and by Inyo and Mono County citizens.

The Bristlecone Chapter endorses:

- The recommendations in ES 4.4 to pursue funding for and development of a Tri Valley Model to understand the hydrology as it impacts Fish Slough.
- The recommendations to develop a pumping plan for Tri Valley in cooperation with private well owners and agricultural interests.

Bristlecone Chapter of the California Native Plant Society
PO Box 364, Bishop, CA 93515

The Bristlecone Chapter recommends:

- Consultation with US Fish and Wildlife Service (USFWS) and California Division of Fish and Wildlife (CDFW) about impacts of groundwater use on special status species.

Response: The OVGA will consider this request. OVGA staff will continue to consult with CDFW to provide hydrologic information as requested and make the OVGA water level database publicly accessible.

III. Owens Lake Groundwater Development Program (OLGDP)

The lakebed of Owen Lake presents several unique challenges that makes it different from the other management areas in the Basin. The lands are mostly owned and managed by the California State Lands Commission (CSLC). CSLC therefore has authority over leases for management of the lakebed. It might or might not be subject to the LTWA but is included in this GSP as a management area. It is presently managed by Los Angeles Department of Water and Power (LADWP) to control dust so is a highly manipulated environment. Despite its barren and managed areas, it has the most GDEs of any of the management areas in the GSP. These occur along the margins of the lakebed where seeps and springs emerge on to the playas. The GDEs contain special status plants (i.e. Owens Valley checkerbloom) and sensitive natural communities.

The CSLC expressed interest in participating as a partner in the development of the Basin GSP. However, OVGA board members decided that a later participation in the in OLGDP would be more productive. The OLGDP's purpose is to replace the use of high-quality water with more saline water pumped from beneath the lake bed. However, it is unclear whether this will create another wellfield that leads to more export from the Owens Valley.

Response: This recommendation is not a necessary component or question for the GSP to address. At this time, there is no final proposed OLGDP project description or monitoring plan. With regard to the last point, SGMA Implementation and Sustainability Criteria #14 (Section 1.2) states:

> *The OVGA opposes groundwater export from the Eastern Sierra that would result in negative consequences to groundwater sustainability, the environment, local economy, and residents.*

There has been a long-running Advisory Committee assisting with the evaluating the potential of groundwater pumping on Owens Lake. Represented were the CSLC, county representatives including ICWD, tribal representatives, CDFW, environmental groups, Great Basin Unified Air Pollution Control District (GBUAPCD), and private well owners and industries such as Rio Tinto and Crystal Geyser. A subcommittee of this advisory group developed monitoring protocols to

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PO Box 364, Bishop, CA 93515

measure changes in vegetation. Areas of high-quality bird habitat have been developed. These are in addition Wildlife Management Areas managed by CDFW. However, recently the Advisory Group has met only twice in the past two years.

The Bristlecone Chapter endorses:

- Participation of OVGA in the OLWDP. These meetings should include members of the Advisory Committee who have invested many hours and much expertise.

The Bristlecone Chapter recommends:

- OVGA should consult closely with CSLC in the development of lease terms for protection of vegetative resources and depth to groundwater. Lease terms can be made binding in lease terms, conditions and possibilities of suspension of the leases for non-compliance.

Response: Section 4.5.1 of the GSP proposes that the OVGA actively participate in the OLGDP working group and coordinate with state and local agencies with land management responsibilities to ensure this management area is managed sustainably to avoid undesirable results.

- As with Fish Slough, OVGA should consult with CDFW and USFWS regarding impacts of groundwater use on special status species and natural communities

Response: see response to comment above regarding consultation with CDFW which would also apply to consultation with USFWS.

- OVGA should develop a position on how groundwater pumping affects not just groundwater levels, GDEs, and subsidence, but also if it leads to more net export of water from Owens Valley

Response; SGMA Implementation and Sustainability Criteria #14 in Section 1.2 of the GSP states:

> *The OVGA opposes groundwater export from the Eastern Sierra that would result in negative consequences to groundwater sustainability, the environment, local economy, and residents.*

IV. Coordination with LTWA

We share concerns with other organizations and community members regarding the separate management plans, the GSP and the LTWA, which govern groundwater resources in the Owens Valley Groundwater Basin area. Ideally, these ecologically connected areas would be managed under a single plan, but we understand these are treated as adjudicated areas under SGMA. We hope the OVGA will leverage opportunities to coordinate with LADWP in mitigating environmental impacts associated with groundwater extraction occurring with the Basin. Under SGMA, the OVGA has jurisdiction over groundwater resources adjacent to adjudicated areas, which certainly will be affected by water management by LADWP, including

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diversion of surface water resources, artesian wells, and pumping of 50,000-95,000 acre-feet each year.

We would like to call DWR's attention to the history of damaged GDEs in the adjudicated areas which have not been mitigated as promised, and springs and seeps which have disappeared or are seriously diminished in flow and associated vegetation. The LTWA provides insufficient enforcement for mitigation projects and effectively no control over annual pumping plans. LADWP owns a significant portion of the groundwater resources in the Owens Valley and is a politically and economically powerful agency which appears to have ignored obligations it has committed to. Examples of these include Five Bridges, Hines Springs, Little Black Rock Springs and many mitigation projects[1]. LADWP routinely disregards recommendations by Inyo County Water Department (ICWD) on pumping levels, even in times of drought. In addition, LADWP has approved the deepening of several wells over a period of years to access deeper aquifers. To the knowledge of the Bristlecone Chapter, no meaningful environmental assessment has evaluated the cumulative impacts of these "replacement" wells.

The Bristlecone Chapter recommends:

- The GSP should reflect that the LTWA is an MOU, not a court-ordered adjudication[2].
- In current or future iterations of the GSP, OVGA should advocate for legislative and regulatory language that includes LTWA areas within the Basin governed under SGMA.
- OVGA encourage the City of Los Angeles and LADWP to include OVGA, tribal leaders, community members and other in important planning efforts such as Operation NEXT and the five-year cycle of the Urban Water Management Plan.
-

Response: These suggestions are outside the requirements for the GSP. See General comment #3.

- Well registration, reporting and permit review as recommended in ES 4.1 and ES 4.2 should be applied to all proposed wells in the Owens Valley, including those considered as replacement wells. Applications for new or replacement wells should be available to the public in an easy-to-use form.

Response: This comment refers Management Actions 1 (Section 4.1) and 2 (Section 4.2). Text in italics added in response to this comment:

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[1] Read an article mourning of the loss of Little Black Rock Springs in the Bristlecone Newsletter July 1989 Vol 8 No 4 by botanist Mary DeDecker

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The OVGA shall determine the timing of when to consider a Well Registration and Reporting Ordinance and Well Permit Review Ordinance following adoption of the GSP. These programs will be necessary to complete and maintain a current database of pumping locations and amounts as required by SGMA. Pumpers in the Basin will be given ample opportunity and time to prepare the requested well and pumping information. Ongoing reporting of pumping would only be required for agricultural, commercial, or municipal pumpers, and CSD/mutual water companies but not *de minimis* users. Section 4.1 states:

> *The ordinance may include a one-time voluntary report to acquire information on well location, well construction characteristics, water levels, and approximate production amounts for the database.*

The proposed Well Permit Review Ordinance could require well construction permit applications submitted to Inyo or Mono Counties be provided to the OVGA for review including permits for replacement wells. Construction permits for small capacity wells for *de minimis* extractors would be reviewed to maintain a database of private wells but are exempt from most SGMA provisions including regulation of pumping."

- Monitoring of depth to groundwater as recommended in in ES 4.3 should include data and modeling obtained from LADWP.

Response: LADWP regularly provides extensive monitoring datasets to Inyo County. LADWP has not provided numerical groundwater models developed by their consultants for portions of the Basin. The ICWD continues discussions with LADWP staff regarding sharing the groundwater models and output files.

V. Minor Comments

- Page 140 of draft GSP. Response to public comment #109 says, "See response to #92," but comment #92 appears to be about a different topic. Please clarify the response to #109.

Response: There is an obvious typo in the GSP; response #92 is not germane to the question asked during the meeting. A response to the question is provided here and in Table 2-6.

Management Objectives and Minimum Thresholds are defined for the six sustainability indicators. Populations of endangered species are not a sustainability indicator. Impacts to species dependent on groundwater can be included as an undesirable result. Impacts to surface water discharge where endangered species occur will be accompanied or preceded in by changes in water level measurements upon which the Objectives and Thresholds were based.

Bristlecone Chapter of the California Native Plant Society
PO Box 364, Bishop, CA 93515

Again, thank you for the opportunity to participate in the development of the GSP. The OVGA has done a great job of assessing current conditions, identifying data gaps, and making recommendations. There is much more work to be done, but thank you for your commitment to the inhabitants of the Owens Valley Groundwater Basin.

Best regards,

Maria Jesus
Conservation Chair
CNPS Bristlecone Chapter

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[2] SB 1168: 10720.8 (c) Any groundwater basin or portion of a groundwater basin in Inyo County managed pursuant to the terms of the stipulated judgment in City of Los Angeles v. Board of Supervisors of the County of Inyo, et al. (Inyo County Case No. 12908) shall be treated as an adjudicated area pursuant to this section

Joyce Geissinger

OVGA Public Review Draft Comments

ovga, I'm going to get right to the point here, it seems as though we are running out of time. You know and I know this whole drought epidemic is uncalled for. Geoengineering , Weather Modification ; Chemtrails to be more specific are the root cause of this terrible drought we've been experiencing in the western states for too long. You have no authority to come after us citizens with rules and regulations to control our water use. But you do have the duty to go to the actual people who are responsible for making the Chemtrails which have pushed damn near every good rain and snow storm away from this area. It must stop !!! In the last 2 weeks alone I witnessed 2 or 3 good storms Chemtrailed away. We The People want Justice now ! Fairness now ! Not NWO

I'll be waiting for a positive reply thank you,

Joyce Geissinger
P.O. Box 991
Bishop, CA 93515
760-937-2732
joycegeissinger@gmail.com

Response: Comments are not germane to the contents of the GSP. SGMA grants the OVGA authority to regulate groundwater pumping. Regulation of the alleged causes of drought stated in the letter are outside the scope of the GSP and SGMA.

Frank and Patricia Hernandez

OVGA Public Review Draft Comments

Ways to comment on the Owens Valley Groundwater Sustainability Plan

COMMENT DEADLINE IS NOVEMBER 8, 2021

Computer: Go to ovga.us/gsa-plan/. You may leave your comment at the bottom of the page. You may also upload your comment in a word document into the web page.

Mail: Send your comments to the Owens Valley Groundwater Authority:

Street Address
135 Jackson Street
Independence, CA 93526
Mailing Address
P.O. Box 337
Independence, CA 93526

RECEIVED
NOV - 1 2021
Inyo County Water Dept.

Email: You may email your comments to: ovga.us/contact-us/

USE THIS COMMENT FORM:

NAME Frank and Patricia Hernandez DATE 10-26-21

ADDRESS: 582 Dawson Ranch Rd Hammil Valley CA. 93514

YOUR COMMENT ON OVGA PLAN: Please Respect our Rights as property owners! We moved here from the city to enjoy the beauty, peace and quiet and privacy that this valley offers. We have purchased and maintained our own private well with no restrictions. ~~The~~ Property was declared a flood zone a few years ago - this was not so when we purchased property. So now it is difficult for a person to get a loan, and if financed flood insurance is very expensive. Monitoring our wells, and eventually telling us how much water we can use - this after it has been pumped. Would not make this property worth anything! We do not want anyone on our property! We have locked gates for a reason. Please leave us and our valleys alone. Sell our water! No! No!

Frank and
Patricia Hernandez

Response: Comments are not germane to the contents of the GSP. Domestic well owners (*de minimis*) are not subject to regulation under SGMA. Any monitoring conducted by the OVGA in privately owned wells is strictly voluntary. The OVGA will not sell Tri-Valley water.

Susan Johnson

OVGA Public Review Draft Comments

Ways to comment on the Owens Valley Groundwater Sustainability Plan

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RECEIVED
NOV - 1 2021
Inyo County Water Dept.

Email: You may email your comments to: ovga.us/contact-us/

USE THIS COMMENT FORM:

NAME Susan Johnson DATE 10-28-2021

ADDRESS: 57451 Hwy 120, Benton, CA 93512

YOUR COMMENT ON OVGA PLAN:

I strongly believe it would be in the best interest of the residents and farmers of the Tri-Valley Groundwater Management District here in Mono County that we withdraw from the OVGA in Inyo County...

On December 15, 2020 - Mono Board of Supervisors Meeting minutes show that they already voted to remove themselves from OVGA at plan completion!

We need to keep our own Entity here in Mono County...

Susan Johnson

Response: Comments are not germane to the contents of the GSP. Recommendations regarding membership in the OVGA is not part of the GSP adoption process. Any comments about Mono County's membership in the OVGA should be directed to the Mono County Board of Supervisors, c/o Mono County Clerk, PO Box 237, 74 School Street Annex I, Bridgeport, CA 93517.

Rick Kattlemann

OVGA Public Review Draft Comments

Name Rick Kattleman
Date 11/08/2021
Email rick@inyo-monowater.org
Phone (760) 935-4088
Address
143 Jeffrey Pine Road
Crowley Lake, CA 93546
United States

Leave a Comment

Overall, the plan appears to be very sound and thorough. The work of the OVGA board, staff, and consultants in developing this plan is greatly appreciated. The GSP seems to be as good as could be expected with the massive constraint of being unable to address much of the groundwater basin. Although the legislatively determined limits of the OVGA and GSP are a legal reality, these boundaries are hydrologic nonsense. Nevertheless, the GSP dealt with that reality in a sensible manner.

I recommend that the GSP be slightly revised to include some mention of project work that has been done or is the planning stage by the Inyo-Mono Regional Water Management Group (e.g., in Big Pine and Keeler). Unfortunately, at a statewide level, SGMA was not sufficiently integrated with the Integrated Regional Water Management Program. In the Owens Valley, there should be some opportunities going forward to coordinate these efforts, especially where disadvantaged communities and small community water systems could benefit. The Inyo-Mono RWMG may also be able to help with future outreach activities of the OVGA, especially to the tribes of the Owens Valley and disadvantaged communities. In the draft plan, the few mentions of the Inyo-Mono RWMG should be made consistent: IMRWMG (e.g., page 40 and 288) IRWMG (page 105), and IMIRWMP (e.g., pages 284, 290, 295) are used.

Response: Additional information about IRWMP projects was included in Sections ES 4.5 and 4.5.2. The interest and offer of future integration of the IRWMP and the OVGA outreach is appreciated. See Section 2.1.9.3 which discusses the difficulty in outreach in Tri-Valley and Section 4.4 which includes another possible OVGA groundwater management public education campaign concurrent with groundwater model development in the Tri-Valley.

A few comments about details of the draft Executive Summary of the GSP:

ES-1 suggest mentioning in the first paragraph that the GSP does not pertain to the adjudicated portion of the basin; get that point across immediately

Response: The following text was added to Section ES-1:

> *Preparation and implementation of the GSP by the OVGA is discretionary as long as the Basin remains very low or low priority. This GSP does not pertain to lands in the Basin that are exempt from SGMA, e.g. Federal and state owned lands, Tribal Reservations, and Los Angeles Department of Water and Power (LADWP) lands managed pursuant to the Long Term Water Agreement (LTWA). LADWP lands in Inyo County are referred to as adjudicated; other lands in the Basin are referred to as GSP lands in this document. Los Angeles-owned lands in the Basin in Mono County are not exempt from SGMA.*

ES-3 suggest rounding off the estimated costs. That level of precision doesn't mean much.

Response: No costs are provided in ES-3. Values in ES 1 and ES 5 are rounded to the nearest $5.

ES-6 the paragraph about "external" influences is a good summary as far as it goes, but should include at least one sentence about potentials involving IWVGSA

Response: Section ES-6 does not exist but presumably the comment pertains to ES-1, p.6. The following summary explanation was added to the GSP:

> *The Indian Wells Valley Groundwater Sustainability Plan includes a potential project to exchange approximately 7,650 acre-feet per year (AFY) water with LADWP. The IWVGA does not currently have access to any water supply from outside of their basin.*

ES-15 middle of bottom paragraph: suggest change to "Water levels under alluvial fans are typically 10s or 100s of feet..." might search for unnecessary apostrophes elsewhere

Response: . The cited text is in ES 2.2.2. and Section 2.2.2.5, and the suggested grammatical correction was made.

ES-24 end of first full paragraph: fix "...CSLC to affect (or lower ..." ES somewhere duplicating a map or two within the Executive Summary could be helpful

Response: The cited text is in ES 3.2.3. .The suggested correction was made.

Ceal Klingler

OVGA Public Review Draft Comments

C. Klingler
940 Starlite Dr.
Bishop, CA 93514

Owens Valley Groundwater Authority
c/o Inyo County Water Department
135 S. Jackson St.
Independence, CA 93526

To whom it may concern,

Thanks very much for the opportunity to comment on the Draft Groundwater Sustainability Plan. A few comments and concerns follow.

I. The standards for "undesirable conditions" are set too low.

A. Conditions are not "overall sustainable" in a basin when one or more species are being pushed significantly towards extinction due to groundwater conditions somewhere in the basin. Criteria for undesirable conditions should be changed in the GSP.

Authors of the report observe on p. 236 that "There are currently no documented undesirable results for the indicators throughout the Basin reflecting the overall sustainable conditions." Given that
1) extremely undesirable results are occurring in the basin—e.g., loss of groundwater-dependent marshes in northeast Fish Slough, corresponding losses in populations of Owens Valley speckled dace and Owens pupfish, and, presumably loss of any remaining springsnails dependent on the Northeast Springs of Fish Slough, and 2) the standards *already* exclude a large portion of the basin, i.e., lands that are treated as adjudicated and excluded from consideration for the GSP, 3) the failure to rate such conditions as undesirable results for the Basin as a whole suggests that standards for undesirable conditions are flawed, not that conditions are sustainable.

Significant population losses for species that are already close to extinction *due to changes in groundwater conditions* should register as unsustainable for the Basin as a whole. If a species has become so rare within a basin that a change in groundwater conditions in one portion of the basin can significantly affect the species' future chances of existence *in the universe at large*—not just in the basin—that should be rated as an undesirable indicator for the whole basin. **When conditions are so dire that a change in one portion of the basin pushes an entire species—or several—significantly closer to extinction, GSP monitoring standards should not indicate that conditions are "overall sustainable."**

Response: The Basin Ranking included criteria related to groundwater conditions and trends, but also criteria related to groundwater reliance, population, well density, etc. that are related to the geography of the Basin. The wording in the GSP was revised to remove inferences between sustainability and basin ranking (e.g. see Section 1.2 and elsewhere).

B. Thresholds for subsidence should be set at zero or close to zero, not 3.6".

1) Setting subsidence standards at unrealistic levels for the Owens Valley is a warning signal that planners are setting thresholds that will never be triggered. Given that subsidence appears to be extremely rare, is mostly unrecorded, and has only been recorded at Owens Lake at 0.43" (see GSP appendix 8), a subsidence of even one-half inch should be regarded as an indicator that something has gone wrong.

2) Subsidence should not be regarded with equanimity in any portion of the basin, particularly at the Owens Lake. Even if the “majority of subsidence” there is elastic in terms of the ability of compressed layers to recover, subterranean species (e.g., spadefoot toads, Western toads, any one of the Owens Valley’s endemic tiger beetle subspecies, etc.) are not elastic when trapped beneath dry, compressed soil or clay. Furthermore, groundwater pumping enough to produce subsidence may affect spring flow, which would affect other special status species such as springsnails. The GSP should neither create special status species by pushing stable species into less stable conditions nor push already rare species closer to extinction.

Response: Groundwater-caused subsidence occurs in the fine-textured layers separating aquifers at depth resulting in a drop in ground surface elevation. It is a distinctly different process than compaction of surface soils that would directly impact the species mentioned. It is highly unlikely that subsidence would result in surface compaction especially if limited as described below.

The measurable objective (goal) for land subsidence has been set to less than 0.07 ft (0.84 inches), the vertical resolution of the remotely sensed inteferometric synthetic-aperture radar (InSAR) data provided by DWR (TRE Altamira, 2021; Towill, 2021). This value represents maximum instrument sensitivity. This value for the objective was chosen because no subsidence has been observed in Basin and the goal is to maintain those conditions.

The minimum threshold of 0.3 ft (3.6 inches) of subsidence measured by InSAR has been proposed as less than significant and reasonable. The minimum thresholds for subsidence are based on the variability in repeat measurements at permanent GSP stations reflecting elevation changes caused by factors other than subsidence (approximately 1.6 inches, see Appendix 8). If this amount of subsidence is observed, it is approximately the smallest value likely not due to noise or some other cause.

C. GSP authors should avoid misleading language with regard to current conditions. Instead, the OVGA should 1) acknowledge real-world conditions, including that even if LADWP has not joined the OVGA, Los Angeles’ practices in the Owens Valley will affect sustainability and 2) adopt language that indicates that the 1991 LTWA and 1997 MOU will be strictly enforced to protect OVGA stakeholders.

The authors of the report postulate that “the Basin is currently ranked by DWR as a low priority basin suggesting that as a whole, groundwater in the basin is managed sustainably with respect to SGMA.” (p. 233) That is not what the DWR ranking reflects. If DWR had included the entire basin in its calculations, rather than being petitioned to exclude LADWP groundwater pumping and exports and to treat the basin as adjudicated, the basin would not appear to be managed sustainably. The basin also does not appear to be managed sustainably in light of Appendix 12 hydrographs, some of which indicated that monitoring wells occasionally run dry and groundwater tables sometimes drop well below rooting zones. Such hydrographs don’t indicate resilient groundwater tables. In addition, groundwater doesn’t respect DWR boundaries. The GSP should, at the very least, include commitments to enforce agreements within the treated-as-adjudicated lands and set firm standards that prevent LADWP from adopting significant new groundwater pumping plans or harming lands and stakeholders outside the borders of land treated as adjudicated, especially at the Owens Lake.

Response: The Basin Ranking includes criteria related to groundwater conditions and trends, but also criteria related to groundwater reliance, population, well density that are related to the geography of the Basin. The wording in the GSP was revised to remove inferences between sustainability from basin ranking (e.g. see Section 1.2).

DWR prioritization included the Basin as a whole. DWR prioritized basins based on a consideration of the components specified in Water Code Section §10933(b) and described in the GSP Section 3.1, including LADWP lands. Hydrographs in the Basin in Inyo County are resilient and resemble a dynamic steady state condition, fluctuating but not chronically declining requiring correction under SGMA (see Figures 2-18 and 2-20).

With regard to LADWP See General response #2.The OVGA cannot enforce commitments to agreements in the adjudicated lands contrary to SGMA. Also, the Owens Lakebed is owned and managed by the State Lands Commission. SGMA "…*does not authorize a local agency to impose any requirement on the state or any agency, department, or officer of the state. State agencies and departments shall work cooperatively with a local agency on a voluntary basis*" (CWC §10726.8(d)). The OVGA cannot simply forbid pumping on state-owned lands. State agencies, however, are required to "…*consider the policies of* [SGMA], *and any groundwater sustainability plans adopted pursuant to* [SGMA], *when revising or adopting policies, regulations, or criteria, or when issuing orders or determinations, where pertinent"* (CWC §10720.9). This GSP sets sustainable management criteria in test wells surrounding the lake and proposes that the OVGA actively participate in the working group and coordinate with state and local agencies with land management responsibilities to ensure this management area is managed sustainably to avoid undesirable results (GSP Section 4.5.1.).

D. At a general level, the GSP should strive for resiliency rather than chronic illness. The GSP does not call for improving conditions; instead, standards are set to respond to dire emergencies and allow current conditions—which would ordinarily not be regarded as low-priority by state standards—to either remain the same or get worse (i.e., be maintained at levels" at or above those during the 2012-2016 drought" (p. 26). Even if OVGA stakeholders are reluctant to commit to on-the-ground improvement, why not include aspirational components in the GSP mission statement? Healthy groundwater-dependent ecosystems are more resilient in emergencies and are more sustainable than drought-stressed vegetation that is subjected to outdated pumping strategies and climate-change-driven increases in temperatures and evaporation rates that would be difficult to adapt to even without groundwater table depletions. Sustainability at the least should include the goal to *first, try to do no harm. S*earching for opportunities to improve conditions should not be excluded from the GSP.

Response: Generally it is true that healthy GDEs are more resilient resistant to perturbation but not necessarily so. Springs, for example, are highly susceptible to groundwater pumping impacts even if previously undisturbed. Setting standards as desired by this comment also requires the GSP include management actions to attain those standards. Given that in most of the Basin where GDEs exist, the GSP would only apply to non-LADWP pumpers, and therefore place the entire burden upon those users to raise water levels to the desired depth. Also refer to General Comment #4.

Sincerely,
Ceal
Klingler

LOS ANGELES DEPARTMENT OF WATER AND POWER

OVGA Public Review Draft Comments

Los Angeles Department of Water & Power
BUILDING A STRONGER L.A.

November 4, 2021

Board of Directors
Owens Valley Groundwater Authority
P.O. Box 337
Independence, California 93526

Dear Owens Valley Groundwater Authority Board Members:

Subject: Comments on the Owens Valley Groundwater Basin - Groundwater Sustainability Plan - Public Review Draft (September 23, 2021)

The Los Angeles Department of Water and Power (LADWP) greatly appreciates the opportunity to comment on the public review draft of the Groundwater Sustainability Plan (GSP) for the Owens Valley Basin. We recognize the significant work effort by the Groundwater Sustainability Agency (GSA) members and consultants represented by this document. The document is well written and illustrated.

The attached table (Attachment A) lists LADWP comments on the GSP, referenced to the text and page numbers of the document. Of this list of comments, our main concern is with the minimum thresholds for the Owens Valley and Owens Lake management areas, which are inconsistent with the Sustainable Groundwater Management Act (SGMA), under which the document was prepared. While minimum thresholds as defined by the SGMA are to represent significant and unreasonable, unsustainable conditions, the GSA has defined the minimum thresholds as represented in temporary drought conditions that did not cause unsustainable conditions, and from which the basin fully recovered afterward.

The GSP contains no technical information to support minimum thresholds based on the 2012-2016 drought in either the Owens Valley or Owens Lake Management areas. As noted throughout the document, significant and unreasonable undesirable conditions were not observed during this time period. GSP Regulations §354.28(b)(1) states that "The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting." Such justification is not provided in the GSP.

111 N Hope Street. Los 1\nq le\. C.1ilforn,a 90011 2607 Marling Address PO Bo, 51111. Los Angeles. CA 90051-5700

Telephone (213) 3G7 4211 lad\'/p com

As noted by the Department of Water Resources in Best Management Practices for Sustainable Management Criteria (2017), undesirable results occur when conditions related to any of the six sustainability indicators become significant and unreasonable. It also states that GSA must consider and document the conditions at which each of the six sustainability indicators become significant and unreasonable. The GSP has not demonstrated how the proposed minimum thresholds in the Owens Valley and Owens Lake Management areas constitute significant and unreasonable conditions.

In addition, the California Water Code §10721(x)(1) states that: "Undesirable result" means the effects caused by groundwater conditions throughout the basin, including: "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods."

Thus, the minimum threshold must account for long-term chronic lowering throughout the basin or management area, and not just one or several localized wells or monitoring locations, and temporary drought conditions which later recover from recharge (as occurred in both the Owens Valley and Owens Lake Management areas in 2017) are not sufficient to establish a chronic lowering of groundwater levels or a significant or unreasonable, undesirable result.

While the GSP does not define minimum thresholds in terms of occurrence of basin- wide (or management area-wide) undesirable results, the LADWP has developed a monitoring network at Owens Lake specifically designed to monitor and protect groundwater-dependent resources. LADWP has also developed resource protection protocols (analogous to minimum thresholds) conservatively linked to undesirable results. We invite the GSP to incorporate this work, which is fully aligned with the SGMA and is publicly available.

LADWP supports the sustainable management of groundwater in the Owens Valley and throughout the state and appreciates the work of the Owens Valley Groundwater Authority (OVGA) in these efforts. The LADWP would be happy to provide further information or assist the OVGA in modifying the draft document to align with the intent and requirements of the SGMA.

For any questions or more clarification on LADWP comments, feel free contact Saeed Jorat, Waterworks Engineer , at (213) 367-1119.

ORIGINAL SIGNED BY ADAM PEREZ

Adam Perez
Manager of Aqueduct

SMJ:mt
c: Dr. Aaron Steinwand, Inyo Valley Water Department
Dr. Saeed M. Jorat

Attachment A

LADWP's Comments on the *Draft Groundwater Sustainability Plan for the Owens Valley Groundwater Basin* Dated September 23, 2021

No.	Page(s)	GSP Text or Figure Number	Comment
1	6	"These [meaning LADWP's] activities may affect the ability of the OVGA to maintain sustainable groundwater management in the basin."	There is no evidence to support this statement. Based on extensive studies by the USGS and others in the 1980s and 1990s, the Long-Term Water Agreement (LTWA, included as Appendix 2 to the Groundwater Sustainability Plan (GSP) states: "Each well field area has been included in a designated management area [now referred to as the adjudicated area]. The boundaries of each management area have been established so as to contain all vegetation that could be impacted as a result of groundwater pumping from the well field area during "worst case" conditions (multiple dry years along with heavy pumping)". If the Owens Valley Groundwater Authority (OVGA) has evidence of current or future unsustainable conditions in the Owens Valley Management Area as a result of LADWP's activities, it should be noted in the GSP. If undesirable results have not been noted in the 30-year history of the LTWA over numerous different climatic conditions, they are unlikely to occur in the future, and this should be noted in the GSP. Response: LADWP has sufficient pumping capacity to cause water levels to decline within the GSP area of the Owens Valley and possibly the southernmost reaches of Chalfant Valley. LADWP pumps considerably less than capacity due to the management and vegetation protection provisions of the LWTA. The GSP recognizes that water levels in most of the Owens Valley and Owens Lake Management Areas are presently in a dynamic steady state, fluctuating but not chronically declining. The statement in the GSP referred to in this comment is precautionary and recognizes the simple reality that in the future, LADWP's operations may change.

2	6	"The Inyo/Los Angeles LTWA contains provision to protect private wells and to prevent other significant impacts on the environment that cannot be acceptably mitigated, including in the non-adjudicated portion of the Basin."	As noted in the LTWA, "adverse effects [on private wells] shall be promptly mitigated by the Department." In the history of the LTWA, the Los Angeles Department of Water & Power (LADWP) has abided by this provision of the LTWA and will continue in the future. Response: It is encouraging that LADWP intends to continue to comply with the LTWA.
3	17	"In Owens Valley and Owens Lake Management Areas, long-term recharge and discharge are approximately in equilibrium based on analysis of both water balance components and long-term monitoring showing stable groundwater levels."	This is true. As noted in several portions of the GSP, there is ample evidence that the LTWA adjudicated area as a whole has been sustainably managed by the LADWP.
4	21	"There are currently no documented undesirable results for the indicators throughout the Basin reflecting the overall sustainable conditions."	This is true. The key word is "throughout". Although there are indications of undesirable results in the Tri-Valley Management Area, there is no evidence of basin-wide undesirable results in the Owens Valley or Owens Lake Management Areas or the Owens Valley basin as a whole.
5	22	"Based on available geologic, hydrologic, and geochemical evidence, pumping in the [Tri-Valley] management area is the cause of declining water levels and spring flow in Fish Slough."	This is an important point. Recent testing of LADWP well W385 (the closest LADWP production well to Fish Slough) showed no impact to the upper reaches of Fish Slough where spring flow originates, indicating declines in Fish Slough flows are not the result of LADWP's groundwater management. Response: This is true as the test was short-lived (only 2 months) from one well conducted according to a plan with extensive monitoring and drawdown triggers to stop pumping if effects greater than expected occurred. No trigger was hit. The conclusion that W385 cannot cause changes in Fish Slough discharge should not be extrapolated to greater pumping amounts or other nearby wells.
6	24	"Presently water levels are stable in the non-adjudicated portion of the [Owens Lake] management area. …Groundwater levels at present are stable and not concerning, and it is unlikely that undesirable results related to sustainable yields or available groundwater storage will occur absent increased pumping related to LADWPs OLGDP…The primary subsidence threat is future LADWP pumping under the lakebed from deeper aquifers."	This statement implies that the Owens Lake Groundwater Development Plan (OLGDP) will cause undesirable results, whereas other activities such as increased private pumping will not. In fact, the OLGDP has proposed extensive monitoring and conservative minimum thresholds to ensure sustainability (including prevention of subsidence), whereas there are no such discussions regarding other groundwater users. Other groundwater users may also cause a subsidence threat, but there are no monitoring facilities proposed to evaluate this as there are with the OLGDP. Response: The OLGDP is the only large proposed pumping project in the Management Area. The GSP is

			required to recognize anticipated projects but does not have to include all possible unknown projects. Other projects subject to the GSP will be evaluated against the sustainable management criteria like any LADWP groundwater pumping project not managed pursuant to the LTWA.
7	25	"A well vulnerability assessment was performed for 189 domestic wells in the management area….. this number of wells being negatively affected by declining water levels is considered significant and unreasonable. Water levels in monitoring wells and Fish Slough spring flows are highly correlated. Because the water levels in Fish Slough and Tri-Valley have similar long-term declining trends (albeit at different rates), a similar extrapolation to estimate 2030 water levels based on the rate of water table decline was used to set minimum thresholds in representative monitoring wells in Fish Slough. The minimum thresholds for wells in Fish Slough represent less than 1.5 feet of additional decline. …An	This is an important analysis because the determination of an appropriate minimum threshold for the Tri-Valley Management Area is based on potential or estimated impacts to beneficial uses such as domestic wells and spring flow in Fish Slough. As noted in the later text regarding the Owens Valley and Owens Lake Management Areas, an analysis of impacts on beneficial uses was not attempted in these management areas. Instead, minimum thresholds were derived arbitrarily from hydrograph information without analysis of effects (or lack thereof) on beneficial uses. Conversely, for the Owens Lake Management Area, an analysis of impacts to beneficial uses has been performed for the OLGDP. The OLGDP information and analysis are readily available to the public on LADWP's website (http://www.LADWP.com/olg) and can be included in the GSP. Additional information is available from the Groundwater Working Group meetings in which ICWD was a co-sponsor and has access to all working group products.

		average flow rate of 0.1 cubic feet per second from the Fish Slough Northeast Spring was chosen as the minimum threshold for the interconnected surface-water depletion sustainability indicator. The minimum threshold represents the minimum flow rate that is necessary to allow management of flows to maintain current habitat conditions according to the CDFS."	Although the use of different minimum thresholds in separate management areas is consistent with SGMA regulations, the OVGA is required to explain the entirely inconsistent hydrologic and geologic rationale used in the Tri-Valley area and the two other management areas in the Owens Valley Groundwater Basin. Response: See summary response #1 below
8	26, 235, 245, 249	"Minimum groundwater elevations observed during the 2012-2016 drought were used to establish the minimum thresholds for groundwater level declines, groundwater storage reductions and surface water depletions [in the Owens Valley Management Area]. If no data were available in a representative monitoring well during this time, the minimum groundwater elevation observed since January 1st, 2000 was used. Impacts to GDEs are preceded by declines in water levels and maintaining water levels at or above those during the 2012-2016 drought should prevent impairment of GDE caused by pumping in the non-adjudicated area."	There is no technical information to support minimum thresholds based on the 2012-2016 drought in either the Owens Valley or Owens Lake Management Areas. As noted elsewhere in the document, significant and unreasonable undesirable conditions were not observed during this time period. GSP Regulations §354.28(b)(1) states that "The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting." This justification is not provided in GSP. As noted by the Department of Water Resources in Best Management Practices for Sustainable Management Criteria (2017), undesirable results occur when conditions related to any of the six sustainability indicators become significant and unreasonable. It also states that GSA must consider and document the conditions at which each of the six sustainability indicators become significant and unreasonable. The GSP has not demonstrated how the minimum thresholds in the Owens Valley and Owens Lake Management Areas constitute significant and unreasonable conditions. In fact, it is stated that unsustainable conditions did not occur. In addition, the California Water Code §10721 x(1) states that and "undesirable result" is a groundwater condition throughout the basin that includes: "Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by

			increases in groundwater levels or storage during other periods." Thus, the minimum threshold must account for chronic lowering throughout the basin, and not just one or several localized wells or monitoring locations, and temporary drought conditions which later recover from recharge (as occurred in both the Owens Valley and Owens Lake Management Areas in 2017) are not sufficient to establish a chronic lowering of groundwater levels or a significant or unreasonable undesirable result. Finally, GSP Regulation §354.28(b)(4) states that a description of minimum thresholds shall include "How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests". As a user of groundwater with property interests in both the Owens Valley and Owens Lake Management Areas, LADWP is interested in groundwater banking or aquifer storage and recovery. As noted in the LTWA §VIII "It is recognized that development of new groundwater storage, and the implementation and operation of feasible groundwater banking and recharge facilities in the Owens Valley and in Rose Valley that will not cause significant effects on the environment may be beneficial". Groundwater banking and storage is common beneficial use in groundwater basins that would be prohibited by arbitrary minimum groundwater elevations that prohibit temporary and localized lowering of groundwater elevations during the recovery phase of groundwater banking. This was not considered as required by §354.28(b)(4), nor was LADWP's interest in the beneficial use of conserving high-quality potable water from the Owens Valley by sustainably using saline water from deep aquifers at Owens Lake to supplement high water demand for dust mitigation. Response: See summary response #1 below
9	27	"Given that water levels in this [Owens Lake] management area fluctuate but no long-term declining trends are present that pumping stress is currently low, minimum groundwater elevations observed during the 2012-2016 drought were used to establish the minimum thresholds for groundwater level declines and groundwater storage reductions. If no data were available in a	See the comment above regarding the lack of technical justification to establish minimum thresholds. A key beneficial use of groundwater in the Owens Lake Management Area is interconnected surface water (springs and seeps). GSP regulations §354.28 c(6) states that: "The minimum threshold establish for depletion of interconnected surface water shall be supported by the following: (A) The location, quantity, and timing of depletions of interconnected surface water.

		representative monitoring well during this time, the minimum groundwater elevation observed since January 1st, 2000 was used. Maintaining water level elevation at or above historical levels is not anticipated to result in significant and unreasonable impacts in the future”	(B) A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this paragraph.” No numerical model or equally effective method is provided in the GSP and the model results published by LADWP in the management area are not considered. Numerical model results and analysis for the Owens Lake Management Area are publicly available on LADWP’s website. Response: See summary response #1 below
10	39, 286	“The Owens Lake Groundwater Development Program [OLGDP] has identified the sensitive resources potentially affected by the project, most of which overlap with SGMA sustainability indicators. Details of the potential pumping project including the monitoring methods and location or management triggers are not yet finalized. A fundamental principal of the OLGDP, however, is to include an adaptive management strategy to evaluate monitoring results, and based on the observations, adjust pumping, monitoring, or management triggers, or take other actions to avoid impacts to sensitive resources.”	All of the sensitive resources identified in the OLGEP overlap with SGMA sustainability indicators. In fact, the proposed monitoring methods, and sustainability indicators for OLGDP are more comprehensive than the GSP because they are based on detailed evaluation of potential undesirable results supported by detailed hydrogeologic analysis and numerical modeling. Information related to the proposed OLGDP sustainability criteria is publicly available on LADWP’s website and/or through the groundwater working group. The GSP text is correct in noting that the OLGDP includes an adaptive management strategy using aquifer testing, starting with conservative low pumping rates, and detailed management triggers (minimum thresholds) to protect beneficial uses. It is important to note that the minimum thresholds proposed in the GSP based on the 2012 to 2016 drought will prevent the adaptive management strategy because necessary temporary testing may not be possible if minimum thresholds are based on the 2012 to 2016 drought which had little effect on deep aquifers. Response: see summary responses #1 and #2 below

11	39	"Given the various sources of uncertainty regarding oversight for the OLGDP, this GSP was prepared assuming it could apply to the lakebed and be amended in the future."	It is unclear how and when the GSP should be amended, or why it would need to be amended if the GSP were properly applied to the Owens Lake Management Area during initial development.
12	75, 221	"The LADWP chose not to provide groundwater models of the valley nor information contained in the models pertaining to water balance and related requirements of the GSP."	This is a misrepresentation. The water balance from the OLGEP study of Owens Lake is cited in the GSP (page 223). A complete listing of information about the OLGEP model (Owens Lake Management Area) is publicly available on LADWP's website. The Inyo County Water Department (ICWD) participated in the development of the Owens Lake model through the Blue Ribbon panel (The OVGA did not exist at the time). LADWP is currently working cooperatively with ICWD on improvements to the Bishop Wellfield model and anticipates doing so in future Owens Valley Management Area model updates. Danskin's 1998 USGS work provides more than enough information for a water balance evaluation for the Owens Valley Management Area. Response: See summary response #3 below.
13	77	"When this flow reaches the Owens (dry) Lake delta, it is either used for dust control or pumped back to the Los Angeles Aqueduct."	Flow is also released onto the Owens Lake delta by LADWP for habitat preservation. Response: Delta habitat use for mitigation was added to this sentence in the Final GSP.
14	86	"The OVGA may evaluate whether these resource protection criteria [referring to OLGDP resource protection protocols] are suitable for inclusion in the GSP as sustainability criteria for resource at Owens Lake."	The resource protection criteria from the OLGEP is currently suitable for the GSP because they are based on a more technically sound basis and supported by numerical modeling. The LADWP will continue to work with stakeholders in Owens Valley (including the OVGA) as OLGDP is being developed and will provide additional information for resource protection protocols for the GSP if requested. Response: No final project description or monitoring or mitigation plan with resource protection criteria have been released by LADWP.

15	89	"Los Angeles exports approximately 100,000 – 500,000 AFY from Owens Valley for municipal use in Los Angeles, and extracts approximately 50,000-95,000 AFY of groundwater, with annual amounts of varying with runoff conditions. These activities may affect the ability of the Owens Valley Groundwater Authority to achieve sustainable groundwater management in the basin."	It should be noted that the entirety of water extracted (or pumped) by LADWP is used to supply (directly or indirectly) in-valley demands including irrigated lands, town water systems, Enhancement/Mitigation projects, and Owens Lake dust mitigation project…and not for export. Much of this water percolates back to the aquifer, supporting sustainable groundwater management and the economy of the valley. As noted in the GSP document, there is ample evidence that the Owens Valley Management Area has been and currently is sustainably managed. Response: See summary response #4 below
16	90	"Depending on the terms of such an agreement, Los Angeles may be motivated to increase water transfers from the Owens Valley to maximize water diversions to Indian Wells Valley."	LADWP has no agreement with Indian Wells, however, exchanging Los Angeles Aqueduct water for State Water Project water is a potential example of efficient water management in California that could save the State's crucial public funds and other resources. Such a project also may increase reliability and reduce export from Inyo County by providing storage in wet and very wet years for use in drought periods. Response: See summary response #4 below
17	90	"Groundwater production in the Owens Basin for export and use in the Indian Wells Basin would be subject to SGMA."	All of the groundwater production by LADWP in Owens Valley are used directly or indirectly in Owens Valley Basin. Exported water from Owens Valley is primarily surface water from Eastern Sierra runoff. Response: See summary response #4 below
18	219	"Potential pumping effects on GDEs are the subject of LADWP's ongoing studies"	These studies (which are necessary to establish a technical basis for minimum thresholds) have been completed (with the exception of vegetated dune areas east and south of Owens Lake which will be completed in the near future). The GSP should pattern minimum thresholds after the OLGDP approach as it did for the Tri- Valley area, namely, linking minimum thresholds to significant and unreasonable undesirable results. The approach utilized in the OLGDP is an example of this approach and should be adopted in the GSP. Response:; See summary response #1 below

19	236	"There are currently no documented undesirable results for the indicators throughout the Basin reflecting the overall sustainable conditions."	This was true for the 2012 to 2016 drought period, meaning there is no technical basis for use of this period to develop minimum thresholds. Response: See summary response #1 below
20	242	"A Minimum Threshold is defined as "a numeric value for each sustainability indicator used to define undesirable results (Reg. 351 (t)). A value for each sustainability indicator denoting undesirable results (Section 3.2) must be include in the GSP and consider the beneficial uses and users of groundwater and other interests within the Basin."	The OVGA should utilize the procedures described in the SGMA regulation to set the minimum threshold (i.e. conditions representing significant and unreasonable undesirable results). The temporary conditions of the 2012- 2016 drought during which unsustainable conditions were not observed are not appropriate for minimum thresholds. The GSP should describe the actions the OVGA will take if a minimum threshold is encountered. Response: See summary response #1 below
21	247	"These [minimum groundwater threshold] values are presented in Table 3-6."	Table 3-6 is labeled measurable objectives instead of minimum thresholds. Response: See summary response #1 below
22	247	"No significant and unreasonable impacts within the management area were reported during this [2012-2016 drought] period."	According to the SGMA, this indicates the 2012-2016 drought period is not appropriate for minimum thresholds. Minimum thresholds are defined by significant and unreasonable impacts occurring, yet the GSP specifically states no such conditions occurred. Response: See summary response #1 below
23	248	Table 3-6	California Water Code §10721 x (1) states that: "Undesirable result" means effects caused by groundwater conditions *throughout* the basin. There is no clear rationale for a minimum threshold at a single well as suggested by Table 3-6. In addition, the rationale for selection of representative monitoring wells is unclear. For example, well T908 is screened at a depth of 1,360 to 1,400 feet below ground surface (fbgs), with significant low- permeability strata above the screen from 300 to 500 fbgs. It is unclear how this well is representative of beneficial uses such as private wells and GDEs, which typically depend on shallow groundwater, particularly when the
			minimum threshold still maintains an artesian head of 43 feet above ground surface in T908. This is true of all deep wells (in aquifers 2 through 5) in Table 3-6. Response: See summary response #1 below

24	248	Table 3-6	Approximately 1/3 of the monitoring wells have a minimum threshold which is above the land surface. These artesian conditions mean there is still an upward gradient toward shallow groundwater-dependent resources and the shallow water table is not affected. Again, there is no demonstrated link of minimum thresholds to undesirable results or unsustainability in the GSP as required by SGMA. Response: See summary response #1 below
25	249	"Minimum thresholds based on a reduction in head gradient measured near springs and flowing artesian wells both vertically and horizontally may be included in a future GSP update. Further analysis and data collection are required to develop these thresholds which are part of the ongoing collaborative LADWP OLGDP"	LADWP has installed piezometers and monitoring wells to measure the head gradient near springs and flowing artesian wells, and thresholds have been developed. They should be utilized in the GSP as suggested in OLGDP resource protection protocols. The next logical further analysis and data collection is operational testing of wells, which could be prohibited by the minimum thresholds suggested in the draft GSP. Response: See summary response #1 below
26	268	"The relationship between interconnected surface water and groundwater discharge can be effectively monitored by comparing changes in groundwater head in a nearby monitoring well to spring discharge in a surface water gauge. The historical relationship between groundwater levels and spring flow in Fish Slough is evident. Similar relationships are expected to be developed in the Owens Lake area as more data are collected as part of the ongoing Owens Lake Groundwater Development Project and incorporated into the OVGA database."	There are already several years of head and gradient measurements surrounding Owens Lake that have been developed and presented in public meetings and are publicly available on LADWP's website. This data should be presented in the GSP and utilized for future monitoring of spring flow around Owens Lake.

27	269	"Chronic lowering of groundwater levels in the Owens Valley and Owens Lake management areas have not been observed and are unlikely."	This is further evidence that the Owens Valley Management Area is sustainably managed, and if the OLGDP protocols are adopted, so will the Owens Lake Management Area. Response: See summary response #1 below
28	270	"As part of the OLGDP, LADWP has proposed to monitor surveyed ground surface locations and install two extensometer locations. As a participant in the Owens Lake Groundwater Working Group the OVGA could insist that survey points extensometer or tiltmeter monitoring be instituted and could add these new locations to the GSP."	As noted, LADWP proposed survey points and install extensometers as part of the OLGDP as the best technical method to monitor subsidence, there is no reason for the to "insist" this monitoring be instituted. Response: comment noted

29	270, 271	"In addition, where groundwater discharge to the surface is primarily related to the amount of upward groundwater gradient, groundwater elevation measurements are an effective proxy for determining impacts to interconnected surface/ groundwater….Examining hydraulic head differences in well clusters consisting of adjacent monitoring wells with differing vertical screen intervals is an additional way to monitor groundwater and surface water connections and to asses changes in vertical hydraulic gradient…By comparing historical and future hydraulic vertical gradient using cluster wells, the monitoring network will detect decreasing in upward groundwater flow that could lead to decreases in groundwater discharge to surface waters."	The measurement of upward groundwater gradient is made possible by cluster monitoring wells on the margins of the Owens Lake installed by LADWP. These facilities should be utilized to monitor upward gradients as suggested in the GSP. Response: Agreed, these are necessary monitoring locations and data.

30	271	"In areas of GDE, evapotranspiration and vegetation cover are related to water table depth and groundwater elevation monitoring (Elmore et al., 2003 & 2006). Monitoring water levels is a sufficient proxy to indicate a potential for reduction in groundwater discharge caused by groundwater management."	It is true that vegetation cover is related to water table depth on a macro scale. For example, vegetation cover will differ greatly in desert areas with a 100-foot depth to groundwater and a desert area with a 3-foot depth to groundwater. However, studies in the Owens Valley have shown that there is no simple relationship between depth to water and vegetation cover on a finer scale (i.e. depth to groundwater < 30 feet). Instead, vegetation cover is believed to be a function not only of depth to groundwater, but more complex relationships involving vegetation type, run-on or applied surface water, precipitation, and soil type. The dune areas around Owens Lake with vegetation cover is a good example of these complex relationships. Response: Agreed, it is not a simple and uniform response to change in pumping, however, vegetation characteristics often integrate the history of water table depth and fluctuations. Pumping effects on vegetation are almost always the result of a change in that existing water table regime.
31	287	"This GSP proposes that the OVGA actively participate in the working group and coordinate with state and local agencies with land management responsibilities to ensure this management area is managed sustainably to avoid undesirable results."	The OVGA has been and is welcome in the working group, which was created before the OVGA existed.
32	289	Table 4.1	It would be helpful in this table or an accompanying text to identify what management actions will be taken if a minimum threshold is encountered.
33	296	"Acquire or develop groundwater model for the Owens Lake management area"	A groundwater model has already been developed for the Owens Lake Management Area and all data and results of the model are publicly available on LADWP's website at http://www.LADWP.com/olg. LADWP is currently conducting studies to further improve the conceptual and computer model of the Owens Lake area. Response: See summary comment #3 below.

Response to LADWP comments are included in this section and organized by the main comments gleaned from the table.

Summary Comment 1: Lack of rationale for minimum thresholds included in the GSP for the Owens Lake Management Area.

The Sustainable Groundwater Management Act emphasizes local management of groundwater resources (e.g. Chapter 1, § 10729.1 Legislative Intent). SGMA grants individual GSAs significant latitude to determine and define what constitutes a significant and unreasonable result based on local public input and conditions. The OVGA divided the Owens Basin into three separate management areas based on hydrologic differences between the geographic regions of the Basin consistent with DWR's Best Management Practices for Sustainable Management Criteria (DWR, BMP#6). In the Draft GSP, Section 2.2.4 describes the rationale the OVGA used to establish the three management areas in the Basin. SMCs in each management area were specifically designed to avoid undesirable results to sensitive resources particular to each area.

> *"Management areas may have different minimum thresholds and measurable objectives than the basin at large and may be monitored to a different level. However, GSAs in the basin must provide descriptions of why those differences are appropriate for the management area, relative to the rest of the basin." (BMP#6 Sustainable Management Criteria, DWR, 2017, pg. 6)*

The Owens Lake is a hydrologic discharge area for the groundwater Basin. Although there is substantial confinement between shallow and deep aquifer zones, an upward hydraulic gradient from deeper aquifer zones provides groundwater discharge to the shallow-most aquifer, especially at springs and seeps and at historic artesian wells which provide GDEs and wildlife habitat. The amount of discharge is proportional to the upward gradient. In the Owens Lake Management Area, pumping stress is relatively low compared to the other management areas (Draft GSP Table 2-10), and vegetation, springs and seeps, and other beneficial uses have adjusted to the relatively low constant pumping stress of recent decades.

The GSP describes rationale and metrics used to set minimum thresholds and objectives (Sections 3.1- 3.4). In recent history, fluctuation in water levels and GDE vigor were primarily associated with drought. Severe changes in GDEs and other hydrologic resources during the 1999-2005 and 2012-2016 droughts were largely avoided due to the transitory nature of water level declines. Elsewhere in the Owens Valley, before the second aqueduct, pumping stress in the Basin was relatively low and short lived during drought periods. Anecdotal reports of rapid changes to the beneficial uses, GDEs, and surface water capture (springs) arose soon after the initiation of persistent pumping to supply the second Los Angeles Aqueduct in the early 1970's. It is conceivable that additional pumping stress in the Owens Lake area would exacerbate changes due to drought and could result in undesirable results (Draft GSP Table 3-3). Setting minimum thresholds at previously observed low water levels caused by drought is consistent with maintaining the sustainable conditions of recent decades and should avoid undesirable results. Similarly, GSP minimum thresholds were set in deeper wells to preserve existing upward gradients within historic ranges in order to avoid reduced discharge and potential surface water capture at springs and seeps. Measurable objectives were set above these minimum thresholds recognizing the desire to maintain water levels at approximately historic values that support current beneficial uses and GDEs. This principle of setting criteria to avoid undesirable results is consistent with DWR guidance:

> *Avoidance of the defined undesirable results must be achieved within 20 years of GSP implementation (20-year period). Some basins may experience undesirable results within the 20-year period, particularly if the basin has existing undesirable results as of January 1, 2015. The occurrence of one or more undesirable results within the initial 20-year period does not, by itself, necessarily indicate that a basin is not being managed sustainably, or that it will not achieve sustainability within the 20-year period. However, GSPs must clearly define a planned pathway to reach sustainability in the form of interim milestones, and show actual progress in annual reporting (BMP #6 Sustainable Management Criteria. DWR, 2017, pg. 21).*

In the Owens Lake Management Area, the GSP pathway to comply with SGMA is to prevent undesirable results before they occur. This is consistent with SGMA and the OVGA desire to remain a low priority basin.

The GSP recognizes that the LADWP Owens Lake Groundwater Development program and associated Master Plan have been in development for several years. At the time the GSP was prepared, no official project description or monitoring and management plan have been released. As noted in the GSP, the OVGA appreciates LADWP's offer to participate in the various Owens Lake working groups and discussions. The OVGA Board of Directors could consider additional criteria or methods to modify SMCs for this management area in the future, but avoidance of undesirable results should continue to be a fundamental principle.

Summary Comment 2: What actions will occur if minimum thresholds are exceeded.

A range of actions can be initiated if minimum thresholds are reached. In general, these can include additional monitoring and analysis to investigate the likely cause(s) of declining water levels, additional trend analysis, modeling to predict future groundwater levels and the potential for undesirable results to occur, and temporary or long-term actions to reduce hydrologic stress including reduction or relocation of pumping. It should be noted that implementation of the GSP will be consistent with guidance provided by DWR:

> *"All undesirable results will be based on minimum thresholds exceedances. Undesirable results will be defined by minimum threshold exceedances at a single monitoring site, multiple monitoring sites, a portion of a basin, a management area, or an entire basin. Exceeding a minimum threshold at a single monitoring site is not necessarily an undesirable result, but it could signal the need for modifying one or more management actions, or implementing a project to benefit an area before the issue becomes more widespread throughout the basin." (BMP #6 Sustainable Management Criteria, DWR, 2017, pg. 20).*

Additional text has been added to Section 3.1 of the GSP to elaborate on the range of potential actions the OVGA could consider if minimum thresholds are exceeded in a given management area.

Summary Comment 3: Data sharing related to existing and current groundwater models.

To prepare the GSP, the OVGA utilized numerous reports and data produced by LADWP and appreciates the availability of this information. During the GSP development process, the OVGA made requests related specifically to LADWP's existing numerical MODFLOW groundwater models covering the Owens Valley and Owens Lake management areas. The LADWP models synthesize the most current hydrologic information for the basin as compared to older reports or models. After the initial discussions and request regarding executable model files, the OVGA requested basic water balance information that is automatically provided as a data output file of the LADWP groundwater models. Although the GSP process is nearing completion, the OVGA is still interested in obtaining the data files detailed in email correspondence between DBS&A and LADWP in July 2020 for the purpose of better understanding the basin's water balance components.

Summary Comment 4: Comparison of extraction and uses and potential water banking or water wheeling activities.

The OVGA supports effective surface water management by LADWP including potential water banking provided the projects do not result in exceedance or failure to attain SMCs or cause undesirable results in the Basin. The OVGA opposes groundwater export from the Eastern Sierra that would result in negative consequences to groundwater sustainability, the environment, local economy, and residents (Sustainable Principle #14, Section 1.2). Please provide the analysis supporting the statement that all LADWP pumped groundwater is used to supply projects in the Owens Valley, i.e. that uses downstream of the wells exceeds pumping.

Carol Ann Mitchell

OVGA Public Review Draft Comments

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November 1, 2021

Aaron Steinwand
Inyo County Water Dept./OVGA
P.O. Box 337
Independence, CA. 93526
Via email and Website

RE: OVGA Draft Groundwater Sustainability Plan

Dear Mr. Steinwand:

I offer the following comments on the OVGA Draft plan as a resident of Chalfant Valley since 1982 and member of the Mono County Tri-Valley Groundwater Management District (TVGMD) since 1990.

- The Tri-Valley area and Fish Slough management areas need to be separated. TVGMD has requested that these management areas be separated due to geographical, and jurisdictional issues. The agencies involved are Inyo and Mono counties, districts and the State. No attempt was made by OVGA to address how management issues would be addressed in the future. Concerns were made in public comment at meetings our representatives drove to between 20 and 40 miles to attend. No detailed answer has ever been given to our request except that OVGA has made the assumption that Tri-Valley and Fish Slough are hydrologically connected. No consistent data has been given to date. It is because our concerns were never addressed TVGMD left the OVGA Joint Powers Agreement.

Response: See General Response #6. Available geologic, hydrologic, and geochemical studies suggest that Fish Slough is a primary discharge point for the Tri-Valley groundwater aquifer system. The technical information supporting that assessment were discussed at length by the OVGA and referenced in the GSP and available on the OVGA.us website, in particular Harrington, R.H. (2016), Hydrogeologic Conceptual Model for the Owners Valley Groundwater Basin (6-12), Inyo and Mono Counties. Other published studies include Zdon et al. (2019), Jayko and Fatooh (2010), Hollett et al. (1991). These references are included in the GSP.

- The Tri-Valley is a stakeholder in this process. The OVGA never held a meeting with local residents during the development of the draft plan. Their own "Communication and Engagement Plan" was never followed. Tri-Valley residents were never given opportunity to "engage" with the OVGA Board and staff or consultants on specific components of the plan which will affect their lives tremendously. The OVGA never held meetings during hours that did not impede work schedules. Their meetings were held at 2:00 – 5:00 p.m. excluding a good portion of Tri-Valley residents. The OVGA **never** came to Tri-Valley to explain the Groundwater

Sustainability Plan process. It was developed in a biased, exclusionary manner so that the goal of grabbing water and power for the OVGA board and Inyo County was accomplished.

Response: Staff from the OVGA attended a meeting of the TVGMD meeting in January 2020 in person to discuss the District's consideration of a request to withdraw from the OVGA. Tri-Valley Groundwater Management District was a member of the OVGA until February 2020. Meetings of the OVGA were conducted in person during the initial development of the GSP until May of 2020, when meetings were converted to an online format, and all meetings were open to the public. As recognized in the GSP (Section 2.1.9.3), the outreach efforts in Tri-Valley during the COVID pandemic were hindered by the lack of internet connectivity and health orders regarding public gatherings. Four additional presentations were provided by the OVGA staff during evening meetings of the TVGMD, and every resident in the Tri-Valley Management Area was contacted via a direct mailer. The mailer provided information regarding SGMA and the GSP process, a survey, and requested feedback regarding the proposed undesirable results and sustainable management criteria. Two evening public workshops to discuss the draft GSP were provided In October 2021 during the public comment period. Staff from Mono County representing the OVGA attended numerous meetings of the TVGMD. Recognizing the challenges of outreach in Tri-Valley, Sections 2.1.9.5 and 4.4 of the draft GSP includes another possible OVGA project:

Tri-Valley Survey: Add a groundwater management public education campaign concurrent with groundwater model development in the Tri-Valley to help Tri-Valley residents understand the situation and become more directly involved in groundwater management decisions that will affect their livelihoods.

- The OVGA never listened to or engaged local agricultural interests or local business owners who have a financial share in the Groundwater Sustainability Plan proposed "actions" such as a pumping plan, fines or fees, so widely encouraged by OVGA.

Response: Concerns of the local agricultural interests were discussed at several meetings of the OVGA before and after the TVGMD departed from the OVGA Board. Agriculture and economy are specifically included for protection in the OVGA Mission Statement (Section 1.2). See response to previous comment regarding outreach in Tri-Valley Management Area.

The GSP does not contain any fines or pumping fees. A proposed pumping plan may be necessary to address chronically lowering water levels in the Tri-Valley Management Area but only after development of additional monitoring and groundwater modelling capability.

- De Minimis users will be required by OVGA to register their wells although this group is exempt from SGMA. I believe this is just administrative overreach and shows the callous disregard OVGA has for the law (SGMA) which created it.

Response: Section 4.1 of the GSP states, "Registration of *de minimis* pumpers is permitted by SGMA, and the ordinance may include a one-time voluntary report to acquire information on well location, well construction characteristics, water levels, and approximate production amounts. This basic information is already required by local and State regulations as part of well permitting and well completion reports. The ordinance will contain procedures, timing, and methods to register a well and submit needed information which will be reviewed for quality control and entered in the OVGA database." Further

Section 4.2 states, "Small capacity wells for *de minimis* extractors are exempt from most SGMA provisions including regulation of pumping. Permits for such wells will be reviewed primarily to acquire information to update the database and ensure the use and production of the well is correctly cataloged as *de minimis*." In other words, for *de minimis* users, well registration is voluntary and they are exempt from regulation of pumping. .

- OVGA wishes to assume administrative authority for well permit review from Mono County. This is again an example of administrative overreach by the OVGA board and staff.

Response: The stated purpose of proposed Management Action #2 (GSP, Section 4.2) is to acquire information necessary to maintain an up-to-date database of pumping wells in the Basin. The proposed ordinance will ask that well construction permit applications or the permits submitted to Inyo or Mono Counties be provided to the OVGA for review. These are public documents. The ordinance would allow the OVGA to maintain an up-to-date list of wells and pumping in the Basin as required by SGMA and if the OVGA deems necessary to include in the ordinance, procedures to determine if regulation of new wells under SGMA is applicable and necessary to ensure sustainable conditions are maintained.

A sentence was added to the GSP Section 4.2 clarifying that the authority to approve well construction permits remains with Inyo and Mono County.

- This letter supports the comments on file by Mono County Board of Supervisors and the Mono County Tri-Valley Groundwater Management District (TVGMD) heretofore submitted.

Response: See response to Mono County and TVGMD letters.

- The draft OVGA plan does little to address the continuing "exceptional" drought conditions which the Eastern Sierra and Tri-Valley have experienced during the time this plan was being considered. The drought should be addressed in the plan as well as what OVGA will do if it continues for the unforeseeable future.

Response: SGMA pertains to basin wide management over a 20-year planning horizon and conditions are compared against Sustainability Indicators including chronic lowering of water levels that persist through drought and wetter periods. SGMA does not require management to correct the effects of drought unless the drought prevents continued beneficial use due to change in storage which is unlikely (see Section 3.2.1). The GSP does evaluate the effects of long term climate change in Section 2.2.3.4.

- The Tri-Valley area of Mono County is rural in nature. We have an expansive view of the Sierras and beauty in the White Mountains. The Los Angeles Department of Water and Power, who is exempt from the OVGA GSA, are the ones historically responsible for so much damage and destruction to the Owens Valley. The LADWP absence from the OVGA plan renders much of the assumption about injurious conditions to Fish Slough mute if the LADWP operations in Inyo County and Fish Slough are not addressed in the Groundwater Sustainability Plan.

Response: Multiple lines of geologic, hydrologic, and geochemical evidence suggest Tri-Valley effects on Fish Slough are greater than LADWP management under the LTWA. There is a hydrologic connection between Fish Slough and the Laws area and similar aquifer materials are found below the Bishop tuff, but the presence of faults and leaky confining layers and pumping managed under the LTWA limits the effect from Laws or Bishop pumping extending into Fish Slough. Variations in LADWP pumping through history are not strongly reflected in water levels in Fish Slough. It is possible for an effect to propagate north into Fish Slough, however, and any pumping impacts from LADWP wells are subject to the LTWA provisions to avoid other significant effects (See General Comment #2).

- Finally, the GSP should note TVGMD's request of February 2021 that OVGA amend its boundaries to exclude lands within TVGMD's jurisdiction. OVGA has refused to take any action on Tri-Valley's request. A meeting held with Inyo County and DWR has resulted in the proverbial drag your feet and do nothing by OVGA, its board, and staff.

Response: The OVGA and DWR are aware of this request, but the requested information is not required to be included in the GSP. The OVGA is operating under the latest guidance from the DWR contained in its letter of May 27, 2021. The OVGA is the exclusive GSA for the Basin with the authorities granted by SGMA. The OVGA may consider the request in 2022.

Respectfully submitted,

CA Mitchell

Carol Ann Mitchell
Chalfant Valley resident
Chairman, TVGMD

Mono County Board of Supervisors

<u>OVGA Public Review Draft Comments</u>

Jennifer Kreitz ~ District One   Rhonda Duggan ~ District Two   Bob Gardner ~ District Three
John Peters ~ District Four   Stacy Corless ~ District Five

BOARD OF SUPERVISORS
COUNTY OF MONO

P.O. BOX 715, BRIDGEPORT, CALIFORNIA 93517
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Scheereen Dedman, Clerk of the Board

Owens Valley Groundwater Agency

P.O. Box 337
Independence, CA
93526

Board Members and Staff of the OVGA:

Thank you for providing the Mono County Board of Supervisors with an opportunity to comment on the draft Groundwater Sustainability Plan (GSP) for the Owens Valley Groundwater Basin (Basin), released on September 23, 2021. In reviewing the document, it is clear that significant effort and resources were devoted to its development. The document is generally thorough, well-organized, and comprehensive.

Accordingly, Mono County's comments, provided below, focus on those items of particular concern and relevance to Mono County and its constituents. As a preface to those comments, the Board notes that Mono County, through this Board, is the only member of the Owens Valley Groundwater Authority (OVGA) Joint Powers Authority (JPA) which represents the citizens of Mono County – and that as such, its voice on matters affecting those areas should be given great weight.

Recognition of Lack of Data Regarding the Tri-Valley Area

The GSP recognizes, and it is widely understood, that there is a lack of data regarding groundwater conditions in the Tri-Valley area. A discrete section should be inserted into the GSP explaining what data is available and recognizing that additional information is needed before firm conclusions can be drawn regarding groundwater conditions in the Tri-Valley.

Throughout the report, wherever statements or conclusions regarding groundwater levels in Tri- Valley are mentioned, the above section should be referenced and, if the conclusion that levels are declining is stated, it should be clearly identified as a tentative conclusion pending development of additional data.

Examples of locations where data limitations should be referenced include, but are not limited to:

- Section 2.2.2 (Historical Groundwater Conditions)

- Page 28 – "Benton and Chalfant show similar rates of decline". In this location, the GSP should describe the data sources for the conclusion, indicate that the conclusion is tentative pending development of more robust information and reference back to section explaining that data is incomplete/lacking.

Response: See response to General Comment #5. Sufficient data exits (both spatially and temporally) to establish that a regional, long-term decline in groundwater levels can be detected in the Tri-Valley management Area. See Section 2.2.2.1 in the Final GSP for hydrographs and an explanation of the data supporting the assessment of conditions regarding water levels and pumping in Tri-Valley. The Final GSP recognizes that there is sufficient data to identify a problem exists but not enough to implement a solution .Data gaps are discussed at length in Appendix 3: Monitoring Plan and Data Gaps Analysis. Additional data are necessary to assess the local conditions within the valleys and assess if the declines create undesirable results. Acquiring the additional information is necessary before implementing pumping or land management action (See Section 4.5.4).

Choice of Words

In several locations, a groundwater model for Tri-Valley is described as necessary because it is "a prerequisite to regulating pumping." This message places the focus on regulating pumping and is not the message that should be sent. Please modify this language by emphasizing the need to acquire more data and information about groundwater conditions in Tri-Valley to determine appropriate management actions, rather than implying that regulating pumping will be the presumed management outcome.

Do not use term "overdraft" to describe conditions in Tri-Valley. This term infers/assumes that conditions are caused by agricultural pumping (rather than by other conditions, such as drought). Causes of suggested decline is not definitively known and the data is incomplete. Again, the section explaining data gaps should be referenced rather than conclusions drawn without complete data.

Response: Conditions of long-term overdraft exist when annual groundwater extraction exceeds replenishment, generally over 10-years or more (DWR Best Management Practices #5, Modeling). In the types of unconfined aquifer materials underlying Tri-Valley, overdraft would manifest as chronic water level decline. SGMA recognizes this basic hydrologic principle and associates overdraft with the definition of chronic lowering of groundwater levels (CWC § 10721). As defined by SGMA, chronic lowering of groundwater levels are persistent declines that continue both during and outside of drought periods. This information was added to Sections ES 2.2.3 and Section 2.2.2.2 of the GSP for clarification.

See General Response #5 regarding an explanation of water level data and trends, pumping, and data gaps in Tri-Valley that support the identification of overdraft and presence of a cone of depression due to pumping. A discussion of the number of wells with long term data and interpretation of water levels was added to Section 2.2.2.1 of the Final GSP.

1. Potential Management Actions

Section 3.4.1.1 lists potential management actions in the Tri-Valley Area. These should be deleted since all assume that groundwater is declining and that agricultural pumping is the cause, despite incomplete data. If another cause is identified, then these management actions would not be appropriate. More data and information are needed to suggest appropriate potential management actions.

Response: The presence of overdraft is discussed in the previous comment. The likely cause of the water level declines is discussed in General Comment #5 and in Section 2.2.2.1 of the Final GSP. The strategies listed in Section 3.4.1.1 are not management actions of this GSP which are described in Section 4. The requested deletion contains a list of strategies to reduce demand that could correct long-term overdraft and achieve the measureable objective for water levels and groundwater storage (set at January 15, 2021 water levels). Clarification was added to this section in the GSP to generalize the discussion and avoid implying these are land management prescriptions for Tri-Valley. The topic sentence of the paragraph referred to in this comment now states:

> *Current water levels are below the management objective. Achieving the 20-year measurable objective to correct declining water levels requires either increasing recharge into the aquifer or decreasing pumping.*

2. *D*efining Unreasonable Risk

Section 3.3.1.1 characterizes a risk of impact to three-to-eight of 189 domestic wells as "significant and unreasonable." Three wells out of 189 is only 1.5% of all wells. Also, no information is provided regarding the quality of the potentially impacted wells (i.e., what is their depth, age, etc.?), which potentially affects their longevity. If potential impact to 1.5% of wells is significant and unreasonable, even without considering the quality of those wells, what is not significant?

Response: Three undesirable results to pumpers caused by lowering of water levels were included in the GSP for the Tri-Valley Management Area: increased pumping costs, drying out shallow domestic wells, and loss of existing monitoring wells. The analysis of the threat to domestic wells was based on the limited information available about the construction of domestic wells in the Basin. Reasonable assumptions about how those wells were likely built was developed based on staff's knowledge of well drilling and construction procedures in the region gained by several local monitoring campaigns in these types of wells. The "quality of the well" is not a germane issue in SGMA. If the wells are likely to fail due to age or poor maintenance practices, for example, the OVGA is not obligated to analyze this variable. SGMA requires that the OVGA consider the impacts its groundwater management actions could have, for example, on water levels. It also requires a trend analysis to be performed that considers the impact that declining/rising water levels have on the beneficial users and uses of groundwater. The analysis only considered the factors required by SGMA: could the wells that exist fail due to water level declines.

Of the three undesirable results in the GSP, the well vulnerability analysis was based on the most severe possible outcome and a conservative (low) estimate of the number of potentially impacted wells. The metric of 30 feet of available water column in a domestic well was chosen in the well vulnerability analysis to represent the potential for complete loss of well operability. This event would entail the maximum expense to the well owner with costs typically of tens of thousands of dollars. The report's findings showed that 6% of wells could become inoperable by 2025 and 8% by 2040. Given the present water level trends, the number of vulnerable wells increases within the planning horizon if the declines are not stopped. The GSP recognized the uncertainty in the analysis and concluded that the number of wells at immediate risk of going dry is low. The Minimum Threshold was set at water levels anticipated to occur in 2007 assuming the present rate of decline continues. After 2007, the number of vulnerable wells increases and impacts to domestic well owners could be significant and unreasonable. Similarly if a less strict metric was used associated with less costly well repairs instead of well failure (e.g. pump replaced or lowered caused by the water column falling to less than 45'), the number of vulnerable wells in 2025 is approximately 11% and 19% during the 20-year GSP implementation period. The undesirable result of declining water levels that increases the annual electrical cost to pump water was not included in the analysis, but all wells in the management area are probably experiencing this undesirable result to varying degrees. Sections ES 3.3.1 and 3.3.1.1 were revised to better explain the reasoning behind the selection and evaluation of significant and unreasonable effects with regard to domestic wells.

3. Recommendation for Well Permitting Ordinance

The GSP includes a management recommendation for a well permitting ordinance which would apply throughout the Basin. Mono County is not interested in adopting an ordinance and/or enforcing such an ordinance adopted by OVGA through Mono County well permits. Mono County is willing to share well permitting data for monitoring and data collection, but unless more complete data is available concluding that water levels are declining and pumping is the cause, consideration of regulatory measures is highly premature and gives the impression of a predetermined outcome.

Response: The conclusion of declining water levels is sound for the reasons described above and the likely cause is identified in General Comment #5, but the GSP recognizes that information characterizing pumping and the variability of water level changes within and across the valleys and Fish Slough should be increased. To effectively monitor how much groundwater is being extracted from the basin (a key OVGA responsibility), the OVGA needs to have a method by which it is notified of new wells, their prospective groundwater extraction rates, and who to contact to collect groundwater extraction data going forward into the future. It is not necessary for Mono County to adopt an ordinance regarding this issue. Mono County as the well permit issuing entity can provide the application and the approved permit to the OVGA for review. The application and permit are public documents. The Final GSP was revised to state that final approval authority of the well construction permit remains with Mono County.

With the exception of *de minimis* or domestic wells, the OVGA has the authority, should it elect to exercise that authority, to specify where a well can be drilled, how much water can be extracted, depth of the well screen, the timing of the extractions, and reporting requirements to the OVGA to ensure basin sustainability. The OVGA can, if it elects to, place conditions on the construction of a well e.g., include a sounding port on all new wells to permit water level measurement. The proposed ordinance could but is not required to include such measures as a separate procedure using the authority under SGMA. It would not be part of the well construction permit approval by Mono County. The OVGA has not drafted an ordinance, and the GSP prescribes several steps in data and technology development that should occur before regulation of pumping in the Tri-Valley.

4. Jurisdictional Issues

Unresolved jurisdictional issues remain. Even if Mono elects to remain a member of OVGA, there is uncertainty regarding OVGA's authority to regulate groundwater in Tri-Valley given the overlapping jurisdiction of the Tri-Valley Groundwater Management District (TVGMD).

Because TVGMD is statutorily authorized to regulate groundwater within its boundaries (including extraction, recharge, permitting and other matters), how would a conflict of regulations between OVGA and TVGMD be resolved? Whether TVGMD's authority pre-empts OVGA's, and other related questions, must be resolved.

Response: The OVGA is operating under the latest guidance from the DWR contained in its letter of May 27, 2021. The OVGA is the exclusive GSA for the Basin with the authorities granted by SGMA.

5. TVGMD Request for GSA Boundary Change:

The GSP should note TVGMD's request that OVGA amend its boundaries to exclude lands within TVGMD's jurisdiction. The GSP should also recognize that TVGMD has asserted its status as the Groundwater Sustainability Agency (GSA) for lands within its jurisdiction.

Response: The OVGA is aware of the TVGMD request, and may consider it in 2022; however, the requested addition is not required to be included in the GSP.

6. Wheeler Crest

There is very little discussion of the Wheeler Crest Area, which is part of the Owens Valley Management Area and covered by the Plan. This is undoubtedly due to the lack of conditions of concern and the robust monitoring system that is already in place in the region, but these conclusions should be specifically stated rather than inferred by omission. Please add language explaining that Wheeler Crest is within the Owens Valley Management Area and noting existing data monitoring points. This information should be included in the minimum thresholds and measurable objectives tables as well (see Section 3.2 – Basin Areas and Settings – add Swall Meadows and Wheeler Crest).

Response: The OVGA is grateful for monitoring data provided by the Wheeler Crest CSD. The monitoring data record is relatively short for the few wells, but was deemed sufficient given that if fills a spatial data gap and the uses in this portion of the Basin are solely for domestic purposes. Additional discussion of Wheeler Crest was included in Section 2.2.2.1. (Section 3.2 discusses Undesirable Results. Section 2.2 discusses Basin setting and groundwater water levels). The Wheeler Crest wells were included as representative monitoring wells and are included in tables in Section 3.3 Minimum Thresholds and Section 3.4 Measurable Objectives.

7. Mono County Land Ownership

Section 2.1.3 – the land ownership data for Mono County is incorrect. Only approximately 6% of the Mono County land base is privately owned, as opposed to the 17% cited in the GSP. Please revise the data in Section 2.1.3 accordingly and modify Table 2-2 as follows:

Response: The acreages in the table below appear to be for the entire County. Table 2-2 in the Final GSP presents ownership just within portion of the Basin that occurs in Mono County.

Owner	Acres	Percent total Acres
BLM	529347.79	26.33%
Private	130414.49	6.49%
LADWP	62735.742	3.12%
USFS	1192636.4	59.32%
State Lands Commission	53638.77	2.67%
Bureau of Indian Affairs (and Tribal lands)	841.4	0.04%
CA Dept of Fish and Wildlife	62.5	0.00%
County	1584.3434	0.08%
TOTAL	1971261.4	98.05%

8. Adjudicated Lands

The GSP should evaluate whether actions in the adjudicated areas are causing undesirable effects, preventing progress toward measurable objectives or triggering minimum thresholds. If so, then the OVGA should make a management recommendation to remediate those issues through the existing Long Term Water Agreement or other means in order to address the impacts specifically caused within the GSP boundary.

Response: See General Comment #2.

Thank you again for providing this opportunity to comment on the GSP. If you have any questions regarding this letter, please contact Mono County Community Development Director Wendy Sugimura at wsugimura@mono.ca.gov (760) 924-1814 or Mono County Counsel Stacey Simon at ssimon@mono.ca.gov (760) 924-1704.

Sincerely,

Jennifer Kreitz

Chair, Mono County Board of Supervisors

Cc Tri-Valley Groundwater Management District

Edwin Pister

OVGA Public Review Draft Comments

437 East South Street
Bishop. CA 93514

760 784 9466

Owens Valley Groundwater Authority
C/0 Laura Piper
Inyo County Offices Independence,
CA93526

Hi!
Good luck on
this. We're with
you all the way
[signature]

Folks:

First off let me express my gratitude to both the Owens Valley Groundwater Authority and the Inyo Register for their coverage concerning groundwater and its status in the Owens Valley for their recent articles (October 5) . "Groundwater" - a simple term with huge ramifications in the future of our county and throughout the Southwest.

I am a retired aquatic biologist (California Department of Fish and Wildlife) who has lived in Bishop since 1952. It was my job to watch out for the many species of fish, wildlife and plants (and their habitats} that live here along with us in the Eastern Sierra. A threatened area is Fish Slough, a few miles north of Bishop. About 1950 two esteemed ichthyologists (Robert Rush Miller from the University of Michigan and his colleague Carl L. Hubbs from the University of California's Scripps institution near San Diego worked throughout this area of the Owens Valley and described many of the native species as part of Miller's doctoral dissertation. One of them was the now famous Owens pupfish (*Cyprinodon radiosus*) which was still hanging on in a good habitat called BLM Spring. This was one of the key areas upon which we built our recovery effort. Fish and Wildlife employees have been watching BLM Spring almost on a daily basis to make sure it remains OK.

During the past couple of years we have noted a decreased flow from BLM Spring, and a general drying of the marsh areas that supply the best fish and wildlife habitat. Fish Slough is one of the very few wetland areas remaining in the Owens Valley. It is mentioned in the federal listing of endangered species. Another endangered species in Fish Slough is the Fish Slough milkvetch *Astragalus lentiginosus*. In a similar situation in New Mexico, where water flow in a spring area was threatened by nearby pumping by alfalfa farmers, the entire area was closed to any water extraction until and if the groundwater levels returned and were stabilized.

We have a similar situation just over the White Mountains in Fish Lake Valley, Nevada, where a seriously threatened fish species (name of the fish) is threatened by groundwater extraction. This is still in litigation under the Endangered Species Act, but the smart money favors the fish.

It is our hope that groundwater extraction limits may be adopted for the Owens Valley that may be sufficient to protect the endangered species while allowing for continued agricultural (alfalfa) production. Nevada law allows only so much water to be removed from an aquifer that will be replenished in a given year. A similar law would do much to resolve Owens Valley problems. Owens Valley citizens have long expressed their concern over the export of local streams into the Los Angeles Aqueduct. The production and export of countless bales of alfalfa (a highly water-consumptive plant) does essentially the same thing and increases local concerns when much of this alfalfa is sold to interests in Asia. It is our hope that the Owens Valley Groundwater Authority may address and resolve these perplexing issues. Adding to this is drying of aquifers that supply water to homes and wells in Chalfant Valley.

Sincerely., Edwin (Phil) Pister

Response: SGMA allows GSAs to regulate pumping to prevent significant and undesirable results including chronically lowering water levels and capture of surface water (e.g., springs). Monitoring data and several studies suggest unsustainable conditions for both of these sustainability indicators may be experienced during the planning horizon of the GSP without management. See General Comments #5 and #6 regarding conditions in Tri-Valley and the connection to Fish Slough. The GSP recognizes, however, that while the existing understanding is sufficient to diagnose a problem, additional data is necessary to implement management regulations without causing potential impacts to soil and air quality and economic hardship. The GSP includes Management Actions to address data gaps identified through the GSP development and to acquire outside funding to develop needed numerical groundwater models to carefully design effective groundwater management

Terry Plum

OVGA Public Review Draft Comments

t.

Sent via Electronic & Regular Mail

November 8, 2021

Owens Valley Groundwater Authority Board of Directors
Aaron Steinwand, OVGA Executive Director
c/o Inyo County Water Department
P.O. Box 337
Independence, CA 93526
asteinwand@inyocounty.us

SUBJECT: OWENS VALLEY GROUNDWATER BASIN GROUNDWATER SUSTAINABILITY PLAN PUBLIC REVIEW DRAFT

Honorable Members of the Board and Dr. Steinwand:

I want to preface my comments by recognizing and commending the tremendous leadership the Owens Valley Groundwater Authority Board of Directors and staff have exhibited in persevering to prepare and adopt a Groundwater Sustainability Plan for the Owens Valley Groundwater Basin even though the Basin is currently ranked "low priority," and the preparation of a GSP is not required at this time. I believe and hope that being proactive in this respect, and preparing the GSP absent the specter of an emergency and State mandates, will ultimately result in a more thoughtful, practical and effective plan to protect and maintain the sustainability of our groundwater basin. It is in this spirit that I offer the following comments regarding the Draft GSP:

Comment #1: Future projects and management actions, including the imposition of fees, should only be implemented if absolutely necessary and must not unduly burden or threaten the viability of existing residences.

I appreciate the GSP's sustainability goal *"to monitor and manage the Basin by [first] implementing a groundwater monitoring network and database and [then] adopting management actions that fairly consider the needs of and protect the groundwater resources for all beneficial users in the Basin"* and recognize that the adoption of any future management actions will be undertaken through a public process. However, given the Basin's current low priority ranking, the GSP should emphasize the possible adoption of management actions in the future – including but not limited to commenting, regulating or issuing well drilling permits; regulating domestic groundwater pumping; and, the imposition of fees related thereto – will only be considered or undertaken after the groundwater monitoring network and database are fully established and the resulting data demonstrates a negative change in existing conditions that are independent of, or unrelated to the City of Los Angeles Department of Water and Power's groundwater pumping in the adjudicated portions of the Basin.

Response: See General Comment #2. The primary purpose for some Management Actions in the GSP is to complete the characterization of extraction and water levels in the Basin and to maintain an up-to-date database, which can then lead to a better understanding of LADWP's effects on the water table before implementing any management measures.

The GSP does not currently propose any fees but in the future, the OVGA Board will determine what management actions to implement and the administrative activities and fees to implement the GSP (Section 5).

Decisions of the OVGA will be guided by the general principles regarding Funding #2 and #3. These principles were adopted by the OVGA and are included in the GSP in Section 1.2

I support the need to manage the Basin in a manner that fairly considers the needs of and protects the groundwater resources for all beneficial users in the Basin, and avoids negative consequences to groundwater sustainability, the environment, local economy, and residents; AND, I believe that the needs of current residences and their human population needs to be prioritized as a first among equals.

Response: Please refer to the OVGA Mission Statement and guiding principles (Section 1.2).

I am an owner of Pine Creek Village (formerly known as Rovana) in Round Valley in the northwest portion of the Basin. Pine Creek Village is comprised of 85 single-family detached homes providing non-subsidized low-income rental housing to Inyo County. Our domestic water system is served by three existing groundwater wells with varying functional capacities. It is entirely possible that these wells may need to be replaced or even relocated in the future. In response to the current drought, Pine Creek Village has cut its groundwater pumping for the domestic water system by-more-than half by limiting and now prohibiting the use of water for landscape irrigation. Doing the right thing, however, has come at the expense of our established residential landscaping, particularly trees and shrubs, and decreased property values and diminished aesthetic appeal. Future management actions contemplated in the GSP should not impact the ability of established communities, such as Pine Creek Village which has existed since 1947, to access and utilize historical groundwater amounts.

Response: See response to Comment #7 in this letter below.

Comment #2. Privately-owned, public water systems such as Pine Creek Village seem to have been omitted from identification among *"the main agencies or programs conducting groundwater monitoring in the Basin."*

Response: The draft GSP recognizes local water providers such as mutual water companies, community service districts or the City of Bishop. The list in the GSP referred to in this comment will be revised to include privately-owned public water systems among the agencies conducting monitoring. OVGA staff will contact Pine Creek Village to explore opportunities to share information.

Comment #3: The GSP should firmly acknowledge that possible future management actions contemplated in the GSP recognize, account for, and be scaled in proportion to the amount of groundwater pumped in the non-adjudicated portion of the Basin relative to the LADWP's significantly greater groundwater pumping in the adjudicated portion of the Basin and its associated impacts on the non-adjudicated portion of the Basin.

Pine Creek Village is located upgradient, and on the northwest boundary of the Basin, and is neighbored (with minor buffers of land managed by the Bureau of Land Management and California Department of Wildlife) by City of Los Angeles-owned land to the north, east and southwest. Similar to remarks made by other commenters, private property like Pine Creek Village should not be unduly penalized by potential future management actions for impacts created by the LADWP's pumping, or potential to pump groundwater on nearby adjudicated portions of the Basin.

Response: See General Response #2.

Comment #4. The groundwater dependent ecosystems (GDE) identified State Department of Water Resources indicators of GDE database (iGDE) are often inaccurate and should not be relied upon.

The iGDE database for the area around Pine Creek Village does not accurately reflect actual conditions and should be removed by the Inyo County Water Department.

Response: The iGDE database is a state prepared product that was the initial basis for the final GDE map in the Basin (excluding LADWP and Tribal lands). OVGA consultants and the Inyo County Water Department staff and prepared a final map by revising the iGDE map based on local experience and knowledge, but were not able to visit each polygon to confirm or revise the iGDE map. A future project to field check and correct the final GDE map has been added as a potential activity in the final version of the GSP (Section 2.1.9.5 and 4.5.3):

Comment #5. The existing groundwater monitoring network for Round Valley appears inadequate for basing future management decisions.

Representative monitoring locations identified in the GSP for which historical water hydrographs are available (T750 and T751) are located, in relation to Pine Creek Village, miles away and down-gradient and, ironically, managed by the LADWP. Similar to the lack of historical hydrograph data from wells nearer to Pine Creek Village, the location of these LADWP wells for which historical data is available is inadequate for informing or triggering future management decisions which could adversely impact Pine Creek Village.

I understand from conversations with OVGA staff that the inadequacy of the current monitoring network in this portion of the Basin is acknowledged as needing to be improved, but also understand that doing so is not a high priority relative to monitoring network needs in other parts of the Basin. When appropriate, Pine Creek Village welcomes the opportunity to work with the OVGA to explore the feasibility of using its groundwater wells as additional monitoring locations.

Response: Management Action #3 recognizes the need for additional monitoring in Round Valley as in other parts of the Basin. We appreciate the opportunity to cooperate and improve the monitoring network in Round Valley.

Comment #6. The GSP properly distinguishes and opposes groundwater export from the Eastern Sierra that would result in negative consequences to groundwater sustainability, the environment, local economy, and residents.

Response: No response required.

Comment #7. The GSP should affirmatively state that future management actions will in no manner serve to further impede the development of housing on private lands in the Basin.

The need for additional housing within the Basin is well documented in, among other places, planning documents and policies promulgated by the City of Bishop, and Inyo and Mono counties. In our region, the scarcity of opportunity to develop additional housing is a reflection of land tenure patterns that result in less than two-percent (2%) of land in Inyo County being privately-owned, with slightly more in Mono County. Furthermore, most of the undeveloped, privately-owned land in Inyo County is located in the southwest portion of the county, miles from the Owens Valley Groundwater Basin. Assuming that housing could be developed on existing, privately-owned, undeveloped land within the Basin – that the numerous existing barriers and challenges to building homes could be overcome and economic incentives identified – the net gain in new residences and associated water needs would be relatively minor compared to existing residences, and especially relative to the groundwater pumped from adjudicated portions of the Basin by LADWP.

As an owner of property in Inyo and Mono counties, separate from Pine Creek Village, I am concerned about any possible future management actions stemming from the GSP that could impede the already challenging and acknowledged slim likelihood of being able to develop additional housing for the community; especially when any such development would be miniscule relative to existing housing and water needs, and the amount of groundwater pumped by LADWP. One example of a significant amount of privately-owned, undeveloped (but developable) land that could be negatively impacted by future water management actions insensitive to the region's housing needs is located on Mustang Mesa, across the highway from Pine Creek Village. These concerns can be lessened by incorporating an affirmative statement or statements in the GSP that it recognizes (1) The region's critical need for additional housing; (2) the limited amount of land available to build housing; and, (3) the reality that any new housing construction will be limited in scale and impact; and then (4) that future management actions identified or contemplated in the GSP will not limit future housing development.

Response: OVGA is committed to maintaining sustainability of groundwater conditions in the Basin but recognizes the need to manage resources for all beneficial users. Refer to the guiding principles developed by the OVGA (Section 1.2), in particular Strategy 6, and Gen #1 and #2. The OVGA is committed to adhering to the SGMA definitions and protections for *de minimis* users (Sus #10, Section 1.2).

SGMA allows for regulation of pumping and GSAs could place conditions on well construction or operation. Purposes for implementing any regulation of future pumping is discussed in Management Action #2 Well Permit Review Ordinance which may include measures for regulation of future pumping projects:

> *"The Ordinance will include criteria the OVGA will apply to determine the need to regulate pumping from a new, reactivated, or replacement well. The scope of the permit review will be tailored as necessary to determine the need for groundwater management based on the potential for a well described in a permit to exceed a minimum threshold, prevent attaining a measurable objective, or to create other significant and unreasonable effects (e.g. well interference, surface water depletion). The Ordinance will describe the conditions the OVGA may place on well construction, location, capacity, or extraction to ensure sustainable groundwater conditions are maintained in the Basin."*

Furthermore, DWR guidance will be adhered to if evaluating whether future projects could cause undesirable results:

> *"All undesirable results will be based on minimum thresholds exceedances. Undesirable results will be defined by minimum threshold exceedances at a single monitoring site, multiple monitoring sites, a portion of a basin, a management area, or an entire basin. Exceeding a minimum threshold at a single monitoring site is not necessarily an undesirable result, but it could signal the need for modifying one or more management actions, or implementing a project to benefit an area before the issue becomes more widespread throughout the basin." (BMP #6 Sustainable Management Criteria, DWR, 2017, pg. 20).*

Thank you for your consideration of these comments, and good luck!

Sincerely,
ORIGINAL SIGNED BY TERRY PLUM

Terry Plum

Sierra Club, Range of Light Group

OVGA Public Review Draft Comments

Range of Light Group
Toiyabe Chapter, Sierra Club
Counties of Inyo and Mono, California
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November 8, 2021

Owens Valley Groundwater Authority Board
Via email: lpiper@inyocounty.us

Re: OVGA Groundwater Sustainability Plan

Dear Board Members,

The Range of Light Group thanks the OVGA Board for inviting the public into the process and for adding a conservation board seat. We appreciate how the public was allowed to ask questions and make suggestions throughout the process as well as to comment on the final product.

We also appreciate that the Board decided to continue with a Groundwater Sustainability Plan (GSP) after the Owens Basin was downgraded to a low priority basin even though a GSP was no longer required. We hope it gives the OVGA better tools for monitoring the groundwater levels in the area covered by the Long-Term Water Agreement (LTWA) as well as monitoring the lands around them. We hope that the OVGA uses the data to put a spotlight on the problems that can occur under the LTWA even though the OVGA has no authority over the Los Angeles Department of Water and Power (LADWP) to correct them.

In 2014 when SGMA legislation was being finalized, Inyo County and LADWP requested the following statement be added, which prevents the OVGA from having authority over the entire Owens Basin.

However, the LTWA was a court stipulation and order; not an adjudication. A judge did not dictate the terms of the LTWA. If it had been adjudicated, the LTWA might have been very different; possibly restoring and protecting the environment more. It is misleading to distinguish the two portions of the Owens Basin as "adjudicated and non-adjudicated" lands. We would like to see that corrected in the GSP.

Response: See General Comment #3.

Under the LTWA, any wellfield on the LADWP side of the Owens Basin can be over-pumped in a given year, so having the OVGA's oversight is important and worth having developed the GSP. Over-pumping a wellfield can cause damage to the surface vegetation on both sides of the boundary and can impact groundwater levels on the OVGA side. The Inyo County Water Department sometimes recommends lower pumping amounts than LADWP has planned for the year, but LADWP doesn't have to follow those recommendations. We think it is safe to say in the GSP, "These activities ~~may~~ will affect the ability of the OVGA to maintain sustainable groundwater management in the basin. (pg. 5). It is worth pointing this out in the GSP and to the state's Department of Water Resources (DWR). It would have been better for the environment, if the whole basin were under the OVGA.

If any over-pumping spills over into the OVGA-managed areas of the Owens Basin, then we hope the OVGA takes strong measures against Los Angeles Department of Water and Power (LADWP). It is not fair to request that the small users, pumping a fraction of the groundwater that LADWP does, must cut back for over-pumping caused by LADWP. (What is the percent of the total water pumped in the Owens Basin that comes from the OVGA part of the Owens Valley Management Area? Page 158 shows that 13% is non-LADWP pumping (10,000/78,000 AFY), but some of that is within the LTWA side.) However, the GSP doesn't explain what actions could or will be taken should that happen.

Response: See General Comment #2. The OVGA agrees that small pumpers subject to the GSP should not be responsible for correcting groundwater conditions caused by actions within the lands under the LTWA. Approximately 11% (10K/88K) of the Owens Valley Management Area pumping is by non LADWP pumpers.

We suggest adding to the reference to the 2020 LADWP Urban Water Management Plan that the plan does not provide any relief to the Eastern Sierra. It is worth driving home this point at every opportunity. The UWMP indicates that the LAA water supply will decrease by only 7,800 AFY over the next 25 years (from 192,000 AFY to 184,200 AFY) due to the expected shrinkage of the Sierra runoff. (2020 LADWP UMWP pg. ES-21 *"Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate impacts.")* So basically, the LAA exports will continue at the same level as they are today.

Response: The LADWP UWMP is discussed in Section 2.1.7. This comment is consistent with the summary in that section.

<u>OVGA GSP basic concerns</u>

1. This GSP should have strong language about keeping the Fish Slough sub-basin attached to the Tri-Valley groundwater basin and thresholds that protect it.

   If Mono County withdraws from the OVGA and Tri-Valley forms their own groundwater authority, Fish Slough must go with the Tri-Valley basin as they are hydrologically connected. If the Tri-Valley/Fish Slough Basin is managed under a separate GA, it might be rated as a medium priority basin; not low priority like the OVGA. The description of the groundwater situation indicates there is cause for concern during droughts for the private wells and for Fish Slough. The GSP says that despite the ever-increasing declines in the groundwater table in the Tri-Valley basin, pumping can continue as is "…during GSP implementation." (pg. 19). We assume that after implementation, the minimum thresholds will apply. It would be helpful to clarify that.

Response: See General Comments #6. The priority ranking is for the Basin, not individual GSAs. The Minimum Thresholds for the Tri-Valley Management Area apply if the OVGA GSP is used to manage that area. The GSP proposes to develop monitoring and modeling capability need to manage groundwater in Tri-Valley. If Mono County terminates their membership, the OVGA will not have a member with jurisdiction to implement the GSP in that portion of the Basin in Mono County. As long as the Basin remains low priority, no GSP would be applicable unless Mono and/or TVGMD acquire GSA status and prepare a plan. If another GSA is established in the Basin, that agency could adopt the Final OVGA GSP or prepare another separate plan included different objectives and thresholds. A Basin with two GSAs and GSPs, must include a coordination agreement.

However, if Fish Slough is already impacted, then pumping should not continue "as is" in the Tri-Valley. Minimum thresholds are usually the bare minimum for a species to survive and are insufficient for a species to thrive and grow. What spring flow would CDFW and USFWS recommend for the Pupfish to be a stable, healthy population? Maybe the threshold should be higher than 0.1 cfs for the springs and maybe no further decline should be allowed in the monitoring wells instead of allowing an additional 1.5 feet of decline. What groundwater flow is really needed to protect the endangered species at Fish Slough?

Response: See General Comment #4.

2. The OVGA GSP sets the minimum thresholds to the low point during the 2012-2016 drought. There weren't dry wells during that period, but a future drought could last even longer. There should be a time-criterion that if the water table is below the objective threshold for a given number of months, then the OVGA will act. This would provide better protection of the surface vegetation.

Response: The Minimum Thresholds are defined in terms of water table depth and the time criterion is currently set at the most conservative value of 1 year, the time step of annual evaluation and reporting. Also note that "*exceeding a minimum threshold at a single monitoring site is not necessarily an undesirable result, but it could signal the need for modifying one or more management actions, or implementing a project to benefit an area before the issue becomes more widespread throughout the basin*" and *"Avoidance of the defined undesirable results must be achieved within 20 years of GSP implementation (20-year period). Some basins may experience undesirable results within the 20-year period, particularly if the basin has existing undesirable results as of January 1, 2015. The occurrence of one or more undesirable results within the initial 20-year period does not, by itself, necessarily indicate that a basin is not being managed sustainably, or that it will not achieve sustainability within the 20-year period." (DWR 2017, BMP 6).*

3. What will the OVGA do if LADWP is over-pumping in a wellfield to the point that it affects the OVGA side? What action(s) will the OVGA take? There is a statement in the GSP, *"OVGA may inspect permits submitted to Inyo and Mono Counties to update its database and determine if new or replacement wells could cause changes in pumping in the Basin that may affect the sustainability of groundwater conditions.*" Could the OVGA stop a well going in the "treated as adjudicated" i.e., LTWA portion of the basin if there might be groundwater

impacts in the OVGA side of the basin?

See General Response #2. OVGA cannot deny well construction permits and cannot regulate LADWP activities on LADWP-owned land.

4. As LADWP replaces wells with wells that go deeper, it is well worth the investment for the OVGA to develop and refine hydrologic models for the whole Owens Basin that will show the cone of depression for each well and pinpoint a specific well that is causing degradation on the surface to vegetation or springs, should that happen. The OVGA should plan for a new future world of LADWP pumping only deep aquifers and address any monitoring gaps related to that scenario. If the deeper aquifers are recharged by snowmelt on the alluvial fans, then that is the BLM's or USFS' water that LADWP will be pumping out of the deep aquifers and it will end up in the LA Aqueduct. How will shallow aquifers be affected if the deeper aquifers don't have enough pressure to push water closer to the surface?

Response: LADWP has not provided numerical groundwater models developed by their consultants for portions of the Basin. The ICWD continues discussions with LADWP staff regarding sharing the groundwater models.

5. The OVGA should encourage the State Lands Commission (SLC) to not allow pumping under the Owens Lake bed for dust control or, should it be allowed, then to insist on thorough pump tests and an environmental review to look at the impacts. The water under the lake bed may have a different chemistry than the ponds on the lake that now support brine shrimp, fish, and migratory birds. There could be subsidence. There are areas of groundwater dependent vegetation around the lake and, as the GSP states, special-status species vulnerable to changes in groundwater conditions. The OVGA should push for replacement water for pumping state water either through a reduction in pumping elsewhere in the Owens Valley or in surface water diversions that would benefit the local environment.

Response: The Owens Lake is owned and managed by the State Lands Commission. SGMA "*…does not authorize a local agency to impose any requirement on the state or any agency, department, or officer of the state. State agencies and departments shall work cooperatively with a local agency on a voluntary basis*" (CWC §10726.8(d)). The OVGA cannot simply forbid pumping on state owned lands. State agencies, however, are required to "*…consider the policies of* [SGMA], *and any groundwater sustainability plans adopted pursuant to* [SGMA], *when revising or adopting policies, regulations, or criteria, or when issuing orders or determinations, where pertinent*" (CWC §10720.9). This GSP sets sustainable management criteria in test wells surrounding the lake and proposes that the OVGA actively participate in the working group and coordinate with state and local agencies with land management responsibilities to ensure this management area is managed sustainably to avoid undesirable results. (GSP Section 4.5.1)

6. The OVGA should be part of the planning for Operation NEXT and the next Urban Water Management Plan update. The 2020 version of the UWMP shows that Los Angeles can be self-sustaining water-wise and that it plans to reduce water purchases from the Metropolitan Water District with the water saved by conservation, recycled water, and the many ways the City of Los Angeles plans to reduce its water usage. The plan does not pass on any of those savings to the Eastern Sierra. On the contrary, it is part of LADWP's plan to continue taking as

much water as possible from here. The OVGA should be part of those conversations and advocate for reduced exports via the Los Angeles Aqueduct. The OVGA might also consider an annual meeting with the Mayor of Los Angeles and City Council members. They should know how the water exports affects the Eastern Sierra environment and economy.

Response: This request is not germane to the components of the GSP, but the OVGA will continue to monitor LADWP Urban Water Planning Actives.

Weaknesses of the LTWA

While the LTWA imposes restraints on LADWP groundwater pumping, it didn't restore vegetation to pre-1970 levels and it doesn't fully protect vegetation. It is important to note that the LTWA did not require LADWP to restore the groundwater levels to where they were before the 20 years of heavy pumping. Damage to the vegetation became permanent i.e., "it was grandfathered in." Since then, vegetation has declined even further in places under the LTWA.

The LTWA is divided into wellfield units. Each wellfield can be "temporarily" over-pumped as long as it is within a rolling 20-year average of recharge and pumping. The over-pumping causes sudden drops in the water table. The surface vegetation is stressed or dies from these unnatural swings in the water table when the groundwater drops below the root zone. There has been a loss of alkali meadows that have been converting to shrub habitat. LADWP's over-pumping can spill over into the OVGA managed part of the Owens Basin. Stronger language should emphasize LADWP's pumping impacts—unnatural hydrographs, DTW levels below GDE root zones, big fluctuations—as unhealthy management for the environment. Page 20 says, "Impacts from LADWP wells in the adjudicated area would be required to be mitigated by the LTWA." However, the LTWA is not effective in preventing damage or slow degradation to the vegetation.

The On/Off well system helps, but isn't perfect. On/Off wells only protect the vegetation to the degree that a well is hydrologically connected to its monitoring well, which isn't always the case. For example, one monitoring well is on the other side of the Owens River from its On/Off well. Not all wells are tied to a soil monitoring well. The On/Off wells are only in areas where the vegetation had been severely damaged during the 1970s-1980s. LADWP can pump non-On/Off i.e., the Exempt wells, which can affect the vegetation around those wells.

The On/Off doesn't stop the amount of pumping in the basin—just where it happens. For example, Blackrock 094 is a parcel that was impacted by over-pumping an exempt well under the LTWA. The vegetation changed from a dominant alkali meadow to a dominant shrub habitat, sparsely interspersed with alkali grass. The alkali meadow was lost under the LTWA. The LTWA specifies that the vegetation should not convert to a drier habitat. However, LADWP refused to accept the overwhelming amount of evidence and the conflict went to arbitration. Pumping in the area was reduced, but the vegetation was not restored or mitigated. Inyo County has to take LADWP to court or arbitration if LADWP violates the terms of the LTWA. The incomplete mitigation projects are another example of LADWP's disregard for the LTWA. There are many mitigation projects that still have not met the vegetation goals that were court ordered in 1997 and 2004. Impacts to the vegetation take years of wrangling with LADWP and lawsuits to correct.

The LTWA imposes some limits on LADWP's pumping and offers some control over the impact to vegetation in mitigation areas, but it isn't strong enough to bring back springs or meadows lost by the over-pumping of the 1970s-1980s. It isn't strong enough to prevent slow decline in

vegetation. It doesn't stop LADWP from mining the deeper aquifers. While tapping the deeper aquifer may shrink the cone of depression in the short-term, there could be impacts in the long-term e.g., subsidence, loss of springs, artesian wells, and wetlands, or dry shallow wells. Keep in mind that mitigations to repair the damage turn into long battles with mixed results.

DWR needs to understand that while there is a lot of monitoring and reporting by LADWP and the Inyo County Water Department, the LTWA is not adequate to protect the environment from over-pumping, which is the whole purpose of SGMA. To change the SGMA legislation so that the OVGA could have authority over the entire Owens Basin, both LADWP and Inyo County would need to agree to the change. This is not likely to happen. Regardless, it should be documented in the GSP and the OVGA should be prepared to take steps to bring problems to the attention of the Inyo County Supervisors, the LADWP Commissioners, the Mayor of Los Angeles, and the public.

Response: See general Comment #2

OVGA GLA Database suggestions

The OVGA GLA map of the Owens Basin is a good tool for the public. I have used it and would like to see a few changes to make it more user friendly:

1. Please rename "Zoom to..." to "Search for a well/monitoring point".
2. Please show the whole Monitoring Point field in the "Zoom to..." box when the GLA is opened. It is truncated and it isn't clear that one can scroll down to see the whole Monitoring Point box. Only the first data point, an unintelligible number, shows. It isn't clear there's a list or that one can enter a well id. It's hard to click on the field with only half of it showing.
3. Please add a legend explaining what blue dots, red squares, and orange circles are.
4. Please indicate if a well is no longer in operation—maybe an "x" in the red square or use a different color.
5. Please update the information about the wells. Hydrographs seem to stop at 2016 or 2017 and newer wells aren't showing.

Response: These suggestions will be addressed by OVGA staff and consultants if the technology/format allows for these modifications.

Thank you for your attention to these important issues. Sincerely,

Lynn Boulton
Chair, Range of Light Group
Toiyabe Chapter, Sierra Club

Tri-Valley Groundwater Management District

OVGA Public Review Draft Comments

MONO COUNTY TRI-VALLEY GROUNDWATER MANAGEMENT DISTRICT

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Carol Ann Mitchell, Chairperson
Phil West, Vice-Chairperson
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Matt Doonan
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November 3, 2021

Owens Valley Groundwater Authority
c/o Aaron Steinwand
P.O. Box 337
Independence, CA 93526

To the Board of Directors for the Owens Valley Groundwater Authority:

The Board of Directors of the Tri-Valley Groundwater Management District (the "Board") writes to provide its comments on the Draft Groundwater Sustainability Plan ("GSP") released for public comment on September 23, 2021 by the Owens Valley Groundwater Authority ("OVGA").

I. Lack of consistency or a clear statement about the data gap in the Tri-Valley Management Area and its implications for the GSP's management actions

The draft GSP lacks critical clarity about the nature of the insufficiency of the data for the Tri-Valley Management Area and what its implications are for the firmness of the conclusions drawn by the GSP are. Throughout, there are acknowledgements of the uncertainties in the data, but no definitive explanation of what that means for the strength of the conclusions and management proposals the GSP contemplates, despite often also drawing what appear to be firm conclusions.

For example, early on, the GSP states that "***The Fish Slough and Tri-Valley Management Area is the least understood portion of the basin***. There have been few hydrogeologic studies conducted in the area and monitoring networks are limited." (Section ES 2.2.4 at page 19). Nonetheless, in adjoining sections, the GSP states that "pumping in the [Tri-Valley] management area ***is the cause*** of declining water levels and spring flow in Fish Slough," though the "overdraft and the pumping effect on spring flow, however, ***are poorly quantified***." (Section ES 3.2.1 at page 22). These whipsaw contradictions with conclusions and uncertainty appear throughout:

- "In the Tri-Valley Management Area, a ***chronic decline in groundwater levels has been detected*** by the existing monitoring network, ***but the spatial coverage of monitoring wells in the management area is deemed insufficient***." (Section ES 3.5 at page 34).

- "***Historical data collection, hydrologic studies, and modeling efforts are limited*** in the Tri-Valley management area and the lack of quantification of inflow/outflow components is identified as a data gap in the GSP. ***However, the Tri-Valley area is likely in overdraft*** based on the current water budget using best available information and observed steady groundwater level declines over several decades that suggest outflows exceed inflows." (Section ES 2.2.3 at page 17).
- "Declining water levels in the Tri-Valley Management Area have been documented as discussed above (Section 2 and Appendix 3). For a largely unconfined aquifer system, this ***suggests*** overdraft is occurring, but the presence or amount of overdraft is not readily apparent in the water balance (Section 2.2.3). The ambiguity is partially due ***large data gaps*** in the management area................................" (Section 4.5.3 at page 288).

The GSP would benefit from a clear, uniform statement about the nature of the data gaps and uncertainties, and what those gaps mean for the confidence of conclusions and the strength of proposed management actions. Such a section should then be referenced in each area of the GSP where the uncertainty or data gaps are implicated. In its current form, the GSP creates an overall impression that though there is not a significant confidence level about groundwater conditions, the OVGA intends to proceed with an undefined pumping program on such limited data.

As such, the Board would like to express its agreement with the way the relationship of the data uncertainty to management actions is expressed in other sections of the GSP, such as 2.2.3.3. at page 226:

> "Analysis prepared by this GSP narrowed the range of estimates of the water balance for Tri-Valley, but lack of agreement among the various methods to assess the water balance reflects a significant data and knowledge gap that must be addressed. ***Identifying an overdraft exists (e.g. chronically lowering water levels) is insufficient information to begin managing pumping to correct the overdraft***. Future projects to better quantify the overdraft and develop models are necessary to inform any groundwater management plan developed for that portion of the Basin."

The Board believes that clearer statements like these built into a single section in the GSP and referenced throughout would provide needed clarity.

Response: See General Comment #5. Relevant portions of General Comment #5 were added to the GSP in Section 2.2.2.1.

Lack of clarity regarding data gaps in and assumptions about the Fish Slough Subbasin. Similarly, throughout the GSP, there are embedded uncertainties and assumptions about the relationship between the Tri-Valley Management Area and the Fish Slough subbasin without a clear statement of the implications of those uncertainties and assumptions. The GSP must be clearer about the limitations on the knowledge about the relationship between Fish Slough and the Tri-Valley Management Area, as well as the other potential groundwater sources.

The GSP contains contradictory language with respect to the need for a better understanding of Fish Slough and the conclusions drawn about connectivity that the GSP summarily repeats necessitate a pumping program in the Tri-Valley Management Area. As with the Tri-Valley Management Area generally, a number of statements seem to suggest there are significant assumptions and uncertainties, while simultaneously drawing conclusions:

- "While the proportions of groundwater discharging into Fish ***Slough are currently unknown***, a large portion is believed to come from the Tri-Valley area." (Section ES 2.2.1 at page 10; *see also* Section 2.2.1.6 at page 173).
- "This stratigraphy combined with preferential flow along faults/fractures that extend from Hammil Valley south to Fish Slough ***are believed*** to result in hydrogeologic connection between Tri-Valley and Fish Slough." (Section ES 2.2.4 at page 19).
- "***Greater understanding*** of the regional hydrogeologic flow system ***is vital to determine causality and to develop solutions*** to arrest or reverse the declines in water levels and spring flow discharge observed within Fish Slough." (Section ES 4.4. at page 38).
- "Based on surface topography, faulting, and inferred subsurface geology, Hollett et al. (1991) identified the Tri-Valley area as ***one of the potential water sources for Fish Slough***, which was supported by geochemical analysis by Zdon et al. (2019)." (Section 2.2.2.5 at page 210).

Response: See General Comment #6. Relevant portions of General Comment #6 was added to the GSP in Section 2.2.1.6.

Similarly, the GSP repeatedly cites to a limited modeling effort that showed an extremely wide "estimated conductivities in the range of 0.01 to 125 ft/day," which is "atypical of course alluvial materials and much lower than those from Owens Valley and Owens Lake." (*See* Section ES 2.2.1 at page 12). The GSP acknowledges that these "unusually low values" suggest that "a significant data gap exists." (*See id.*). This atypical and vast range in values is repeated in Section 2.2.1.6. The GSP seems to base a significant proportion of its conclusions on this conductivity to set the basis for implementation of a pumping program.

Response: The range of conductivities values is taken out of context. The entire sentence is:

> *A modeling effort in the Tri Valley and Fish Slough region estimated hydraulic conductivities in the range of 0.01 to 125 ft/day, with most of the values falling in the 1 to 20 ft/day range. These values are atypical of coarse alluvial materials and much lower than those from the Owens Valley and Owens Lake. The unusually low values may be due to model calibration artifacts suggesting a significant data gap exists.*

Uncertainty in alluvial aquifer conductivity was not a basis in the GSP for the development of a pumping plan for the Tri-Valley. The purpose for such a plan is included in the heading of the section where this additional OVGA activity is discussed: *Section 4.5.3 Develop a pumping program to stabilize water levels in Tri-Valley*. The evidence concluding chronically declining water levels exist in the Tri-Valley Management Area caused by pumping is discussed in General Comment #5.

Similarly, in section ES2.2.2 at page 12, the GSP concludes that the sparsely documented -0.5 ft/yr declines in Benton and Chalfant Valleys and the -1.8 ft/yr declines in Hammil Valley are consistent with the much lower -0.15 ft/yr decline in Fish Slough. (*See* Section 2.2.2.1 at page 177, where the conclusions are repeated again). Nowhere does the GSP acknowledge any cause or explanation for the differential rates in documented declines.

Response: See General Comment #5 for an explanation why water level declines vary between the three valleys and Fish Slough.

Finally, in only one paragraph of the entire GSP are the other potential sources of groundwater connectivity to the Fish Slough Subbasin mentioned. Towards the very end of the GSP on page 284, the plan states:

> "Based on general geochemistry, stable isotopes, and tritium, Zdon et al., (2019) concluded Fish Slough springs were sourced by a combination of water from Tri-Valley to the east, ***or the shared recharge areas for Adobe Valley and the Volcanic Tablelands to the north and northwest***. The geochemistry of source water varied spatially within Fish Slough, suggesting it is located at a convergence of regional groundwater flow paths. The ***authors did not quantify the proportion each source area contributed*** to a particular spring or seep discharge." (Section 4.4 at page 284).

It is unclear why this acknowledgement about the multiple sources of groundwater inflow is only included at the end of the GSP, when the multiple sources and lack of information about the contributing proportion of each potential source has significant implications for the pumping programs repeatedly suggested throughout the GSP for the Tri-Valley Management Area supposedly designed to benefit Fish Slough. This information seems to contradict the strength of the management action to recommend a pumping program in Section 4.5.3. The Board feels strongly that this information should be included in the GSP more prominently and throughout in a way that informs both the confidence of recommended management actions and the need for more data regarding Fish Slough prior to implementing a pumping program.

As in Section I of this letter, the Board wishes to express its approval and agreement for the way the relationship of the data uncertainty to proposed management actions is expressed later in the GSP. For example, in Section 3.1.1 at page 236, the GSP states:

> "The Tri-Valley Management Area exhibits declining water levels and spring flow in Fish Slough; however, ***lack of a groundwater model to evaluate and assess pumping effects prevents immediate measures to alter pumping or land management***. This GSP includes a plan for additional studies predicated on acquiring outside funding to prepare a numerical groundwater model."

Such statements about the relationship between the unknown data points and the management proposals should be made clearer either in one section of the GSP or referenced throughout.

Response: See General Comment #6. Additionally, the GSP suggests development of a pumping plan for the Tri-Valley Management Area (including Fish Slough) to address declining water levels, including Fish Slough and to ameliorate surface water capture from the springs. The identification of multiple spring water sources in geochemical studies is not surprising. Pertinent conclusions from Zdon et al. (2019) were:

> *"Northeast Spring is from a regional water source, deriving part of its water from the alluvial Tri-Valley groundwater system."*
>
> *"Northwest and BLM Springs are regionally derived and are a possible mixture of more sodic sources to the north (Adobe Valley and Benton Hot Springs area) and northwest (Volcanic Tablelands), mixing with Fish Slough Northeast Spring/Tri-Valley water."*
>
> *"These results have identified additional source areas contributing to spring flow in the Fish Slough area, including connections to the regional aquifer systems. The connections to the regional aquifer systems explain how regional water withdrawals in the area have resulted in the decline of spring flow in the Fish Slough area over time."*

The only source water area for the springs and the regional aquifer system upgradient from Fish Slough with significant pumping and similar water level trends as wells near the sampled springs was also recognized by Zdon et al. (2019):

> *"Future groundwater development and management in the region should be cognizant of the potential hydraulic connection between the basin-fill aquifer in the southern Hammil–northern Chalfant valleys and Fish Slough."*

The suggestion to develop a pumping program following increasing the monitoring and groundwater water model capability in Tri-Valley is prudent and consistent with the recommendations of Zdon et al. (2019) and several other lines of geologic and hydrologic evidence (e.g. summarized by Harrington, 2016) connecting groundwater pumping, declining water levels, and declining spring flows.

II. Contradictory language about insufficient data and conclusions about significant and unreasonable results for domestic wells

While several portions of the draft GSP acknowledge the difficulty of relying on the well vulnerability assessment for the Tri-Valley Management Area, several other portions of the draft GSP go on to make firm conclusions about the likelihood of "significant and unreasonable" outcomes.

For example, on page 37 of the draft GSP in section 4.3, the GSP acknowledges that "***Without reasonable estimates of the groundwater elevations across the valleys***, a domestic well vulnerability assessment is difficult and reliant on several (though reasonable) assumptions. ***It is not certain the average rate of decline*** based on the available data is consistent across each valley." Similarly, later in the GSP in section 3.2.1 on page 238, the GSP states that "[t]he assumptions, though reasonable, limit the confidence in the conclusions beyond determining that whether the number of vulnerable wells is few or many and whether significant and unreasonable effects are eminent or possible much later in the planning horizon of this GSP."

Nonetheless, repeatedly throughout the GSP the OVGA abandons these caveats to make definitive conclusions about the significant and unreasonable outcomes for domestic wells. For example, on page 25 of the draft GSP in section 3.3.1, the GSP states that based on "the limited amount and types of publically [*sic*] available data," the vulnerability assessment of 189 domestic wells in the Tri-Valley Management Area, it is predicted that between 3 and 8 wells may be at risk of refurbishment or replacement, and that "this number of wells being negatively affected by declining water levels ***is considered significant and unreasonable***." (*See also* Section 3.3.1.1 at page 243).

The Board would like to raise several issues with this conclusion and its repetition throughout the GSP: first, there is no or very limited discussion about the quality of the wells in the vulnerability assessment such as age, depth, and active use of wells. (*See* Section 3.3.1.1 at page 243, "Because no wells in the Tri-Valley area have been reported going dry, it is possible that these older wells are no longer the primary water supply for the property.). Such factors are highly relevant to determining significant and unreasonable outcomes, as are reliable estimates of the groundwater elevation throughout the Tri-Valley area, which the GSP repeatedly acknowledges are not yet available absent a groundwater model.

Second, the GSP is not clear on how significant and unreasonable are defined. 3 to 8 domestic wells of the 189 amounts to between 1.6% and 4.2% of the *assessment* wells, not the *total amount of wells*, which the GSP acknowledges is unknown (see Section 3.3.1.1 at page 243, "…the total number of domestic wells in the three valleys is not accurately known."). The GSP should explain significance as defined in setting these standards, particularly when the analysis to generate these "significant and unreasonable" results "relied on several assumptions due to the lack of information." (*See* Section 3.2.1 at page 238).

Response: Three undesirable results to pumpers caused by lowering of water levels were included in the GSP for the Tri-Valley Management Area: increased pumping costs, drying out shallow domestic wells, and loss of existing monitoring wells. The analysis of the threat to domestic wells was based on the limited information available about the construction of domestic wells in the Basin. Reasonable assumptions about how those wells were likely built was developed based on staff's knowledge of well drilling and construction procedures in the region gained by several local monitoring campaigns in these types of wells. The "quality of the well" is not a germane issue in SGMA. If the wells are likely to fail due to age or poor maintenance practices, for example, the OVGA is not obligated to analyze this variable. SGMA requires that the OVGA consider the impacts its groundwater management actions could have, for example, on water levels. It also requires a trend analysis to be performed that considers the impact that declining/rising water levels have on the beneficial users and uses of groundwater. The analysis only considered the factors required by SGMA: could the wells that exist fail due to water level declines.

Of the three undesirable results in the GSP, the well vulnerability analysis was based on the most severe possible outcome and a conservative (low) estimate of the number of potentially impacted wells. The metric of 30 feet of available water column in a domestic well was chosen in the well vulnerability analysis to represent the potential for complete loss of well operability. This event would entail the maximum expense to the well owner with costs typically of tens of thousands of dollars. The report's findings showed that 6% of wells could become inoperable by 2025 and 8% by 2040. Given the present water level trends, the number of vulnerable wells increases within the planning horizon if the declines are not stopped. The GSP recognized the uncertainty in the analysis and concluded that the number of wells at immediate risk of going dry is low. The Minimum Threshold was set at water levels anticipated to occur in 2007 assuming the present rate of decline continues. After 2007, the number of vulnerable wells increases and impacts to domestic well owners could be significant and unreasonable. Similarly if a less strict metric was used associated with less costly well repairs instead of well failure (e.g. pump replaced or lowered caused by the water column falling to less than 45'), the number of vulnerable wells in 2025 is approximately 11% and 19% during the 20-year GSP implementation period. The undesirable result of declining water levels that increases the annual electrical cost to pump water was not included in the analysis, but all wells in the management area are probably experiencing this undesirable result to varying degrees. Sections ES 3.3.1 and 3.3.1.1 were revised to better explain the reasoning behind the selection and evaluation of significant and unreasonable effects with regard to domestic wells.

III. Inconsistent separation of Fish Slough from the Tri-Valley Management Area

Though the Fish Slough subbasin was incorporated in the Tri-Valley Management Area despite repeated protests from this Board, there are repeated areas within the GSP where the Fish Slough subbasin is treated distinctly from the Tri-Valley Management Area in a way that obscures the management relationship between the areas that OVGA and the GSP propose.

For example, in section ES 2.2.2 on page 16 of the draft GSP, in the assessment of ecological values are oddly separated out: "Based on the assessment completed for this GSP, the Tri-Valley Management Area was determined to have low ecological value. The Fish Slough subbasin, the Owens Valley Management Area, and the Owens Lake Management Area were determined to have high ecological value." (*See also* Section 2.2.2.5 at page 218, where the Tri- Valley Management Area is again analyzed as separate from the Fish Slough Subbasin). No other management area in the GSP has a component area analyzed separately. Doing so confuses and obscures the intention in the GSP of managing the Tri-Valley Management Area for the benefit of the ecological values in the Fish Slough subbasin. (*See*, *e.g.* Section 3.4.1.3 at page 253, "Therefore, achieving the measurable objective for spring flow will likely require increasing the flow gradient from Tri-Valley into Fish Slough, which translates to increasing water levels in the valleys. Potential management actions for achieving this are discussed above in Section 3.2.1.1 and in Section 4.").

Response: Unique to the Basin, Fish Slough is a federally-designated Area of Critical Environmental Concern due to the presence of rare plants and animals. It is recognized as a subbasin within the Owens Valley Groundwater Basin. Fish Slough has substantially different ecology and land use than the primarily agricultural areas Benton, Hammil, and Chalfant valleys, and the ecology was evaluated separately from those valleys for that reason. It is more informative to characterize special status areas separately within the GSP. Lumping the biological assessment of Fish Slough with Tri-Valley would elevate the environmental susceptibility analysis of the Tri-Valley Management Area as a whole when in actuality the most unique and sensitive ecological resources only occur in a portion of the Management Area. See General Comment #6 regarding the hydrologic connection between Tri-Valleys and Fish Slough.

IV. Continuing questions about jurisdiction and legal authority to implement proposed management actions

The Board remains concerned, as it has expressed in previous comments to the OVGA, that jurisdictional issues regarding authority to implement some of the management actions proposed by OVGA in the draft GSP appear to remain unresolved. The OVGA under the Joint Powers Authority, as stated in the GSP, has the authority to act in the stead of its member organizations. Assuming Mono County remains a member organization, it is still unclear whether the OVGA, using Mono

County's authority, would have the ability and jurisdiction to implement well registration and permitting ordinances, when the Tri-Valley Groundwater Management District has specific statutory authority to conduct such management activities.

Response: The OVGA is operating according to the latest guidance from DWR contained in its letter of May 27, 2021 explaining that the OVGA is the exclusive GSA for the Basin with the authorities granted by SGMA.

V. Lack of detail regarding timeline for implementation and conditionality of certain actions on the development of a groundwater model

The Board also requests that the final GSP provide more clarity in the detail regarding the timing and ordering of management actions proposed following adoption of the GSP. In several instances, the GSP references a vague timeline for reaching 20-year milestones that seems to suggest there will be 5 years without management action. (*See, e.g.* Section 3.4.1.1 at page 250 "Following the initial five years of decline, this GSP anticipates five years of stabilizing groundwater levels as projects and management actions begin to come online . . .").

Similarly, the order and timing of the proposed management actions in Section 4 are confusing, particularly in that it is unclear what management actions will be treated as conditional upon the completion of a groundwater model for the Tri-Valley Management Area. Language sprinkled throughout the GSP simultaneously seems to suggest an immediate need for management through a pumping reduction program, while also stating that without a groundwater model development of such a pumping program is infeasible. For example, in section ES 4.4 at page 38, it states "It is not feasible or reasonable for the residents and agricultural producers in the Tri-Valley communities to make immediate or drastic reductions in pumping without economic and social hardship or without potentially impacting air quality. The capability to manage groundwater pumping is dependent on an ability to predict the impacts of recharge and pumping on the aquifer system." This statement presupposes both that immediate action would be necessary to reduce pumping and that more information is needed. The GSP should be clear about what management actions depend on developing a groundwater model.

Otherwise, inconsistent statements that the GSP "is not proposing immediate projects or management actions that would alter the operations of well owners in the basin" do not create any sense of when or under what conditions such management actions will be taken. (*See, e.g.* Section 2.1.4 at page 87).

Response: The referenced management action to develop a pumping program is contingent upon and would occur after the implementation of Management Action #3 to increase the monitoring program to characterize water levels at more locations in the Tri-Valley area and Management Action #4 to develop a groundwater model for the Tri-Valley Management Area. Management Actions #3 and #4 are necessary to make informed management decisions to address the chronically declining water levels throughout the Management Area. This is deemed a more prudent approach than implementing management immediately. The text quoted in this comment makes clear that the GSP deems it infeasible to immediately regulate pumping without additional monitoring information and completion of a groundwater model. Implementation of these measures will take time and given the potential economic and possible environmental impact to air quality, implementing regulations before the additional information is acquired would not be prudent. Failure to make progress on these steps or continued water level and spring declines, however, would be factors considered by DWR when the GSP is evaluated in 2027 and/or if the Basin priority is re-ranked.

Drastic management actions are proposed on limited reliable data and without reference to authority for implementation

The Board disagrees with the presentation of proposed management actions for the Tri- Valley Management Area. In Section 3.4.1.1 at page 251, the GSP proposes a number of drastic management actions while acknowledging that insufficient data exists to support the need for such drastic actions:

> "Reducing demand is the most likely course for arresting the chronic groundwater declines and groundwater storage reductions. This can take many forms such as improving irrigation efficiencies, ***retiring less productive agricultural lands***, changing crop types, or deficit irrigation. Development of any of these strategies necessarily follows steps in this GSP to address data gaps in this management area and probably acquisition of funding. ***Uncertainty in the water budget and the lack of a numerical groundwater flow model for the area prevents an accurate assessment of how much groundwater pumping in Tri-Valley would need to be reduced*** to achieve the measureable [*sic*] objectives."

Moreover, there is no statement in the GSP of what authority exists or would be used to achieve such measures like forcing the retirement of agricultural lands in the hands of private owners, nor about how the relative productivity of agricultural lands would be measured when the OVGA is making decisions about forcing them out of production. The GSP in its current form ignores cooperative measures to reduce groundwater demand that could be achieved through partnership with landowners or through education.

Response: The presence of overdraft is discussed in the previous comment. The likely cause of the water level declines is discussed in General Comment #5 and in Section 2.2.2.1 of the Final GSP. The strategies listed in Section 3.4.1.1 are not management actions of this GSP which are described in Section 4. The requested deletion contains a list of strategies to reduce demand that could correct long-term overdraft and achieve the measureable objective for water levels and groundwater storage (set at January 15, 2021 water levels). Clarification was added to this section in the GSP to generalize the discussion and avoid implying these are land management prescriptions for Tri-Valley. The topic sentence of the paragraph referred to in this comment now states:

> *Current water levels are below the management objective. Achieving the 20-year measurable objective to correct declining water levels requires either increasing recharge into the aquifer or decreasing pumping.*

SGMA (CWC §10726(b)) specifically grants the following authority to GSAs: Provide for a program of voluntary fallowing of agricultural lands or validate an existing program. Clearly, involuntary retirement of agricultural lands by the OVGA is not permitted nor is it contemplated in the Final GSP.

VI. Missing detail from proposed management actions regarding well registration and well permitting ordinances

There is unclear information in the GSP about the scope and applicability of the well registration ordinance. In Section 4.1 at page 276, the GSP suggests but does not clearly state that the ordinance will apply to all wells, including residential: "Registration of *de minimis* pumpers is permitted by SGMA, and the ordinance may include a one-time voluntary report to acquire information on well location, well construction characteristics, water levels, and approximate production amounts." Stating that something is permitted is quite different than stating that something is planned or intended. Further, the same Section 4.1 states that information to be collected by the proposed ordinance "is already required by local and State regulations as part of well permitting and well completion reports." If the information is already collected, why is the OVGA ordinance necessary? Will this ordinance apply retroactively to all existing wells? These fundamental details about the proposed ordinance are missing from the GSP. Further, there is confusion in the GSP about which wells will be registered under a proposed ordinance. In Section ES 4.1 at page 36, it states that "if it becomes necessary for the OVGA to regulate pumping amounts or well spacing to prevent well interference or other undesirable results, a more complete registration of non-de minimis pumpers is necessary." This seems to suggest that only domestic wells will be registered at first.

Response: The OVGA will have the discretion whether to proceed with an ordinance. The proposed Well Registration Ordinance description is clear regarding the voluntary registration of wells of *de minimis* users. It is not certain whether or not the OVGA will choose to include even voluntary registration in a final ordinance, though the primary benefit to the well owner is that potential impacts to their well could be included in any future analysis of new pumping projects.

Relatedly, other statements make unclear to whom the well permit review ordinance will be applied. In section ES 4.2 at page 36, it states that "[t]he ordinance will describe the conditions the OVGA may place on well construction, location, capacity, or extraction to ensure sustainable groundwater conditions are maintained in the Basin. *De minimis* extractors are exempt from most SGMA provisions including regulation of pumping." This seems to suggest that residential well permits will not be reviewed under the proposed ordinance, but this is not clear.

Response: To effectively monitor how much groundwater is being extracted from the basin (a key OVGA responsibility), the OVGA needs to have a method by which it is notified of new wells, their prospective groundwater extraction rates, and who to contact to collect groundwater extraction data going forward into the future. All well permits will be reviewed to keep the OVGA data base up-to-date. Authority to approve permits remains with Inyo and Mono Counties. Pumping by *de minimis* users for domestic uses cannot be regulated under SGMA.

VII. Managing Tri-Valley for the benefit of other management areas in the basin

The Board is deeply concerned that it appears the GSP contemplates imposing management actions on the Tri-Valley Management Area for the benefit of the Owens Valley Management Area. On page 28 of the draft GSP at section 3.4, the GSP contemplates that "Stabilizing water levels and spring flow declines in the Tri-Valley Management Area, as proposed by this GSP, would stabilize groundwater flow and spring discharge into the Owens Valley Management Area and ***not contribute to undesirable results in the Owens Valley Management Area.***" No other management area in the plan is similarly suggested to be managed for the benefit of another. The Board feels it is inappropriate to set objectives and standards for one management area because of potential impacts to another management area, particularly if only one management area in the basin is so burdened and constrained.

The Board is also concerned that a reference to the Owens Valley Management Area appears in the Measurable Objectives for the Tri-Valley Management Area. On page 29 of the draft GSP in section ES 3.4.1, the minimum threshold for subsidence is set with reference to what is reasonable for the Owens Valley. While the Board assumes this is a typographical error, because of the reference to managing Tri-Valley for the benefit of the Owens Valley Management Area's undesirable results, the Board wishes to raise the issue.

Response: Stabilizing water levels in the Tri-Valley area would stabilize groundwater levels and/or Fish Slough discharge into the Owens Valley Management Area. This is a simple statement of fact. The impetus for potentially implementing a pumping program would be to correct chronically declining water levels in the Tri-Valley Management Area (Section 4.5.3) and avoid undesirable results (Section 3.2). The Final GSP proposes OVGA exercise its authority to increase monitoring and seek outside funding for development of a groundwater model. These are the necessary steps before developing a pumping program. The subsidence reference in this comment is a typographical error and was corrected in the Final GSP.

The draft GSP should be clear about the circumstances under which the OVGA would implement management fees

Finally, the Board wishes to raise that the GSP should be clearer about under what circumstances fees would be imposed on groundwater users in the basin. In several instances, the GSP mentions that there could be circumstances that "may require the OVGA to consider fees for analyses and groundwater management activities" or that the OVGA could consider "assessing fixed fees or fees based on extraction quantity on local pumpers in the non adjudicated areas." (*See* Section ES 1.3 at page 4, Section ES 4.5 at page 41). These cursory statements do not suggest under what circumstances residents of the basin will be charged and for what management objectives, or whether fees will be basin-wide or specific to management area.

Response: Implementation of any Management Action is at the discretion of the OVGA in the future. At the time this GSP was prepared, it was not possible to anticipate future the composition of the OVGA Board of Directors or their decisions regarding which projects to implement. With regard to management actions, the Final GSP states in Section 4:

> *The OVGA has chosen to develop this GSP to ensure groundwater conditions in the Basin are maintained or improved where applicable. An additional consideration in developing this list of Management Actions and Projects was to not place an undue financial or regulatory burden on local residents recognizing that compliance with SGMA is voluntary for the OVGA (See Fund1 in guiding principles, Section 1.2).*

*   *   *

In closing, the Board has identified a number of fundamental issues that impact the clarity of the draft GSP and create confusion about the implications of the GSP for residents of the Tri-Valley. The Board urges the OVGA to make significant changes to the GSP to address these issues ahead of adoption.

Sincerely,

Emily Fox
On Behalf of the Tri-Valley Groundwater
Management District Board of Directors

October 6, 2021 SGMA GSP Stakeholder Outreach

OVGA Public Review Draft Comments

October 6, 2021
SGMA GSP Stakeholder Outreach
Public Workshop
Transcribed Public Comment

Q & A – Stanleya Pinnata – Can you please share with us how many are in attendance for this evening

Q & A – Philip Anaya – Will the public comments be posted

Response: yes.

Edie Trimmer – I do wonder how much the Owens Valley Groundwater Association can protect groundwater resources in the Owens Valley given that LADWP controls so much of the water resources in this basin. How much can we protect this basin through the OVGA.

Response: See general comment #2.

Lynn Boulton - I would hope that the GSP and the data you've collected would help you to realize when any part of the basin is in decline, could you distinguish whether LADWP's pumping is impacting the OVGA part of the basin vs some pumping that's done on the alluvial fans or OVGA part.

Response: See general comment #2. The GSP Section 2.1.2 and elsewhere states:

> *The monitoring program in this GSP will aid detection of cross-boundary impacts on the GSP area from LADWP's pumping activities and will alert the OVGA to coordinate with LADWP and/or Inyo County in mitigating any such effects.*

Sally Manning – I haven't been able to read it yet but certainly the tribe will be submitting comments, Big Pine Paiute Tribe of the Owens Valley. I do want to get an answer on the website and how the database will be maintained because I think it is a valuable resource and I see it has data up to about 2017 then stops and I'm wondering if that will be maintained and kept up to date.

Response: Section 2.1.2 states:

> *The Inyo County Water Department plans to use OVGA database as a repository for LADWP data for their daily operations in the future, and therefore it is anticipated to be updated regularly as additional data are collected and become available for import. The OVGA will determine the timing of the acquisition of data to update the database from other sources as funding and the scope of the GSP implementation in a low priority basin requires. The OVGA will also determine whether to require reporting of missing data collected by pumpers or to implement additional monitoring programs to fill identified data gaps (see Section 4, below).*

Nancy Masters – I have a follow up comment to Sally Manning's comment about data and its collection. It was my understanding that SGMA was going to provide for a statewide database that's going to be robust and inform decision making in all the various basins. I guess my question is through the GSP will OVGA be able to insure that all pumpers in the Owens Valley basin supply all the data to the statewide database. I guess my comment was really whether all pumpers will be contributing to that database in a transparent manner.

Response: Management Actions #1 and #2 (Section 4.1 and 4.2) describe possible actions to complete the data gaps in pumping within the basin and to keep the OVGA database management system up to date. Implementation of the measures will be at the discretion of the OVGA.

Lynn Boulton – I wanted to suggest you post next week's presentation on either the OVGA or inyowater, I look for it there and I lost my email and couldn't find it. People might go there to look if they didn't get a notice from Laura, the information to access the meeting.

Response: comment noted.

Philip Anaya – So I'm going to harp again on the biggest problem to sustainability in the non-adjudicated portion of the basin is going to be what LADWP does in the adjudicated portion of the basin. The more they pump, the more water they are going to drain across the adjudicated non-adjudicated boundary so I'm looking for something, I think there's a vast improvement in the draft GSP vs the administrative draft in terms of some language about the management across that boundary. I still want to see under additional activities in the projects, the OVGA making a formal statement to the State of California that we are pursuing a management agreement across the adjudicated non-adjudicated boundary and we are willing but so far DWP is not willing. I think that will pay dividends towards maybe them coming to the table to begin to talk about issues like what happened in 2013/14 where right across Barlow Ave., south Barlow Ave in west Bishop, you had w407 pumping away, w408 pumping away down there in the cone, t389 lost 17 feet and subsequently by August, August/September of both those years, we had no water in the ditches. So a combination of all those things caused three dozen domestic wells to go dry. Those people were not reimbursed, it was a violation of the LTWA, and the County didn't do anything so we need to put teeth into the GSP. We have an existing infrastructure for surface flow recharge in west Bishop to prevent that kind of thing and we need to have an ambitious statement in the GSP that speaks to that. I still don't see it in the GSP. What I would like to see also if it's possible I would like to get a hydrograph of this year's t389 measurements. I would like to know what's going on this year because the ditches are looking really slow and I'm thinking that we may have a repeat of 13/14 here in 2021. I would like the data so I can post an appropriate comment if that's possible. I would like to see it myself so that I can write a succinct letter, a succinct public comment regarding the issue and I really want to see under additional projects a statement that we are pursuing a management agreement with the DWP regarding the flow of groundwater across the adjudicated non-adjudicated boundary. That is the greatest threat to sustainability in the non-adjudicated portion of the basin and there is nothing in the current draft that is vigorous enough to alert the SGMA that this is an issue and an issue we are pursuing.

Response: The hydrologic changes and management that occurred in West Bishop in 2013 were widely reported. The suggestion to include in the GSP a project to acquire and manage surface water in West Bishop in the area managed by the Bishop Creek Water Association has been offered at several meetings of the OVGA, but the Board has not directed staff to include such projects in the GSP. The feasibility of acquiring surface water rights for recharge, reservoir storage costs, and acquiring staff to manage surface water (and asking the Basin residents to fund) would considerable obstacles. The Owens Valley and Owens Lake Management Areas are not in overdraft and all surface water recharge is used in Tri-Valley Management Area. Regarding the remainder of the comment see General Response #2.

Edie Trimmer – I'm concerned about our local participation, are we not getting the voices of our local citizens. All of us know about water issues in the Owens Valley but it seems there is only a few of us that speak up. What can we do the few people that speak up? I wonder if the public feel the OVGA is really only acting in their own best interest and so they are not concerned. But our concern is the big lands controlled by LADWP. I just wonder if that's part of the lack of response.

Response: The summary of outreach efforts is discussed in Section 2.1.9.

Nancy Masters – You are absolutely right Holly I have not had time to review this document extensively so this may indeed be covered in the document. I would like to see the GSP have some control or authority or directional activity over water spreading on the forest service lands that rim the basin of the Owens Valley including diversions from those creeks and how that water spreading is done. I know those are federal lands but some private lands are effected by that and I think that's recharging the basin and it's important that that activity is at least overseen to a certain extent. It may be a matter of coordinating with the federal agencies for work on diversions and water spreading and construction of berms, that kind of thing. So a coordination effort.

Response: Those activities are conducted by LADWP as part of aqueduct operations and might be considered activities pursuant to the LTWA.

Philip Anaya - Going back to the public participation, I don't want to slam the process but I do want to say I think that the COVID has really had an impact on the process. Zoom meetings have been ok but are not like having the get together like the real public meetings we were having previous to COVID. I would say that public participation has been welcomed at the OVGA. When we were at the meetings you could get to the diocese and talk, we were given a lot of latitude. Maybe one thing that could have helped with public participation would be for instance if the interested parties had been brought on board at a much earlier period of like before the consultant was hired. That's all water under the bridge but I definitely think that zoom meetings have been an impediment to public participation. It's not as easy to express yourself over the computer. One last thing I do want to say is the GSP we end up with is a GSP that anybody who's going to comment on it, is going to comment on it in a favorable way. We don't want to have a lot of public comments criticizing the GSP at the state level when it goes there. So it's real important now up to November 8 to try and reach out even more so and double the efforts to get some public input so that we don't have people that are going to be complaining about it later.

Response: The summary of outreach efforts is discussed in Section 2.1.9.

Jerry Gabriel – I've been staying quiet for a couple of reasons and it's not a lack of interest. I have a lot of interest especially historical interest about water in the valley; the early diversions into the power plants; and the water is supposed to come back out. I'm in the Dixon Ln area and I think I have coverage of surface water by the Chandler Decree, I could be wrong about that but anyway I have ditch water. I think I have noticed when the ditches stay dry for a while it effects my domestic well. My domestic well is very low volume and one of the concerns I have is if you ask me how much I'm pumping that well and how much water I'm getting from the ground, I couldn't tell you, I have no idea, so that concerns me. Mainly I've kept my mouth shut because of lack of knowledge not a lack of interest but because many of the things you're talking about, the agencies you've mentioned, I know we use acronyms a lot and I don't know what those letters mean so I didn't want to display my ignorance but I'm doing it.

Response: Thank you for the comment but it is not directly related to the GSP.

Q & A – Lynn Boulton – I'll submit comments later

Q & A – Sally Manning – The website and notice should also state the comment deadline of November 8.

Response: The schedule was placed on the website

Q & A – Lynn Boulton – Thank you for having this meeting to reach out to the public

Q & A – Sally Manning – Gabriel, you should talk to Philip Anaya. Interesting that low ditch flows on Dixon seem to affect depth to groundwater. Feel free to reach out to me too. Sally Manning s.manning@bigpinepaiute.org

Mary Roper – So I have a question and I really should know this since I go to the OVGA meetings for months. So after all the public comment and the GSP in its final form is submitted to DWR and they accept it, how easy is it in the future if things change to amend the plan.

Response: The procedure to amend the GSP is described in CWC § 10728.4. The GSP is also subject to review by DWR every five years.

Jerry Gabriel – Our water comes from what was originally Birch Creek and at one time we contemplated and tried to get started on a Birch Creek Water Association but it never went anywhere so we are pretty much on our own out here but thank you, you've pretty much said what my belief is that we do have some water rights because of riparian on Birch Creek that used to go through here so thanks for that. Many years ago there was a very large ranch that was irrigated in this area and it's been divided, and divided, and divided and it gets complicated.

Response: Thank you for the comment but it is not directly related to the GSP.

October 13, 2021 SGMA GSP Stakeholder Outreach

OVGA Public Review Draft Comments

October 13, 2021
SGMA GSP Stakeholder Outreach
Public Workshop
Transcribed Public Comment

Q & A – Kevin Carunchio – Just Curious, how many people are participating tonight?

Q & A – Kevin Carunchio – How's that compare to last week?

Kevin Carunchio – Thanks for providing the forum tonight, I'm still making my way through the document, got through the Executive Summary and sort of jumping around. The most salient comment and I don't know if it reappears outside the Executive Summary but on page 4 in the description of the plan area, Los Angeles is the largest land owner in Inyo County about 53% of the land I think, that should be in the ground water basin or in the Owens Valley. They certainly don't own 5,000 square miles in Inyo County.

Response: The acreage value was corrected. The % ownership values in Table 2-1 represent values for the Basin, not the entire Inyo County.

I have some more general questions to inform more comments so if other people are raising their hands and want to jump on with specific comments I'm happy to circle back later. I appreciate the vastness of the basin and the management areas that were identified and it seem to make perfect sense to me. My interest is more in the Owens Valley Management area which is still immense. With a little bit of non-adjudicated lands in there and stuff so I'm understanding and probably won't use the correct hydrologic terms but the Owens Valley Management area is considered to be in a pretty good place of (astasis)???, dynamica, sustainability, I forget the exact terms used. A lot of that is due to the LTWA being implemented but for private land owners in the non-adjudicated area, you know, and some of this is a little bit of forecasting I guess the future because you haven't even drafted an ordinance yet but I'm trying to envision how it plays out. What would qualify, just in general terms, as a large pumping project on non-adjudicated land given that, tremendous impact identifying the plan that LADWP pumping and the basin is just so large, does that make sense.

So on the database is well specific criteria set to the GSP or is it really just extrapolating back from that drought year. So if I'm looking at the representative monitoring locations in the management area, I can go to that database and just pick some of the wells identified on these figures and see what's what.

Response: This is correct. The functionality of the database was subsequently discussed and demonstrated for Mr. Carunchio.

One other database question I have is I was having trouble reading the GDE figures in the plan. I did go to the IGDE site so I could blow those up a little better through DWR. The amount of work in this is tremendous. Do I understand the Water Departments cold version of the map is also on the same database you just showed me? I don't want to go too far down the rabbit hole but I guess my concern was, I'll look at that first and I understand that throughout the document the connection between the interconnected surface water and groundwater is really unlikely especially higher up on the fans. The reason I'm asking about it is because when I looked at the

IGDE database and saw the lay of the land out there it seemed to contain some fairly obvious errors or misconstructions that have been well debated in the valley for years.

Response: The functionality of the database was subsequently discussed and demonstrated for Mr. Carunchio including the vegetation database. The GSP recognizes that improvements to the GDE map are needed in some areas of the Basin which were included as a potential Management Action (Section 4.5.3)

> *Several improvements to the final GDE map in Figure 2-25 should be completed during implementation of this GSP before the five year assessment or if there is a change in prioritization of the Basin. Funds were not available to conduct fieldwork to ground truth all parts the iGDE map or the final GDE map (after ICWD staff review). The GDE map refinement should include updates to reflect more accurate mapping of springs and seeps and vegetated dune areas near Owens Lake.* :

I'll look at the database first and see what the revised maps show. So sort of a hypothetical at this point I kind of went into the plan looking for is if you have a public water system that's pumped pretty significant for people over the years but in light of the current drought situation has reduced it's pumping by half. I'm thinking down the road is there going to be a problem increasing that pumping, hypothetically. When I'm reading the plan it's like if they were pumping at the higher level during the 2012-2016 drought barring external factors, resuming to that level shouldn't really necessarily cause a trigger or anything, under the current plan. What I was concerned about is maybe a baseline being set to low based on current pumping levels which have really been influenced by the current drought conditions where eight years ago it was full bore. I just want to be sure on how the plan is being interpreted rather then tied to specific historic pumping levels. I appreciate the free ranging conversation tonight to help me formulate better comments. One thing I wasn't clear on is are some of the monitoring wells are those necessarily water wells or water quality wells associated with like waste water treatment plants , are those water quality wells for a specific purpose but could influence groundwater. Using the landfill monitoring as sort of an example, what I was curious about is a landfill monitoring well type situation for water quality, sometimes those wells go dry when water levels drop then are no longer a good monitoring well. Are those also being used in the GSP as water level monitoring wells even though they are installed for water quality purposes?

Response: Some landfill wells are being used for water quality and water level representative monitoring sites.

I think the service this plan is going to do to all de minimis users, kind of protecting their smaller wells is of tremendous value just as a talking point. I'm curious on the well permit review process, as I understand it the OVGA would act just like inter county departments in terms of reviewing well permits before they are issued offering comments but kind of playing that out if it needs to have a little more teeth, has there been some discussion because I think in both Inyo and Mono well permits are currently ministerial actions. I'm sorry you've been losing Board Members. The whole structure was set up to provide as many seats at the table to give people voices. To jump ship at this point doesn't seem necessarily one of self-interest. Thank you for the ability to chit chat and get a little more informed on there.

Philip Anaya – Just wanted to comment, that was a great discussion with Kevin and I'm glad that I was able to hear it. I'm making my way through the GSP and I wish more people were in tune to the whole thing but it is what it is. Thank you again for this public comment period.

Kevin Carunchio – I have more of a ticky tac question to see whether it would be helpful or not but I noticed in some of the reading there's some discussion of disadvantaged communities. My take is that it was relative to the Communication and Engagement Outreach plan and some of the challenges and extra challenges presented by the pandemic but if we are aware of other communities that should be considered for that should we point that out in comments. I haven't seen any other real tie-in's I know it does to some of the funding, funding opportunities and stuff, now would that be worthwhile. Everything I've seen so far addresses it up in the Tri-Valley area for communication and outreach. I think it's great the OVGA decided to pursue the GSP because I think it's easier to craft a document like this when you're not under the pressure of a medium or high priority basin and there seems to be a lot of flexibility and adaptability built into this with the wisdom of future Boards.

Q & A – Jen Roeser – That was a great discussion! I learned quite a bit. Thank you Aaron and Holly – you've gone above and beyond to outreach and obtain public engagement and comment.

Q & A – Kevin Carunchio – Thank you!

October 20, 2021 Tri-Valley Groundwater Management District

OVGA Public Review Draft Comments

TVGMD

Special meeting 10.20.21

OVGA presentation by Aaron Steinwand: Note the Responses are paraphrased and simplified from the recording of the videoconference meeting by TVGMD . The TVGMD did not have a quorum to take action at an official meeting but continued as a community meeting.

1. If this goes through, would they [residents of Tri Valley] be required to put meters on their wells, and would they be charged for the water they use?

   Response by Aaron during meeting: Not automatically, no. For domestic users, no, absolutely no… It has not been discussed by the OVGA as requiring that.

2. If she gives you permission to monitor her well and then sells the property, is the buy obligated to continue with the agreement?

   Response by Aaron during meeting: No, the agreement is with the individual.

3. If a well has the equipment on it for monitoring and it needs to be re-drilled, is OVGA going to take off the equipment so the driller can work on the well?

   Response by Aaron during meeting: We don't need continuous information, just periodic/annual measurements taken when the owner is home.

4. Why did the Basin get re-rated?
5. Since the groundwater is declining 6" – 2' a year, why would it make sense to pump out water from the TV?

   Response by Aaron during meeting: SGMA was designed to try and stop that pumping.

6. Been drilling in the county for 40 yrs, I've done 12,000' of drilling in one year. Yes or No, our water right today, we can pump all the water we want from our wells as long as we don't interfere with a neighbor intentionally? Your intent is to take the water right away from us so you can regulate it in the future. Will you regulate it in the future, limiting our ability to pump water from our pumps?

   Response by Aaron during meeting: No, SGMA does not affect any existing water right, but it allows regulation of the water right.

   Your organization has more than one lawyer representing it

   Response by Aaron during meeting: Yes, Inyo and Mono Counsels

   I, Russell Kyle, oppose any regulation of private water wells for the entire future of California. I oppose the State of CA, the TVGMD, the OVGA, taking away the water rights we have today.

7. It's been stated that you probably would not start management actions for 5 yrs or until re-rated to medium. (approximately, the trigger is the groundwater model, if re-ranked we would have to do something).

At the August meeting, the Board approved a 2022-23 budget for TV of $xxx which includes well registration and reporting ordinance of $xxx, well permit review permit of $xxx, increasing groundwater monitoring network of $xxx, and a groundwater model of $xxx, and any grant assistance of $xxx. (xxx=amount reported in draft budget) If actions don't start until later, why did the Board approve a budget?

I don't understand if this is going to be next year or 5-years.

Response by Aaron during meeting: The OVGA did not adopt a GSP budget in August. That was a presentation of information regarding costs required to be included in a GSP. The OVGA is operating under the 2021-2021 FY budget adopted in June, 2021. It will adopt another annual budget in May 2022.

8. Follow up, if you can't get grant funding, how would $365,000… would it be a fee or something that goes onto the residents?

   Response: Implementation management actions in the GSP are at the discretion of the OVGA. Currently, the OVGA has directed staff to pursue outside grant funding for the groundwater model project, the largest component of the quoted value.

9. Question – if the TVGMD withdraws from the OVGA do they risk being re-ranked as a med or high priority area due to dropping water levels?

   Response by Aaron during meeting: They have withdrawn and have requested to be their own GSA. Basin re-ranking is done for the entire basin

10. What is the real interest behind monitoring the water wells of private people? Because I have heard the answer earlier but I don't understand because we know that LA is taking a lot of our water, the power today to monitor the water through other way so I don't understand how by monitoring wells of people that have been doing it for years, how is that gonna raise the water of the wells?

    Response by Aaron during meeting: It's allowing us to describe the basin more adequately.

    Why do you have to do that?

    Response by Aaron during meeting: The rate of decline may vary within the basin. It's something you should do, elsewhere in the valley there are a ton of monitoring wells but in the TV it is sparse. Information would help guide what pumping should be.

    Want to understand what the benefit to Benton residences is to monitor all the wells, do we monitor LA? Do we know how much water they take from us?

    Response by Aaron during meeting: They [LADWP] don't pump north of Laws.

    How are they gonna implement that? I don't own my own land, how do you implement what you are going to do? Knock on their door and ask them to give you their water rights?

    Response by Aaron during meeting: Monitoring is voluntary.

    What about the agriculture?

Response by Aaron during meeting: They are large enough to be regulated under SGMA, and by the OVGA.

What is the risk of refusing, if I have ag land in Benton, what do I risk if I do not want you to monitor my pumping?

Response by Aaron during meeting: None for households or de minimis users. SGMA could conduct investigations, but we [OVGA] haven't talked or considered that far ahead for other pumpers.

For household they can still refuse, exist, and manage as they are doing now.

Response by Aaron during meeting: Yes, this is getting hypothetical. A GSA can enforce compliance with a GSP. We have not discussed that heavy-handed regulation.

Yes, but we need to know what could happen in 10 yrs. Who could they allow to own the water? Who is in charge of that?

Response by Aaron during meeting: That gets into water rights questions. If you buy the property you can sink a well and put it to a use, securing the water right. SGMA will not affect a water right but it can regulate it. That will be a large legal question to figure out what that means.

I need simple explanations, that was fine.

11. What would happen if fish slough is completely dry, no more water, and 5-10 springs around here are zero water., how long would it take for DWR, state organization, to start applying rights to say, if you don't have a well on your property, you can't drill one.

Response by Aaron during meeting: There are several steps. Before DWR gets involved, the OVGA or GSA would have to be re-ranked, requiring a plan, and …. If all fails then the State has the authority to regulate pumping amounts, well installation and reactivation.

What if in 5 years we have drought condition, fish slough is gone and springs are gone, how long would it take for them to up-date us to a high priority?

Response by Aaron during meeting: The state cannot intervene until re-ranking occurs. I don't think they can re-rank as soon as something like that happens.

Owens Valley Groundwater Sustainability Plan:
Hydrogeologic Conceptual Model

Prepared For

Owens Valley Groundwater Authority
Owens Valley, CA

OWENS VALLEY GROUNDWATER AUTHORITY

Prepared by

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November 30, 2021

Certification

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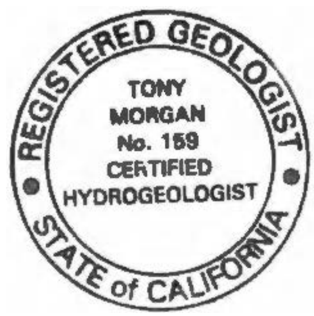

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Acronyms and Abbreviations

Acronym	Acronym definition
AF	acre-feet
AFY	acre-feet per year
Ag	agriculture
amsl	above mean sea level
BCM	[USGS] Basin Characterization Model
bgs	below ground surface
BMP	best management practices
CA	California
CASGEM	California statewide groundwater elevation monitoring
CCR	California Code of Regulations
CFS	cubic feet per second
CIMIS	California irrigation management information system
DBS&A	Daniel B. Stephens & Associates, Inc.
DEM	digital elevation model
DPWM	Distributed Parameter Watershed Model
DTW	depth to water
DWR	[CA] Department of Water Resources
ET	evapotranspiration
ET_0	reference evapotranspiration
FT or ft	feet
GAMA	[USGS] groundwater ambient monitoring & assessment

GDE	Groundwater dependent ecosystem
GIS	geographic information system
GPS	global positioning system
GBUAPCD	Great Basin Unified Air Pollution Control District
GSA	groundwater sustainability agency
GSP	groundwater sustainability plan
HCM	hydrogeologic conceptual model
Hydrodata	hydrologic data server
LADWP	Los Angeles Department of Water and Power
LAUWMP	Los Angeles Urban Water Management Plan
OLGDP	Owens Lake Groundwater Development Program
OVGA	Owens Valley Groundwater Authority
RP	reference point (elevation)
RWQCB	[CA] Regional Water Quality Control Board
SWRCB	[CA] State Water Resource Control Board
TD	total depth
TDS	total dissolved solids
TOS	top of screen
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey

Executive Summary

The Owens Valley groundwater basin is large and complex hydrogeologic system consisting of an alluvial and fluvial aquifer interbedded with clayey lacustrine sediments and volcanic flows. The basin is closed both topographically and hydrologically, with the terminus located at the southern end of the valley at Owens (dry) Lake. Confined to semi-confined conditions are generally found along the axis of the valley, with unconfined conditions present along the margin. Faults intersect the groundwater basin and act as both conduits for and barriers to groundwater flow depending on the location and orientation. Groundwater is primarily sourced from runoff that infiltrates into the alluvial fans along the margins of the valley as streams flow across them. Groundwater flow is generally from the margins towards the axis of the valley, and from the north towards the south. Naturally elevated solute concentrations are present either due to leaching of volcanic deposits or evaporative concentration in the Owens Lake area. Groundwater and surface-water in the basin are highly managed by the LADWP, with the majority of extracted groundwater exported out of the basin to the south for use in Los Angeles. Groundwater is used for a variety of purposes within the basin including agricultural, municipal, domestic, ecological, industrial, and recreational uses.

Introduction

A hydrogeologic conceptual model (HCM) is a framework for understanding how water moves into, within, and out of a groundwater basin and underlying aquifer system. According to the California Department of Water Resources (DWR), the HCM fundamentally provides [DWR, 2016]:

- *An understanding of the general physical characteristics related to regional hydrology, land use, geology and geologic structure, water quality, principal aquifers, and principal aquitards of the basin setting*
- *Context to develop water budgets, mathematical (analytical or numerical) models, and monitoring networks*
- *A tool for stakeholder outreach and communication*

All groundwater sustainability plans (GSPs) are required to include an HCM (23 CCR §354.14) that contains the following information:

- Regional geologic and structural setting
- Basin boundaries
- Principal aquifers and aquitards
- Primary use or uses and general water quality for each principal aquifer
- At least two (2) scaled geologic cross sections
- Physical characteristics (e.g., topography, geology, soils, etc.)

Development of a basin HCM is an iterative process as data gaps (see Appendix 3) of the Owens Valley Groundwater Sustainability Plan) are addressed and new information becomes available.

Owens Valley Hydrogeologic Conceptual Model

Numerous geologic and water resource studies have been conducted in Owens Valley since the early 1900's. A detailed review of all previous work is beyond the scope of this report, but all relevant information was reviewed during development of the Owens Valley hydrogeologic conceptual model. The sections below summarize information pertinent to HCM development.

2.1 Physiography

Owens Valley is located on the eastern side of the Sierra Nevada Mountains in California on the western edge the Basin and Range Province (Figure 2-1). The surrounding watershed is approximately 3,287 mi^2, extending from Long Valley and Benton Valley in the north to Haiwee Reservoir in the south. The Owens Valley groundwater basin is comprised of Owens Valley (6-012.01) and Fish Slough subbasins (6-012.02), which are about 1,032 mi^2 and 5 mi^2, respectively. Locally, the northern arm of the Owens Valley subbasin that contains Chalfant, Hammil, and Benton Valleys is referred to as “Tri-Valley.” For the purposes of this plan, this area is included when referring to the Owens Valley groundwater basin unless stated otherwise.

Elevations in the watershed range from 14,505 ft above mean sea level (amsl) at the summit of Mt. Whitney to 3,529 ft amsl in the Owens Dry Lake portion of the watershed. Topography can be broadly classified into three categories: mountain uplands, volcanic tablelands, and valley fill. The margins of the watershed are primarily composed of the steep, mountainous uplands. The western boundary is formed by the Sierra Nevada Mountains and the eastern boundary is formed by the White and Inyo Mountains, resulting in an elongated U-shaped watershed. The volcanic tablelands located to the north of Bishop are not nearly as prominent as the mountainous uplands but form a local topographic high. Valley fill makes up nearly a third of the total watershed area, formed by deposition from the Owens River, tributaries draining the surrounding mountains, and paleolakes.

The Owens River enters the northern portion of the groundwater basin near Bishop and then meanders southward through the valley towards Owens (dry) Lake (Figure 2-2). Numerous tributaries drain the Sierra Nevada and enter the western portion of the groundwater basin. A relatively high drainage density and large volume of annual runoff has caused the alluvial fans formed by these streams to coalesce and form a broad apron or bajada that extends eastward towards the center of the valley (Danskin, 1998). In contrast, there is relatively little runoff coming into the basin from the Inyo and White Mountains as they receive less precipitation due to rain-shadowing by the Sierra Nevada. Alluvial fans on the east side of the valley are not nearly as large and overlap less compared those on the west. The Owens River generally flows on the east side of the valley as a result of this asymmetrical fan configuration.

The Owens Valley is a closed basin due to the Coso Range at the southern end of the watershed preventing groundwater and surface-water outflow. Surface-water and groundwater flow toward to the south, the natural terminus of the watershed. Prior to construction of the Los Angeles Aqueduct in the early 20th century inflows to the valley generally exceeded evapotranspiration rates and formed Owens Lake, which covered more than 100 mi^2 and had depths greater than 20 ft (Danskin, 1998). Diversion of surface-water for irrigation within the valley and for export south via the Los Angeles Aqueduct significantly altered the water budget and desiccated the lake by 1926 (Saint-Amand et al., 1986). With the exception of very wet years, Owens (dry) Lake is a playa and was one of the largest sources of dust pollution in the United States due to the combination of high winds and easily erodible sediments (Gill, 1996). In recent years, LADWP has conducted extensive dust control mitigation on the lake including shallow flooding, managed vegetation, and mechanical methods like gravel cover and berm construction.

2.2 Climate

Climate in Owens Valley watershed is strongly correlated with elevation. The high elevation portions of the watershed are cooler (Figure 2-3) and receive the greatest amount of precipitation (Figure 2-4), primarily as snow from October-March. The watershed experiences a strong west-east precipitation gradient due to the "rain shadow effect" caused by the Sierra Nevada. Moist air masses moving westward off the Pacific Ocean rise when they encounter the Sierra Nevada, the rising air cools, and water vapor condenses and falls as rain or snow. As air masses descend the eastern slope, the descending air warms, clouds evaporate, and precipitation declines east of the Sierra Nevada. The combination of topography and the rain shadow effect results in highly variable precipitation in the watershed. Long-term averages of total annual precipitation (1981-2010) are about 57 inches in the Sierra Nevada, 14 inches in the White and Inyo Mountains, and 5.9 inches on the valley floor (PRISM Climate Group, n.d.).

2.3 Vegetation

Native vegetation covers most the Owens Valley watershed (Figure 2-5) as the majority of land area is owned by federal, state, or municipal entities with limited residential or industrial development. Vegetation in the Owens Valley groundwater basin varies with elevation, floristic region, soil salinity, and water availability. Vegetation communities range from salt-tolerant shadscale scrub, alkali sink scrub, desert greasewood scrub, alkali meadow, and desert saltbush scrub on the low elevations of the valley floor, to more drought-tolerant Mojave Mixed Woody Scrub, Blackbush Scrub, and Great Basin mixed scrub on alluvial fans (Danskin, 2000; Davis et al., 1998). The groundwater basin lies on the boundary of the Great Basin and Mojave deserts; consequently, the southern part of the basin has vegetation communities such as Mojave creosote bush scrub characteristic of the hot Mojave Desert to south and the northern part of the basin has communities such as Big Sagebrush scrub characteristic of the cooler, higher elevation Great Basin Desert. Hydric vegetation communities associated with streams, springs, and wetlands occupy relatively small areas of the groundwater basin, but are important habitat resources. At higher elevations in the watershed, vegetation types include Pinyon-Juniper woodland, montane forest and meadow, subalpine forest and meadow, alpine plants, and barren terrain above timberline (Danskin, 2000).

In the arid environment of the Owens Valley, vegetation communities are mediated by hydrology. On alluvial fan surfaces, where the water table is disconnected from the root zone, plants subsist on precipitation alone. Near stream channels, ditches, canals, and along the Owens River, surface-water supports riparian communities. Areas of shallow groundwater support alkali meadow, alkali sink scrub, shadscale scrub, and desert saltbush scrub communities. Groundwater discharge zones support alkali meadow, phreatophytic scrub communities, transmontane alkali marsh and aquatic habitat.

2.4 Soils

Surficial soil data were obtained from the Natural Resources Conservation Service (NRCS) soil survey geographic (SSURGO) database. Areas of similar soils are grouped into map units, which have similar physical, hydrologic, and chemical properties. Map unit properties are assigned a range of values based on the soils contained within them.

The large geographic extent and complex geology of Owens Valley results in a wide range of soil types. A total of 467 unique soil map units were identified within the Owens Valley watershed, with 263 overlying the groundwater basin. Figure 2-6 shows a general summary of these map units classified by soil texture, which covers approximately 78% and 91% of the watershed and groundwater basin area, respectively. Areas not covered by SSURGO data include the eastern Sierra Nevada and the southeastern portion of the watershed.

Table 2-1. Summary of groundwater basin surface soil texture composition

Soil Type	Area (acres)	Area (%)
Silty Sand	303,182	45.69
Unknown	82,501	12.43
Silty Gravel	76,900	11.59
Low Plasticity Clay	51,732	7.80
Clayey and Silty Sand	29,202	4.40
Poorly Graded Gravel	17,933	2.70
Low Plasticity Clay and Silt	17,277	2.60
Silt	10,726	1.62
Clayey and Silty Gravel	4,364	0.66
Clayey Gravel	2,888	0.44
Poorly Graded Silty Sand	2,872	0.43
Organic Silt and Clay	1,681	0.25
Clayey Sand	1,607	0.24
Poorly Graded Sand	1,457	0.22
Peat	333	0.05

Surface soil textures are dominated by sands and gravels, primarily silty sand which alone accounts for 46% of the groundwater basin area (Table 2-1). Finer grained soil textures such as silts and clays make up approximately 25% of the area and are generally located adjacent to the Owens River. About 12% of the area is labeled “Unknown” in the SSURGO database. The majority of this category is located near Owens (dry) Lake, where soils are dominated by evaporite salt deposits (Murphy, 1997).

Figure 2-7 shows the drainage class for soils in the watershed. In general, soils located along the margins of the groundwater basin are well to moderately drained due to a combination of coarse soil textures and the lack of a shallow water table. Poorly drained soils are found primarily in areas adjacent to the Owens River, where finer textured soils and shallow depths to groundwater are found. Although the SSURGO database classifies most of the Owens (dry) Lake area as "Unknown" it can likely be considered poorly drained due to the presence of thick clay layers near the land surface (MWH, 2013) and upward vertical hydraulic gradients (MWH, 2011a).

Saturated soil hydraulic conductivity in the groundwater basin ranges over four orders of magnitude from 0.001 to 32.5 ft/day (Figure 2-8). The lowest conductivity soils are located in the Owens (dry) Lake area and adjacent to the Owens River (excluding areas of exposed bedrock). The distribution of hydraulic conductivity values are similar to the distribution of soil textures in the groundwater basin, which is expected as coarser soil textures tend to have greater hydraulic conductivities. With the exception of Owens (dry) Lake and areas adjacent to the Owens River, saturated hydraulic conductivity within the groundwater basin generally exceeds 5 ft/day. Therefore, infiltration capacity for most of the Owens Valley groundwater basin is considered to be very high.

Soil salinity in the watershed ranges from non-saline to strongly saline (Figure 2-9). In general, the high elevation areas of the watershed and the western portion of the groundwater basin have non-saline soils due to the greater amount of precipitation received. Moderately to strongly saline soils are primarily found adjacent to the Owens River where the water table is shallowest and in the Owens (dry) Lake area where strong vertical gradients move water upwards through saturated clay layers at the surface. The most saline soils in the watershed are found near Owens (dry) Lake where the basin is closed and water can only leave via evapotranspiration which increases the concentration of solutes in the remaining groundwater and salts accumulate in the sediments over time.

2.5 Geology

The geologic history of Owens Valley is a complex mixture of rifting, faulting, volcanism, and deposition, as shown in Figures 2-10 through 2-12. Owens Valley lies at the western edge of the Basin and Range Tectonic Province, and the dramatic topography of the basin is an expression of the underlying tectonic processes. The Basin and Range Province is characterized by north-south oriented mountain ranges and narrow intermountain valleys bounded by normal faults, and the Owens Valley is the westernmost basin in the Province. On the west, the Sierra Nevada consists of uplifted granitic and metamorphic rocks, locally mantled by glacial and volcanic deposits. To the east, the White-Inyo Range consists of Paleozoic sediments, Mesozoic volcanic rocks, and metamorphic rocks that have been folded, faulted, and intruded by granitic plutons, and are locally mantled with Quaternary sediments and Tertiary volcanic rocks. The present topography was produced by extensional faulting that initiated in the Miocene and produced northwest trending faults (Hollett et al., 1991). A later phase producing north-south trending normal and strike slip faults initiated in the Pliocene or Pleistocene and is still active. The contact between low permeability fault-bounded mountain blocks and more permeable valley-fill material generally forms the bedrock boundaries of groundwater basin; however, the basin boundary west of Chalfant and Hammil valleys is formed by the edge of the surficial expression of the Bishop Tuff, a Pleistocene rhyolitic ignimbrite that overlies basin fill and bedrock (Hollett et al., 1991).

The Sierra Nevada and the White-Inyo Range were glaciated during the Pleistocene and Holocene. Glaciation was far more extensive in the Sierra Nevada due to its westerly position, proximal to the Pacific Ocean and incoming synoptic scale storms. Glacial moraines extend beyond the range front and into the groundwater basin in the region from Big Pine to Round Valley, contributing material to the alluvial fans flanking the Sierra Nevada (Bateman et al., 1965).

Owens Valley was formed as a result Basin and Range extensional tectonics that caused land surface parallel to the fault trace to subside. The down dropped valley block created space into which valley-fill accumulated, consisting mainly of sediment shed from the adjacent mountain blocks deposited in alluvial fans, rivers, and lakes in the valley. Basalt flows erupting from volcanoes formed due to crustal thinning as a result of the extension are interbedded with the valley-fill in some locations. Sedimentary material consists of unconsolidated to moderately consolidated alluvial fan and glacial moraine deposits adjacent to the mountain range fronts, fluvial plain deposits near the axis of the valley, deltaic deposits, and lacustrine deposits. Older alluvial fan deposits tend to be elevated and at the margins of the valleys. Sediments of the central axis of the valleys are typically fluviolacustrine, playa, and dune deposits. In well logs, these valley fill sediments are expressed as sands, gravels, boulders, and clay layers. Sedimentary strata are variable vertically and laterally. Depositional environments change over relatively short distances resulting in laterally discontinuous sand, gravel, and clay lenses. Tectonic activity and climate variations change sediment supply and depositional energy at any given point, resulting in lithologies changing over vertical distances of a few feet to a few dozen feet. Laterally extensive clay strata are present beneath Owens (dry) Lake and in the Big Pine area. Owens Lake expanded and contracted during Pleistocene glacial and interglacial periods, periodically rising above the topographic high at the south end of Owens Valley to hydrologically connect with Searles Lake and Lake Manly. Owens Lake most recently overflowed into Rose Valley and Indian Wells Valleys to the south about 3 thousand years ago (ka).

Volcanic rocks are present as valley fill near the basaltic cinder cones and flows of the Big Pine Volcanic Field south of Big Pine, in small basaltic plugs west of Bishop, and in the northern Owens Valley as Bishop Tuff. Bishop Tuff is a rhyolitic welded tuff erupted from the Long Valley Caldera 767 ka (Crowley et al., 2007), northwest of Owens Valley. Bishop Tuff dominates the land surface north of Bishop and west of Chalfant and Hammil Valleys, and is present at depth in Chalfant Valley, Laws, and Bishop according to well logs. The Bishop Tuff consists of basal unconsolidated pumice, overlain by a dense heat-welded zone, and a less dense gas welded zone. Where Bishop Tuff forms the groundwater basin boundary west of Chalfant and Hammil valleys, it is likely underlain by valley fill. In the Owens River Gorge, near the northwestern extent of the groundwater basin, Bishop Tuff is underlain by granitic bedrock. Hollett et al. (1991) considered that recharge to valley fill was likely to occur where the basal pumice layer of the Bishop Tuff was exposed, and that recharge through the welded zones was unlikely except along faults and fractures. Basalt flows south of Big Pine emanate from vents along the range front and are interstratified with valley-fill sediments. Basalts between Big Pine and Independence are the highest permeability aquifer materials found in Owens Valley.

Structural geology and geometry of the Owens Valley groundwater basin is dominated by faulting related to regional tectonism, with both normal and strike-slip components. Faults at the margins of the basin are generally normal faults with the basin down-dropped relative to the mountain blocks. Some mountain-downward normal faults occur locally, forming minor grabens along the range front. Faults found in the valley-fill are generally parallel to the axis of the valley. The Owens Valley Fault extends from Owens (dry) Lake to north of Big Pine. The largest recorded earthquake in the Basin and Range Province occurred on the Owens Valley Fault in 1872, with an estimated magnitude of 7.5-7.8, generated by dominantly right-lateral motion. Numerous sag ponds, sand blows, pressure ridges, and other features related to the 1872 event are present along the trace of the fault (Beanland & Clark, 1982; Slemmons et al., 2008). Other faults occur as branches of the range front faults and Owens Valley Fault. A number of springs occur along faults where the faults act as barriers to flow across the fault plane. In the Volcanic Tableland, the Bishop Tuff is broken by many north-south and northwest-southeast oriented fault scarps, the largest of which forms the eastern boundary of Fish Slough, north of Bishop and west of Chalfant Valley (Harrington, 2016).

Bedrock beneath the Owens Valley fill consists of down-dropped fault-bounded blocks at varying depths. Numerous geophysical methods have been used to define the form and depth of the bedrock surface (Danskin, 1998; MWH, 2010, 2011b; Pakiser et al., 1964), which showed that the bedrock beneath the valley is not a single down-dropped block, but rather is a series of deep basins separated by relatively shallow bedrock divides. The deepest part of the basin is beneath Owens (dry) Lake and is overlain by more than 8,000 feet of valley fill, and another deep basin is estimated to have valley-fill of about 4,000 feet thick lies between Bishop and Big Pine (Hollett et al., 1991). Other shallower basins are present east of Lone Pine and beneath Hammil Valley. These basins are separated by blocks of shallower bedrock. Valley-fill strata within the deeper portions of the basin have a "stacked bowl" configuration with the deepest part of each stratigraphic horizon occurring in the deepest part of the basin. Gravity data indicate bedrock is relatively shallow between Benton and Hammil valleys and between Laws and Chalfant Valley located east of Fish Slough subbasin (Hollett et al., 1991; Pakiser et al., 1964).

2.6 Hydrogeologic Framework

Approximately 35% of the land area and the majority of water rights in Owens Valley groundwater basin are owned by the Los Angeles Department of Water and Power (LADWP) for the purpose of exporting water from the Eastern Sierra to Los Angeles (Figure 2-13). Los Angeles has developed extensive facilities for water storage and export, land and water management, groundwater production, groundwater recharge, surface-water and groundwater monitoring, and dust control. Because of the importance of water supplied from Owens Valley to Los Angeles, LADWP monitoring is extensive and considerable study has been devoted to Owens Valley hydrology. Conversely, Chalfant, Hammil, and Benton valleys, collectively referred to as the Tri-Valley area, are less studied and monitoring is relatively sparse as LADWP owns little land in those areas.

The primary surface-water features in the groundwater basin are the Owens River and its tributaries draining the eastern slope of the Sierra Nevada (Figure 2-2). The Owens River flows from Long Valley, enters the northwest potion of the groundwater basin, and flows south towards Owens (dry) Lake. Streams draining the high elevations of the east slope of the Sierra Nevada join either the Owens River or are diverted into the Los Angeles Aqueduct. Like many watersheds in the Basin and Range Province, the Owens Valley is internally drained with the natural terminus of the watershed at Owens (dry) Lake. Flow in the Owens River is controlled by a series of reservoirs operated by LADWP and Southern California Edison Corporation (SCE), supplemented near its headwaters by diversions through the Mono Craters Tunnel from the Mono Basin.

Streams within the Owens River watershed that have a significant amount of runoff are gaged by LADWP. The combined total of these gages is reported as a single value referred to as "Owens Valley Runoff" (OVR). Water-year (WY; period from October 1 - September 30 designated by the calendar year in which it ends) totals of OVR from 1935 - 2017 ranged from 188,000 acre-feet per year (AFY) to 835,000 AFY, with a median value of 392,000 AFY. Releases from Pleasant Valley Reservoir, where the Owens River enters the groundwater basin, had a median value of 256,000 acre-feet per year (AFY) and ranged from 75,000 to 444,000 AFY from WY 1959-2017. Numerous tributary streams drain the east slope of the Sierra Nevada and either join the Owens River or are diverted into the Los Angeles Aqueduct. The largest of these, Bishop Creek, has median annual runoff of 71,000 AFY and ranged from 35,000 to 134,000 AFY for WY 1904-2017. Combined inflows to the Owens Valley groundwater basin for all gaged tributaries ranged from 106,000 to 418,000 AFY, with a median of 181,000 AFY from WY 1988-2017.

No direct surface-water connection exists between the Tri-Valley area and the Owens River except for an ephemeral wash that occasionally flows from Hammil through western Chalfant into the Laws area during extreme runoff or precipitation events. Surface-water that enters the Tri-Valley area as runoff from the surrounding mountains, less any water lost to evapotranspiration or vadose zone storage, is believed to recharge groundwater. In wet years LADWP diverts a portion of surface flows from the Owens River into the McNally Canals, the majority of which recharges groundwater in the Laws area due to the canals intersecting coarse sands and gravels. Similarly, LADWP diverts Owens River water annually for irrigation near the communities of the Bishop and Big Pine. These diversions are more consistent than those for the McNally Canals. Flow data for Tri-Valley streams is very limited, with only one long-term LADWP gage established in the southern portion of the Tri-Valley for Piute Creek. The western slopes of the White Mountains have streams that have been described as perennial, with high flows during the snowmelt period or following intense rainstorms (PW&A, 1980). Most of these streams are either diverted for irrigation or rapidly infiltrate into the alluvial fans once they enter the valley floor. Runoff from the surrounding mountains into the Tri-Valley area has been estimated to range from about 16,500 to 27,000 AFY on average (MHA, 2001; PW&A, 1980). Results from a Distributed Parameter Watershed Model (DPWM), a rainfall-runoff model which accounts for snowpack, that simulates conditions in the Tri-Valley from WY 1995-2019 produces average inflows of about 18,000 AFY and median inflows of about 13,500 AFY (See Appendix 13 of the GSP for more details).

The Fish Slough subbasin, located to the north of Bishop and to the west of Chalfant Valley in the volcanic tablelands, is a federally-designated Area of Critical Environmental Concern (ACEC) due to the presence of rare plants and animals. Although little precipitation falls directly on the

Fish Slough subbasin, habitat is supported by groundwater discharged to springs and seeps along faults. Some of this discharge becomes surface-water runoff that flows approximately five miles and eventually enters the Owens Valley groundwater basin north of Bishop. Annual runoff volume from Fish Slough has steadily declined by approximately 78 AFY over the last half century. Mean annual volume reported at LADWP Station 3216 (Fish Slough at L.A. Station #2) was 6,500 AFY for WYs 1967-1976, and 3,400 AFY for WYs 2008-2017. While all the sources of groundwater discharging into Fish Slough are poorly understood, existing evidence suggests, a large portion comes from the Tri-Valley area (Jayko & Fatooh, 2010, Zdon et al.,).

Inflows to the Owens Valley groundwater system are primarily sourced from infiltration of surface-water into alluvial fans near the margins of the valley, with a small amount of recharge derived from direct precipitation on fan surfaces, deep percolation from irrigated agricultural fields, and seepage from losing reaches of the Owens River, Los Angeles Aqueduct, numerous Sierra creeks and irrigation ditches in the valley. Groundwater flows from recharge areas high on the alluvial fans (areas of high hydraulic head) to discharge areas on the valley floor (areas of low hydraulic head) resulting in groundwater flow directions that roughly parallel topographic gradients (Figure 2-14). Most natural groundwater discharge occurs on the valley floor in the form of spring flow, wetlands, baseflow to gaining reaches of the Owens River, evapotranspiration in phreatophytic vegetation communities, and evaporation from valley lakes, reservoirs, Owens Lake playa, and Owens Lake brine pool.

The basin boundaries are generally delineated by the contact between alluvium and the bedrock of the adjacent mountain blocks. At the south end of the basin, the boundary is defined by the topographic high between Owens Valley and Rose Valley. This portion of the basin boundary is in alluvium and straddles north and south Haiwee reservoirs. It was previously hypothesized that a permeable pathway south to Rose Valley could exist. However, more recent potentiometric data indicate the basin is indeed closed and there is no significant groundwater outflow to Rose Valley (MWH, 2013). The boundary west of Chalfant and Hammil valleys is formed by the contact between valley-fill alluvium and the Bishop Tuff. At this boundary, the Bishop Tuff likely overlies valley fill that was present when the tuff was deposited. The northeastern boundary of Benton Valley is jurisdictional, formed by the California-Nevada state line. The bedrock boundary at the bottom of the valley fill has been characterized by geophysical methods (Pakiser et al., 1964) and, as noted earlier, reveals that the basal bedrock forms deep basins separated by bedrock highs. Shallow bedrock is present between Chalfant Valley and Laws, between Benton and Hammil valleys, and between Big Pine and the Los Angeles Aqueduct intake.

Valley fill material is highly heterogeneous and although sedimentary strata generally cannot be traced over long distances, the basin’s aquifer system can be generalized into a shallow unconfined zone and a deeper confined or semi-confined zone or zones separated by a confining units (Figure 2-15). A review of 251 driller's logs of wells in Owens Valley found that 89% of wells had indications of low permeability material in the well log (MWH, 2003). This three-layer conceptual model was used in numerical groundwater flow models for Owens Valley (Danskin, 1988, 1998) and the Bishop-Laws area (Harrington, 2007). The shallow zone is nominally about 100 feet thick and the transmissive portion of the deeper zone extends to approximately 1,000 feet below land surface.

Most of the valley fill is clastic material shed from the surrounding mountains, the majority of which is sand and gravel. Alluvial fan sediments are coarse, heterogeneous, and poorly sorted at the head of the fan and finest at the toe. The transition zone from fan to valley floor deposits is characterized by relatively well-sorted sands and gravels that likely originated as beach, bar, or river channel deposits. This zone is a favored location for LADWP groundwater wells because the well-sorted sandy aquifers provide high well yields and the transition zone corresponds to the alignment of the Los Angeles Aqueduct. Extraction of groundwater from the transition zone has impacted groundwater dependent vegetation such that LADWP has implemented or plans to implement a number of revegetation, irrigation, and habitat enhancement projects to mitigation the effects of groundwater pumping (LADWP and County of Inyo, 1991).

Although volcanic flows comprise a relatively small volume of the valley fill, the most transmissive aquifers in the Owens Valley occur in basalt flows between Big Pine and Independence. Historically, the largest springs in Owens Valley occur where high permeability basalt flows terminate against lower permeability sediments or are in fault contact with sediments. Most of these large springs stopped flowing shortly after 1970 due to increased groundwater pumping (LADWP and County of Inyo, 1991).

Hydraulic conductivity, determined from aquifer tests in Owens Valley and the Owens Lake area, ranges from less than 10 ft/day to over 1,000 ft/day (see Figure 16 in Danskin, 1998; Table 3-6 in MWH, 2013). Where lacustrine sedimentation has prevailed for long periods of time at Owens Lake and Bishop-Big Pine area, extensive thick clay confining layers are present. Although the clay layers are disrupted and off-set by faulting, the confined nature of the deep aquifer is evident from generally higher heads in the deep aquifer than in the overlying shallow aquifer and the presence of flowing artesian wells near Bishop, Independence, and Owens Lake. A modeling effort in the Tri Valley and Fish Slough region estimated hydraulic conductivities in the range of 0.01 to 125 ft/day, with most of the values falling in the 1 to 20 ft/day range (MHA, 2001). These values are much lower than those from the Owens Valley and Owens Lake, possibly due to model calibration artifacts.

The principal geologic structures affecting groundwater flow are the basin's bedrock boundaries and faults in the valley-fill material (Figure 2-15). The bedrock boundaries delineate the geometry of permeable valley fill. Faulting generally parallels the axis of the valley and can form barriers to groundwater flow across the faults due to the offset of high permeability layers and due to the formation of low permeability material in the fault zone resulting from fault motion (fault gouge). Evidence for faults acting as groundwater flow barriers includes emergence of springs along fault traces, sharp changes in water table elevation across faults, and reversal of vertical gradients observed in wells with multiple screened intervals on opposite sides of faults. North of the Alabama Hills, blocks of aquifer are compartmentalized by en-echelon faults, restricting lateral flow into the compartments. Recharge to individual compartments is limited to local sources such as a stream segment within the compartment or precipitation. Absent lateral inflow, effects of pumping may be more long-lasting in compartmentalized areas, because recharge in compartmentalized aquifers may be limited to direct precipitation, which provides relatively little recharge.

Due to the arid landscape, aquifers in the Owens Valley serve a variety of purposes. Irrigation and domestic water supply are the primary aquifer uses in Tri-Valley, with agriculture being the dominant use. Some portion of groundwater is likely discharged from Tri-Valley into Fish Slough which creates springs that sustain habitat for endangered species such as the Owens pupfish and the Fish Slough milk-vetch. In the central Owens Valley between Tri-Valley and Lone Pine, the majority of groundwater extractions are from LADWP for export to Los Angeles for municipal use. In-valley uses of groundwater water include irrigation for agriculture, municipal supply, domestic use, and support of phreatophytic vegetation on the valley floor. Groundwater pumped from the Owens Lake portion of the aquifer system includes relatively small volumes of water for municipal and domestic use, industrial use from a single water bottling plant, agricultural irrigation, and recreational use at an approximately 6 acre water ski pond. Natural springs and flowing artesian wells also provide localized habitat in the area.

Outside of the Owens Lake area, water quality is generally very good due to the large amount of snowmelt runoff in the largely undeveloped Eastern Sierra Nevada that recharges the groundwater aquifer combined with the limited amount of industry and agriculture in the basin itself. Arsenic is the primary constituent of concern with naturally occurring but elevated concentrations observed in localized areas, believed to be sourced from dissolution of volcanic rocks. Evaporative concentration of solutes (primarily salts) in the Owens Lake area caused by the lack of a physical outlet results in generally poor groundwater quality in the western and southern portions of the Owens Lake area, and therefore limited pumping demand. The small number of groundwater users generally pump water from the upgradient margins of the playa, presumably sourcing the relatively low total dissolved solids (TDS) concentration of recharge water sourced from the Sierra Nevada before it mixes with the high TDS Owens Lake groundwater.

The majority of groundwater dependent ecosystems (GDEs) within the Owens Valley are composed of phreatophytic vegetation that relies on shallow groundwater as a primary water source or small wetland areas adjacent to springs or abandoned flowing artesian wells. Figure 2-16 shows the extent of GDEs within the GSP area that have been identified. Note that this does not include GDEs known to be present in the valley that are located on lands owned by the LADWP (see Appendix 9 of the GSP for more details), as management and protection of those GDEs are covered by the Inyo-LA Long Term Water Agreement and therefore not subject to SGMA regulations. Most of the GDEs within the GSP area are concentrated in Fish Slough and Owens Lake.

Conclusions

The Owens Valley groundwater basin is large and complex hydrogeologic system consisting of an alluvial and fluvial aquifer interbedded with clays and basalt flows. Confined to semi-confined conditions are generally found along the axis of the valley, with unconfined conditions present along the margin of the valley. Faults intersect the groundwater basin and act as both conduits for and barriers to groundwater flow depending on the location and orientation. Groundwater is primarily sourced from runoff that infiltrates into the alluvial fans along the margin of the valley as streams flow across them. Groundwater flow is generally from the margins towards the axis of the valley, and from the north towards the south. Groundwater quality in the basin is generally high; however naturally elevated solute concentrations are present either due to leaching of volcanic deposits or evaporative concentration in the Owens Lake area. Groundwater and surface-water in the basin are highly managed by the LADWP, with the majority of extracted groundwater exported out of the basin to the south for use in Los Angeles. Groundwater is used for a variety of purposes within the basin including agricultural, municipal, domestic, ecological, industrial, and recreational uses.

References

Bateman, P. C., Pakiser, L. C., & Kane, M. F. (1965). *Geology and Tungsten Mineralization of the Bishop District California*. U.S. Geological Survey Professional Paper 470.

Beanland, S., & Clark, M. M. (1982). *The Owens Valley Fault Zone, Eastern California, and Surface Faulting Associated with the 1872 Earthquake*. U.S. Geological Survey Bulletin 1982.

California Department of Water Resources (2016). *Best Management Practices for the Sustainable Management of Groundwater: Hydrogeologic Conceptual Model*, December 2016. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-3-Hydrogeologic-Conceptual-Model_ay_19.pdf

Crowley, J. L., Schoene, B., & Bowring, S. A. (2007). U-Pb dating of zircon in the Bishop Tuff at the millenial scale. *Geology*, *35*(12), 1123–1126. https://doi.org/10.1130/G24017A.1

Danskin, W. R. (1988). *Preliminary Evaluation of the Hydrogeologic System in Owens Valley, California*. U.S. Geological Survey Water-Resources Investigations Report 88-4003.

Danskin, W. R. (1998). Evaluation of the Hydrologic System and Selected Water-Management Alternatives in the Owens Valley, California. U.S. Geological Survey Water-Supply Paper 2370-H. In *Hydrology and Soil-Water-Plant Relations in Owens Valley, California*.

Danskin, W. R. (2000). Plant Communities. In J. Smith (Ed.), *Sierra East, Edge of the Great Basin*. University of California Press.

Davis, F. W., Stoms, D. M., Hollander, A. D., Thomas, K. A., Stine, P. A., Odion, D., Borchert, M. I., Thorne, J. H., Gray, M. V., Walker, R. E., Warner, K., & Graae, J. (1998). *The California Gap Analysis Project - Final Report*. University of California, Santa Barbara, CA.

Gill, T. E. (1996). Eolian sediments generated by anthropogenic disturbance of playas: human impacts on the geomorphic system and geomorphic impacts on the human system. *Geomorphology*, *17*, 207–228. https://doi.org/10.1016/0169-555X(95)00104-D

Harrington, R. (2007). *Development of a Groundwater Flow Model for the Bishop/Laws Area: Final Report for Local Groundwater Assistance, Grant Agreement No. 4600004129* (p. 54).

Harrigton, R. (2016). Hydrogeologic Conceptual Model for the Owens Valley Groundwater Basin (6-12), Inyo and Mono Counties (p. 43). https://www.inyowater.org/wp-content/uploads/2015/12/owens_valley_conceptual_model.pdf

Hollett, K. J., Danskin, W. R., McCaffrey, W. F., & Walti, C. L. (1991). Geology and Water Resources of Owens Valley, California. U.S. Geological Survey Water-Supply Paper 2370-B. In *Hydrology and Soil-Water-Plant Relations in Owens Valley, California*.

Jayko, A. S., & Fatooh, J. (2010). *Fish Slough, a geologic and hydrologic summary, Inyo and Mono Counties, California*. U.S. Geologial Survey Administrative Report.

Jennings, C. W., Strand, R. G., & Rogers, T. H. (1977). *Geologic Map of California*. California Division of Mines and Geology, scale 1:750,000.

LADWP and County of Inyo. (1991). *Agreement Between the County of Inyo and the City of Los Angeles and its Department of Water and Power on a Long Term Groundwater Management Plan for Owens Valley and Inyo County, Stipulation and Order for Judgement, Inyo County Superior Court, Case no. 1* (p. 95).

MHA. (2001). *Task 1 Report: Preliminary Data Collection and Hydrologic Models for the USFilter Tri-Valley Surplus Groundwater Program, Mono County, California* (p. 261).

Murphy, T. P. (1997). *Soils of the Owens Lake Playa, Report I*. Great Basin Unified Air Pollution Control District.

MWH. (2003). *Confining Layer Characteristics Cooperative Study: Final Report*.

MWH. (2010). *TM: Evaluation of Geophysical Data - Phase I (September 2010)*. Appendix Q of Final Report on the Owens Lake Groundwater Evaluation Project (2013).

MWH. (2011a). *Report: Updated Conceptual Model (November 2011)*. Appendix H of Final Report on the Owens Lake Groundwater Evaluation Project (2013).

MWH. (2011b). *TM: Evaluation of Geophysical Data - Phase II (June 2011)*. Appendix R of Final Report on the Owens Lake Groundwater Evaluation Project (2013).

MWH. (2011c). *TM: Preliminary Updated Conceptual Model (January 2011)*. Appendix C of Final Report on the Owens Lake Groundwater Evaluation Project (2013).

MWH. (2013). *Final Report on the Owens Lake Groundwater Evaluation Project*.

Pakiser, L. C., Kane, M. F., & Jackson, W. H. (1964). *Structural Geology and Volcanism of Owens Valley Region, California - A Geophysical Study*. U.S. Geological Survey Professional Paper 438.

Phillip Williams & Associates. (1983). *Water Resources and Their Relationship to Agricultural and Urban Development of Hammil Valley* (p. 54).

PRISM Climate Group. (n.d.). Oregon State University, http://prism.oregonstate.edu, retrieved 22 April 2020.

PW&A. (1980). *The Hydrology of the Benton, Hammil, and Chalfant Valleys, Mono County, California, Final Report* (p. 45).

Saint-Amand, P., Mathews, L. A., Gaines, C., & Roger, R. (1986). *Dust Storms From Owens and Mono Valleys, California*. NWC-TP-6731, Naval Weapons Center, China Lake, CA.

Slemmons, D. B., Vittori, E., Jayko, A. S., Carver, G. A., & Bacon, S. N. (2008). *Quaternary fault and lineament map of Owens Valley, Inyo County, eastern California*. Geological Society of America map and chart series MCH096, scale 1:73,500.

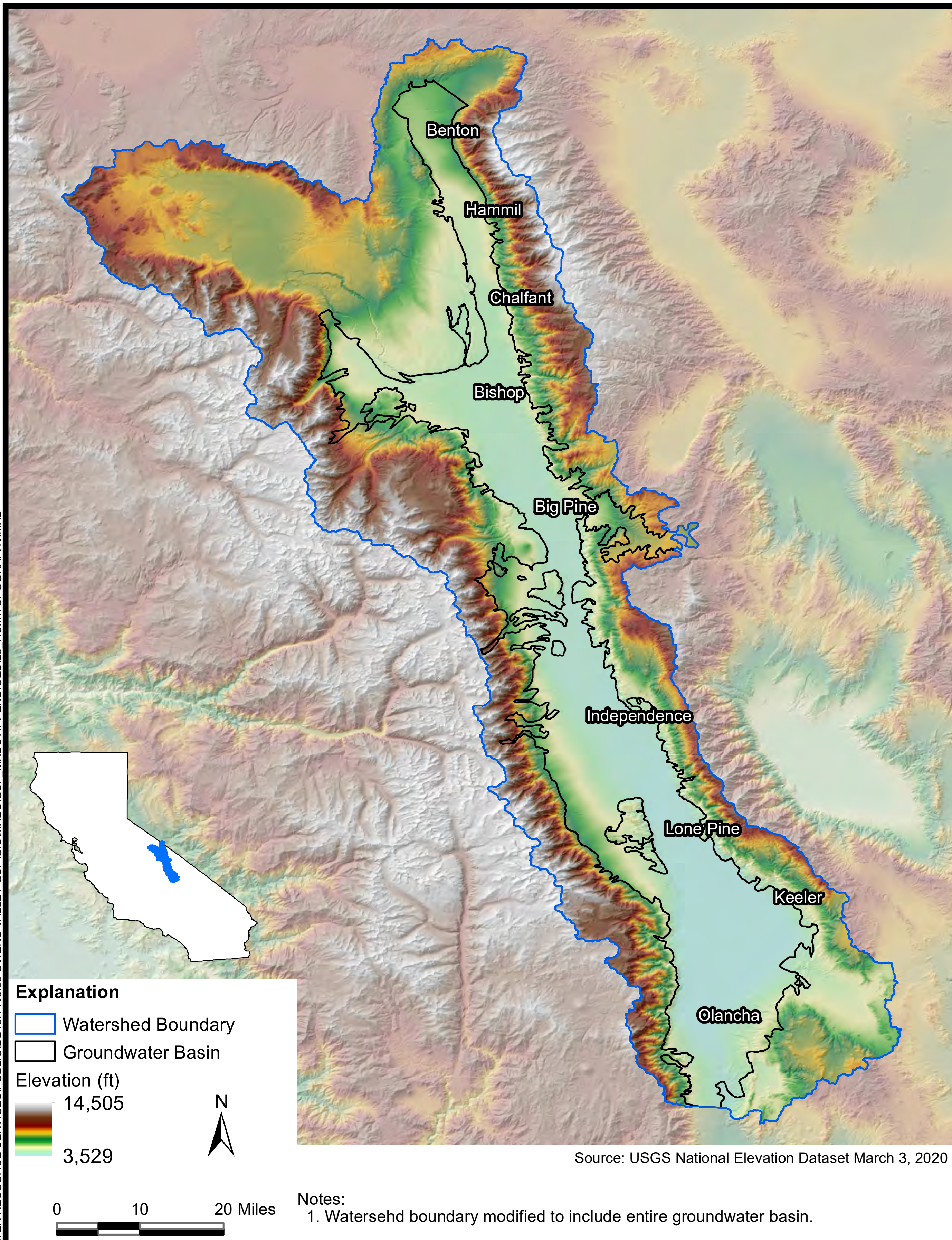
Soil Quality Institute Staff. (2001). *Soil Quality Test Kit Guide*. Natural Resources Conservation Service, U.S. Department of Agriculture.

Soil Survey Staff. (n.d.). Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database. Available online at https://sdmdataaccess.sc.egov.usda.gov. Accessed [04/27/2020].

Stewart, J. H., & Carlson, J. E. (1978). *Geologic Map of Nevada*. U.S. Geological Survey and Nevada Bureau of Mines and Geology, scale 1:500,000 (not part of any formal series, printed and distributed by the U.S. Geological Survey, G75163, reprinted, 1981, G81386).

USGS. (2019). *National Hydrography Dataset*. available online at https://viewer.nationalmap.gov/basic/, accessed May 20, 2020.

Zdon, A., Rainville, K., Buckmaster, N., Parmenter, S., & Love, A. H. (2019). Identification of Source Water Mixing in the Fish Slough Spring Complex, Mono County, California, USA. *Hydrology*, 6(1), 26.



Source: USGS National Elevation Dataset March 3, 2020

Notes:
1. Watersehd boundary modified to include entire groundwater basin.

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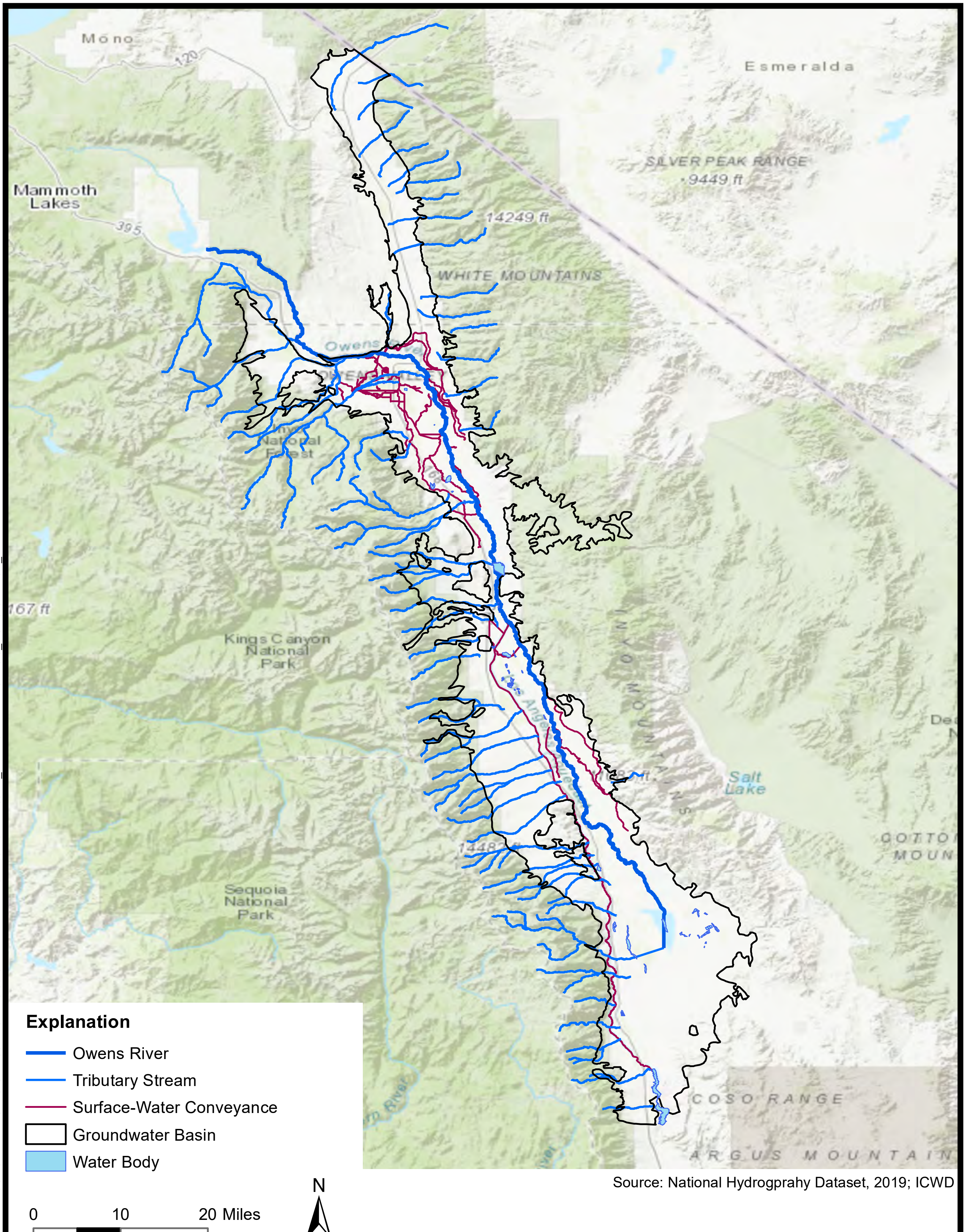
HYDROGEOLOGIC CONCEPTUAL MODEL
Owens Valley Watershed Topography

Figure 2-1



Source: National Hydrogprahy Dataset, 2019; ICWD

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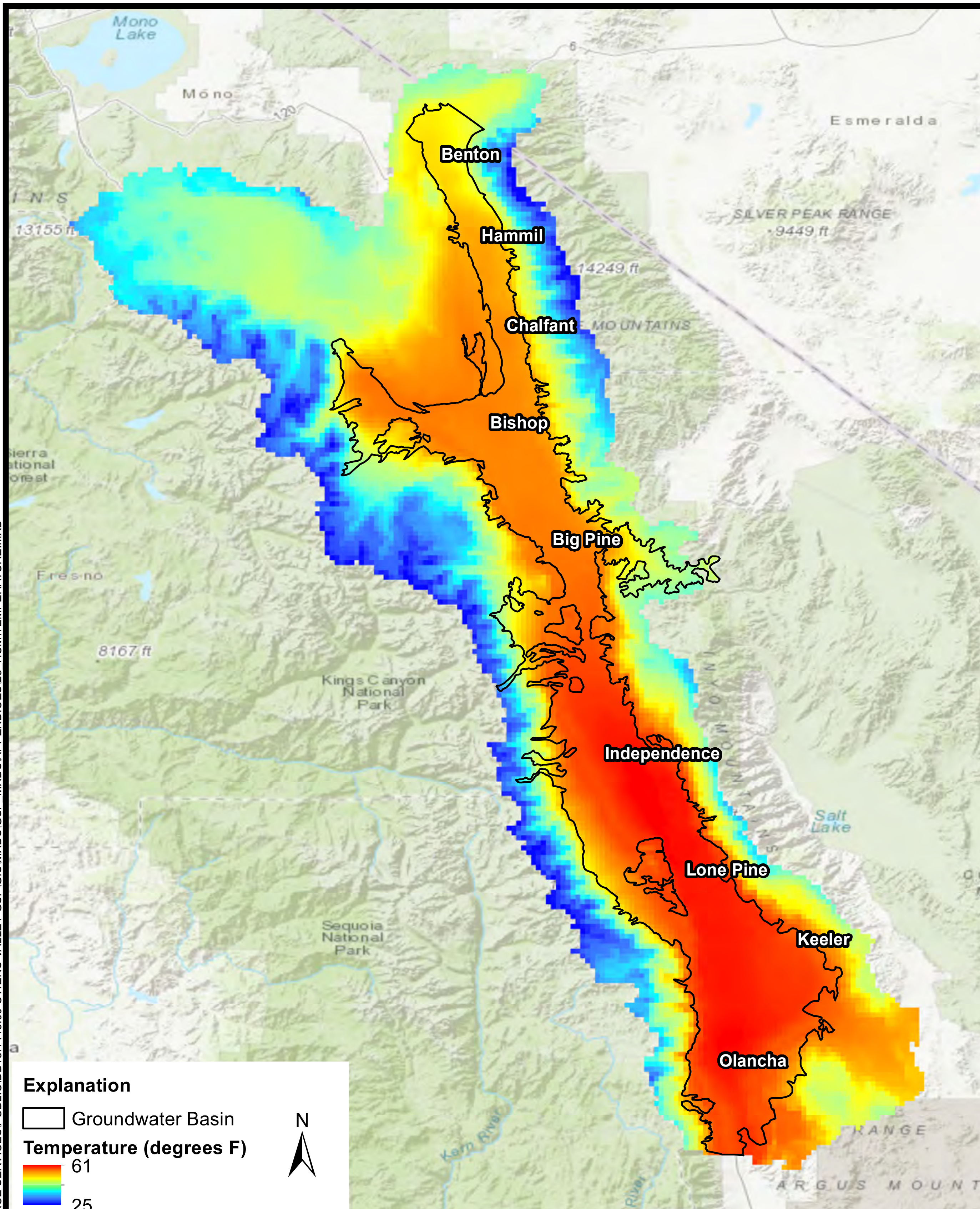
HYDROGEOLOGIC CONCEPTUAL MODEL

Surface-Water Features

Figure 2-2



0 10 20 Miles

Source: CADWR, April 23, 2020

Notes:
1. Temperature data from PRISM 30-year normals (1981-2010).

HYDROGEOLOGIC CONCEPTUAL MODEL

Mean Annual Temperature

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Figure 2-3

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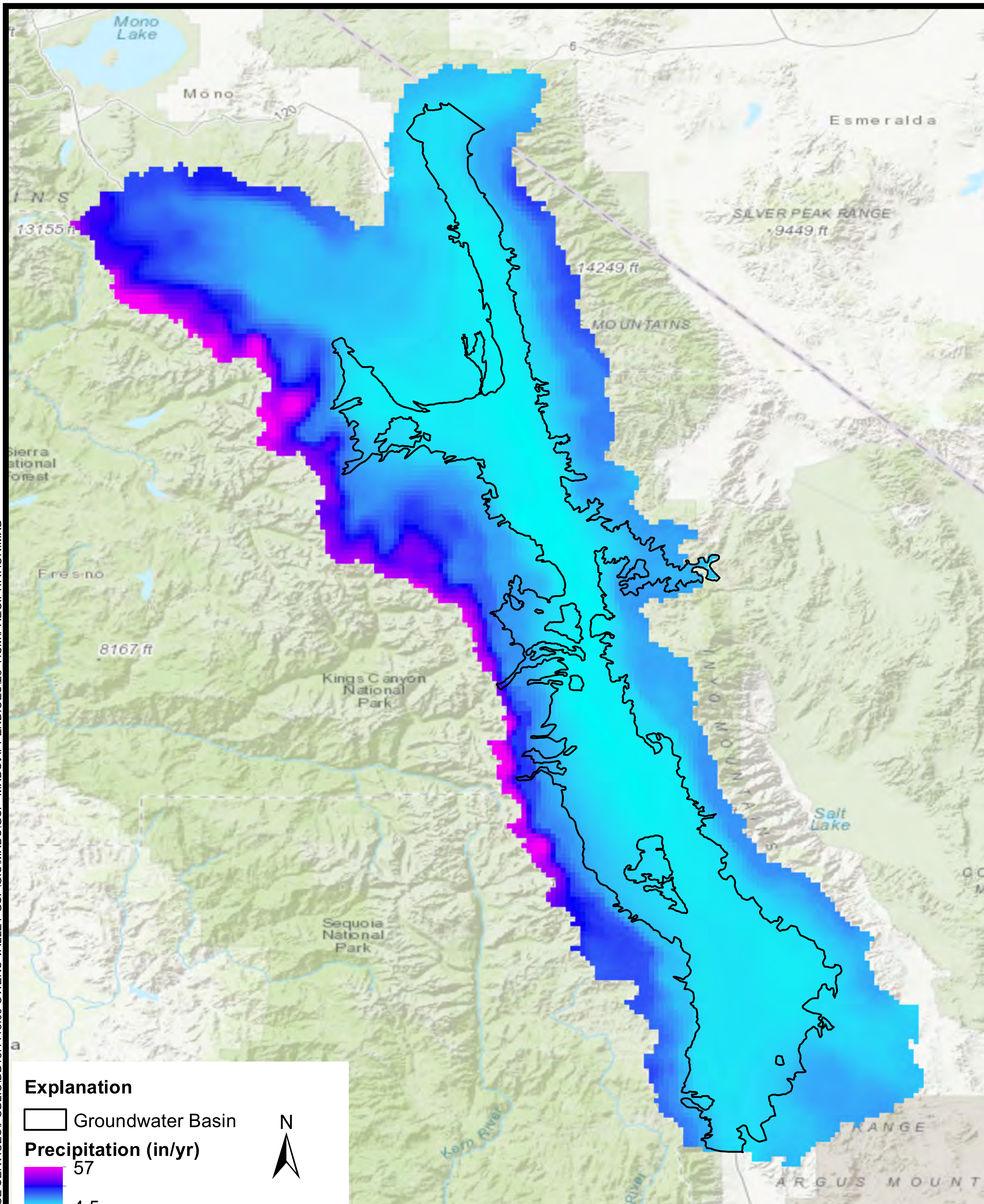

0 10 20 Miles

Source: CADWR, April 23, 2020

Notes:
1. Precipitation data from PRISM 30-year normals (1981-2010).

HYDROGEOLOGIC CONCEPTUAL MODEL
Mean Annual Precipitation

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Figure 2-4

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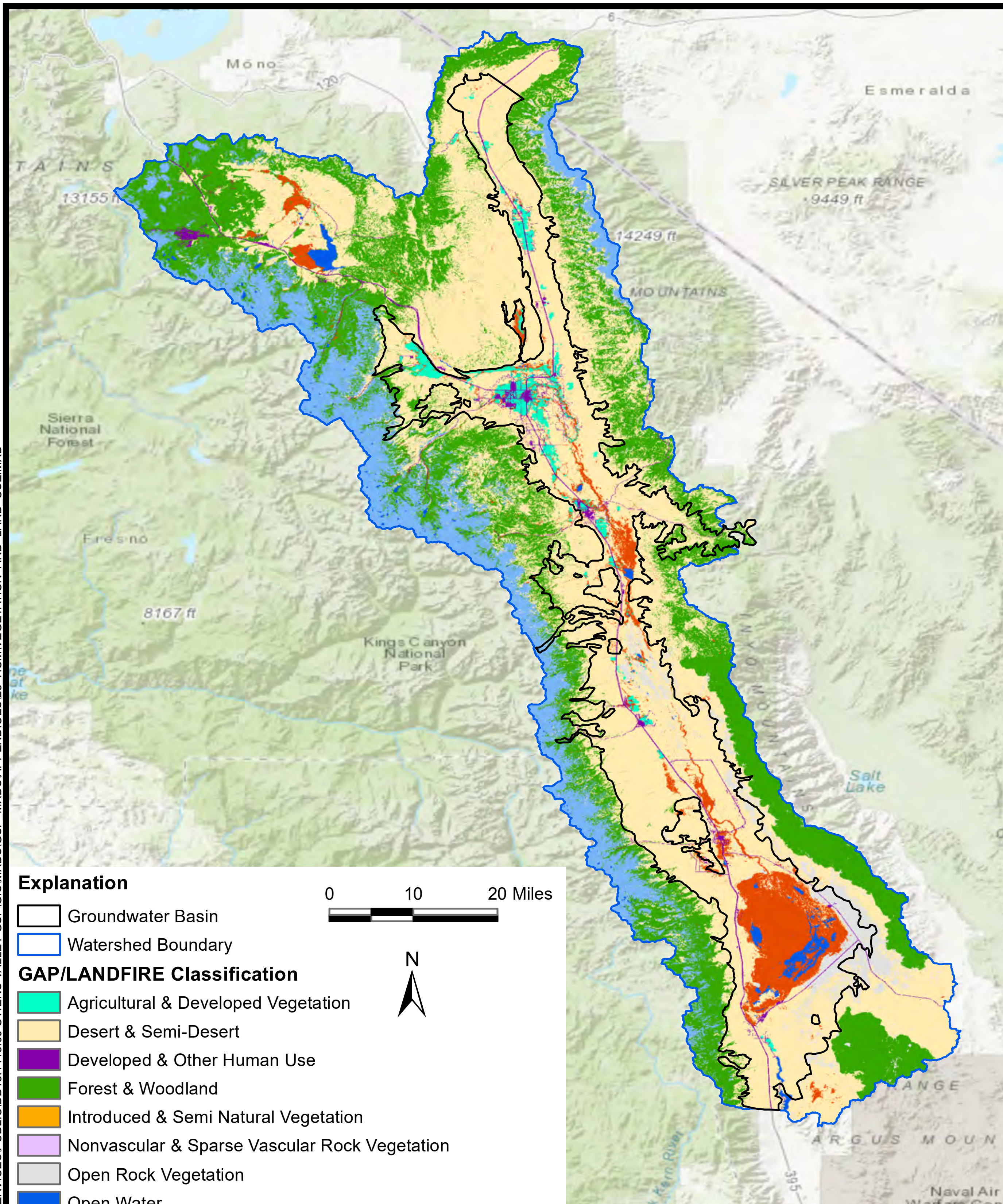

Source: GAP/LANDFIRE National Terrestrial Ecosystems 2011

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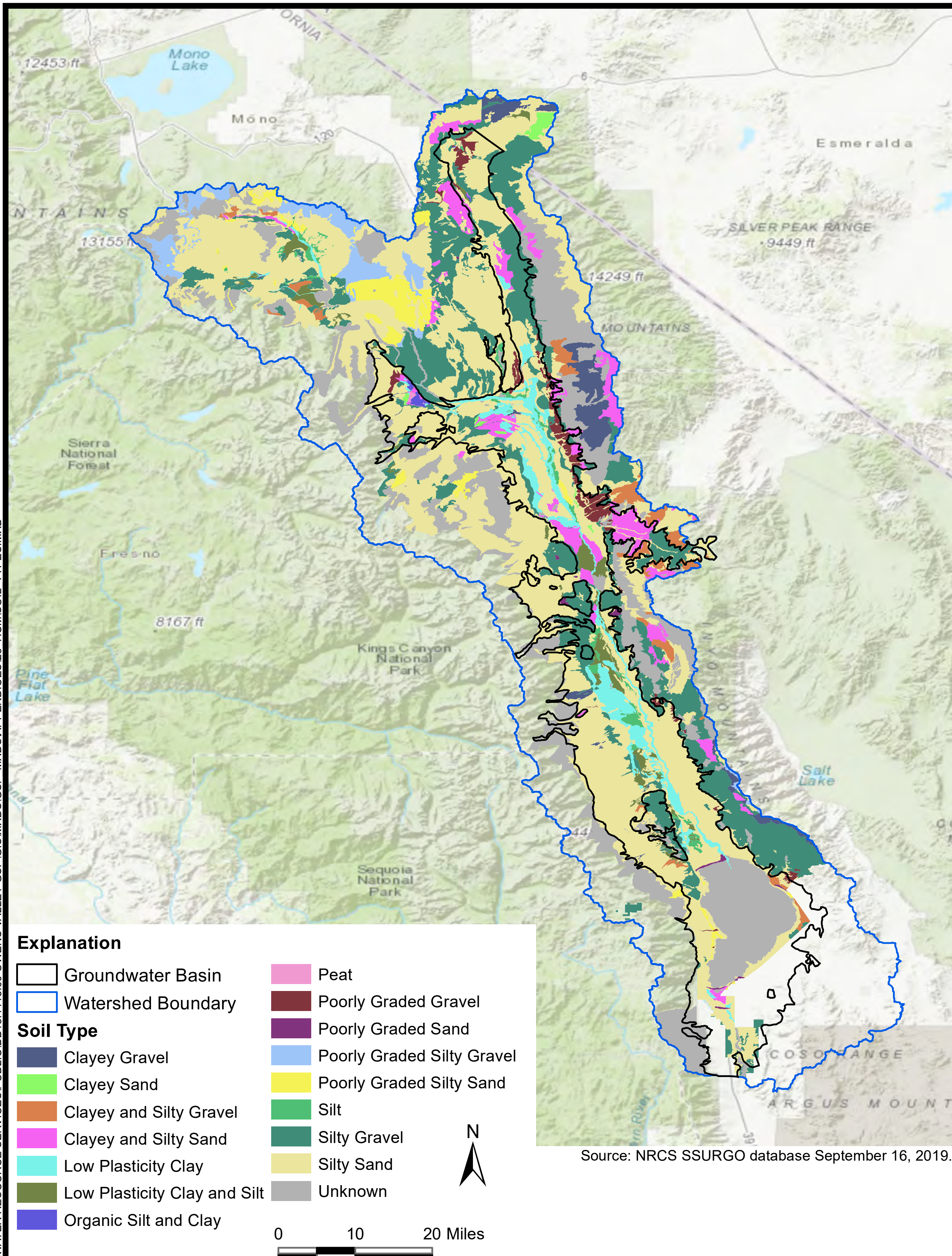
HYDROGEOLOGIC CONCEPTUAL MODEL
Vegetation and Land Use

Figure 2-5



Source: NRCS SSURGO database September 16, 2019.

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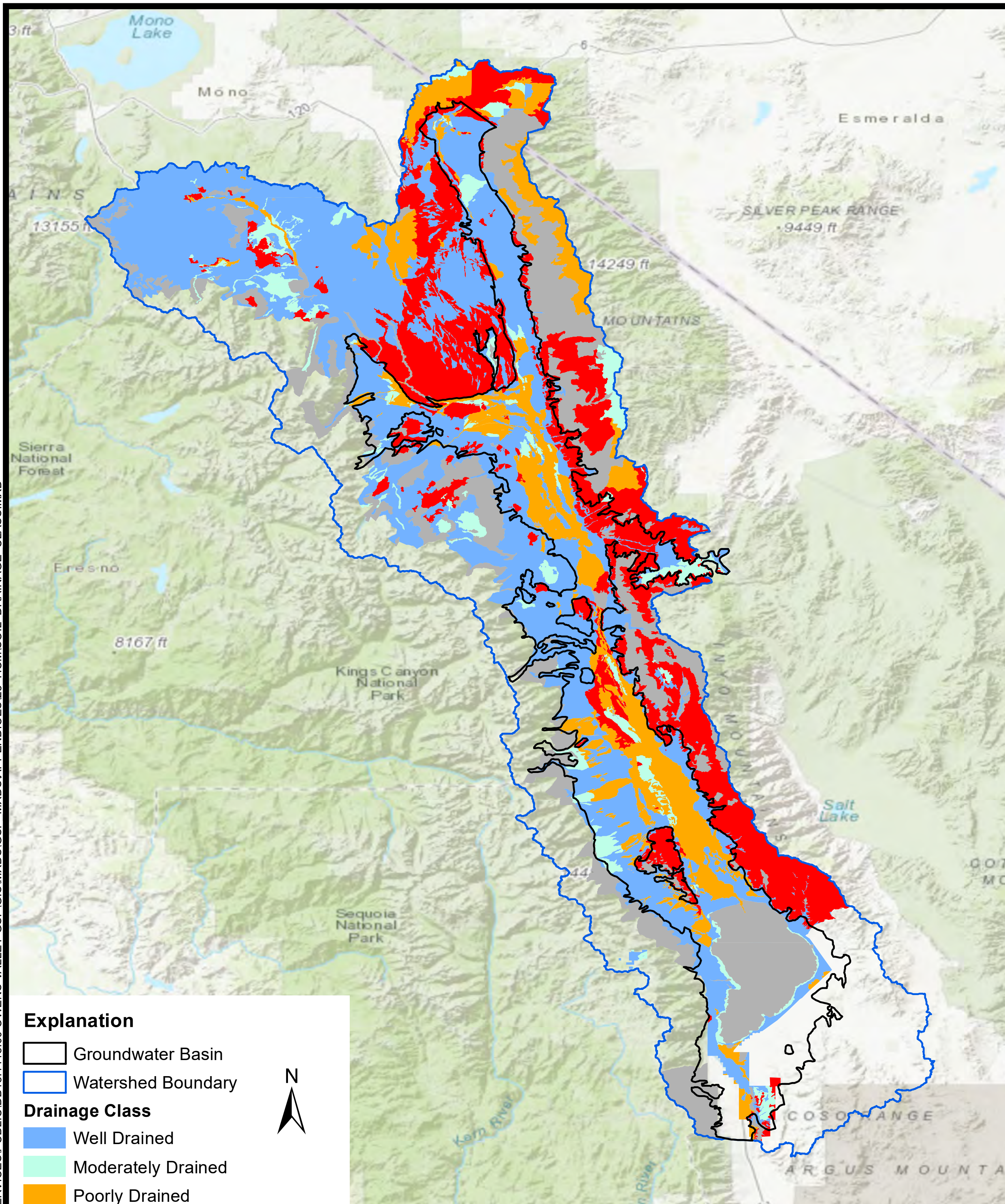
HYDROGEOLOGIC CONCEPTUAL MODEL
Soil Types

Figure 2-6



Source: NRCS SSURGO database September 16, 2019.

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP MXDS\APPENDICES\23 HCM\SOIL DRAINAGE CLASS.MXD

HYDROGEOLOGIC CONCEPTUAL MODEL

Soil Drainage Class

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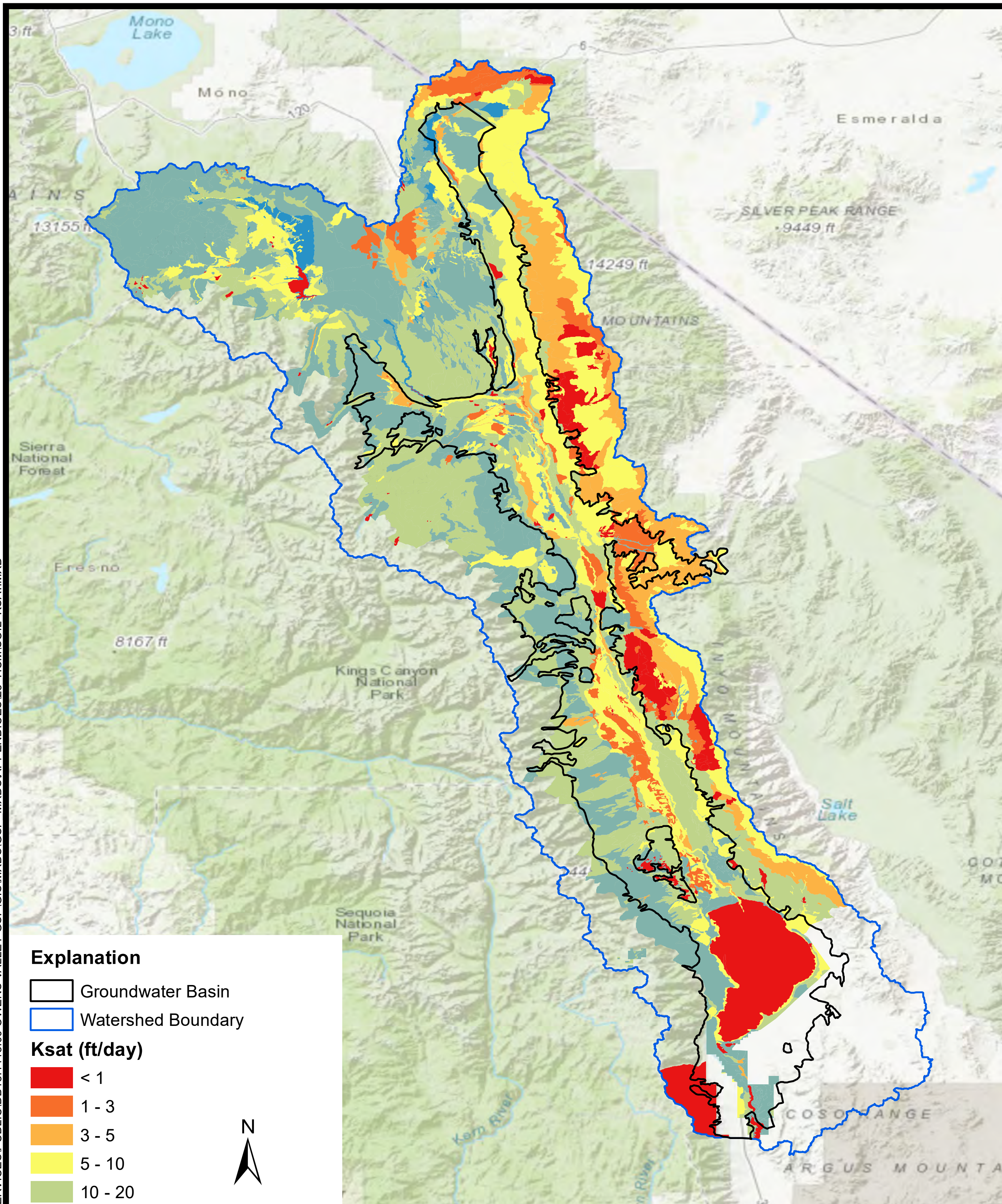
5/19/2021 DB18.1418

Figure 2-7



Explanation

Groundwater Basin

Watershed Boundary

Ksat (ft/day)

- < 1
- 1 - 3
- 3 - 5
- 5 - 10
- 10 - 20
- 20 - 30
- > 30

N

0 10 20 Miles

Source: NRCS SSURGO database September 16, 2019.

Notes:

1. Values represent weighted average of saturated hydraulic conductivity (Ksat) for all soil layers.

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP_MXDS\APPENDICES\23_HCM\SOIL_KSAT.MXD

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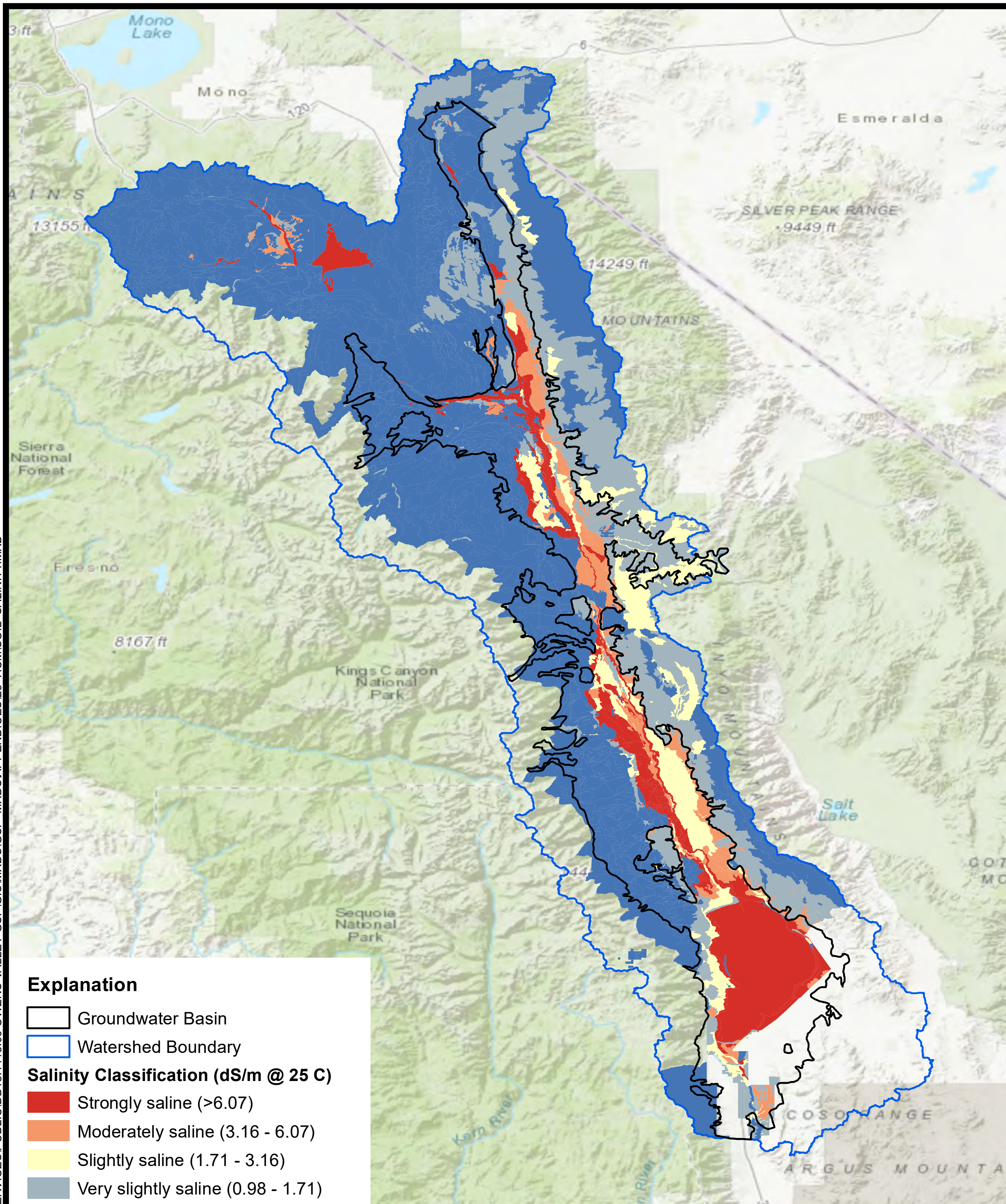
HYDROGEOLOGIC CONCEPTUAL MODEL

Soil Saturated Hydraulic Conductivity

Figure 2-8



Source: NRCS SSURGO database September 16, 2019.

0 10 20 Miles

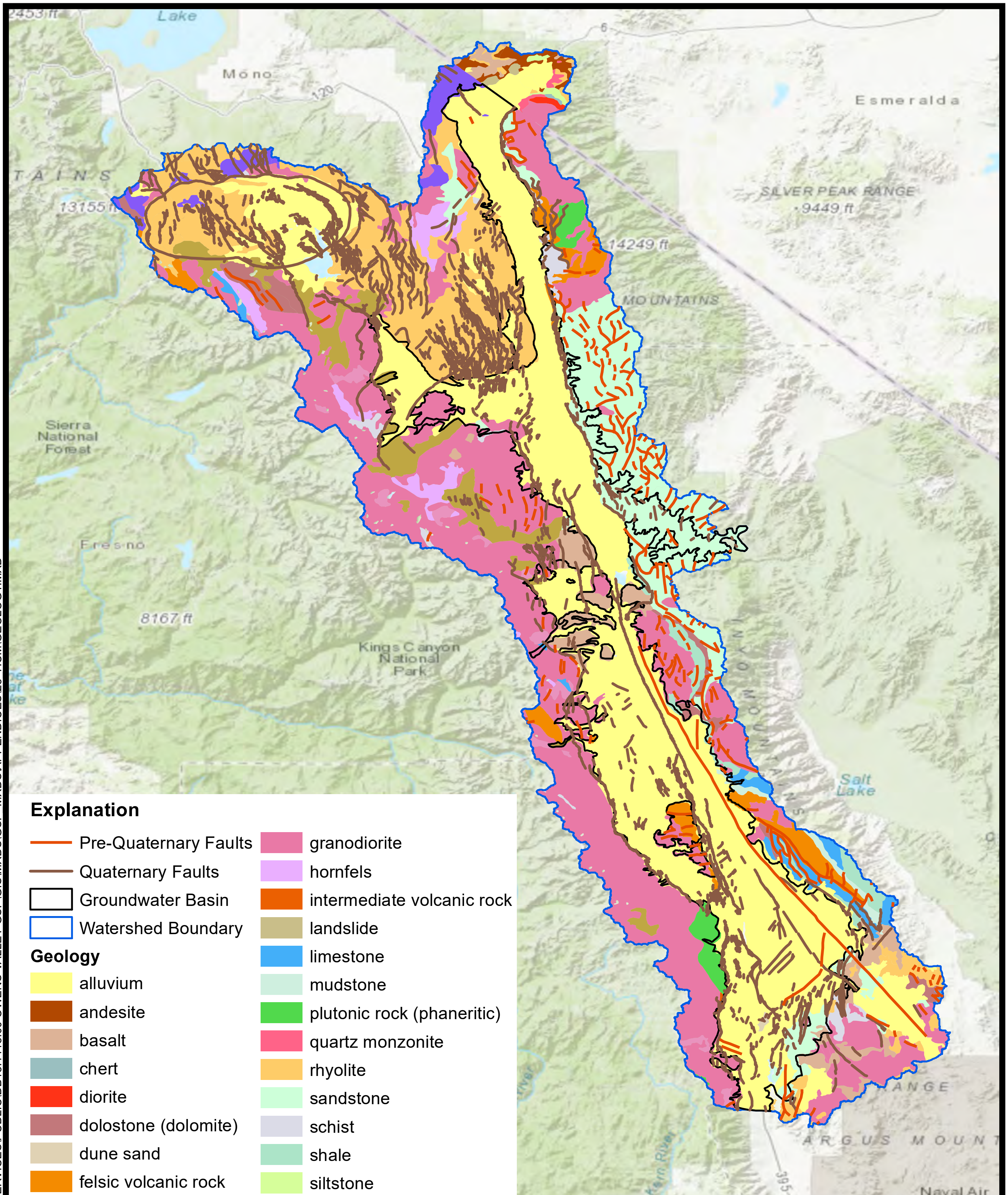
N

Notes:
1. Values are weighted average from all soil layers
2. Salinity classifications from Soil Quality Institute (2001)

HYDROGEOLOGIC CONCEPTUAL MODEL

Soil Salinity

Figure 2-9



Source: Jennings et al. (1977), Stewart & Carson (1978)

0 10 20 Miles

N

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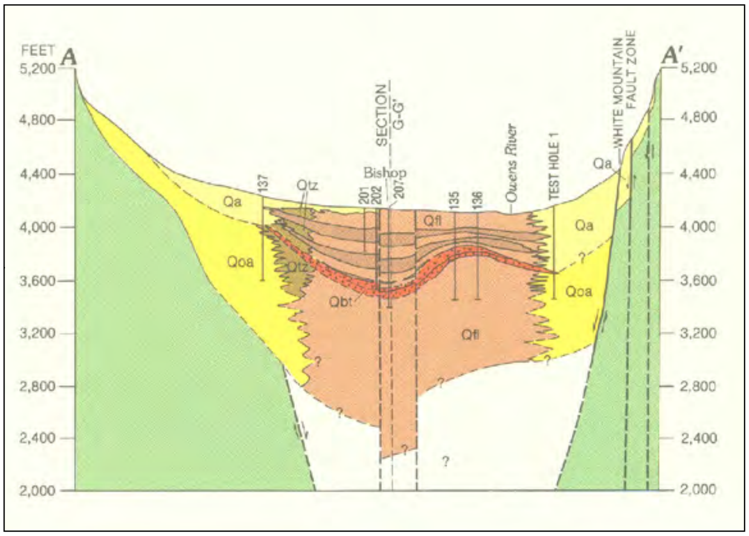
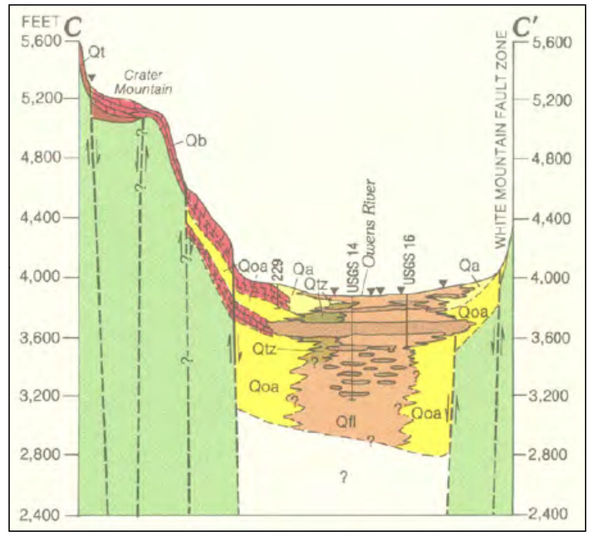
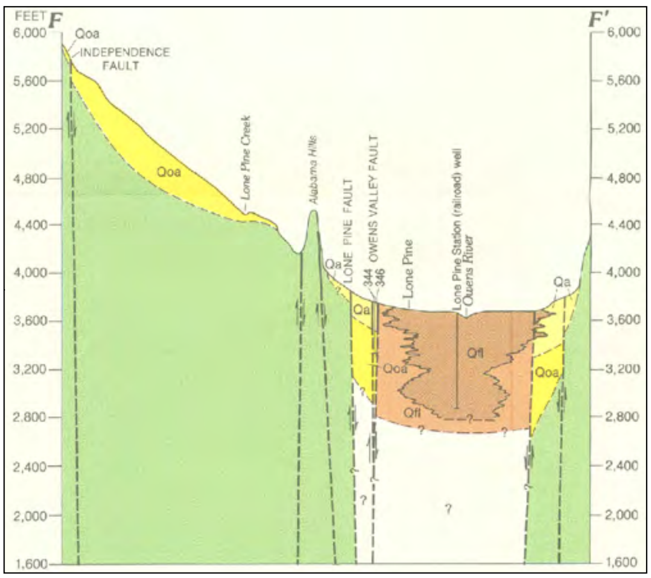
HYDROGEOLOGIC CONCEPTUAL MODEL
Surface Geology and Mapped Faults

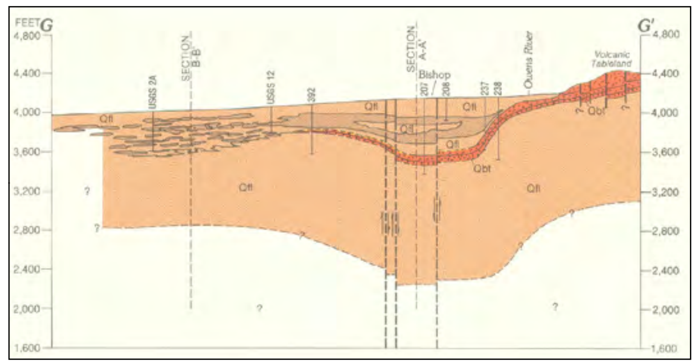
Figure 2-10

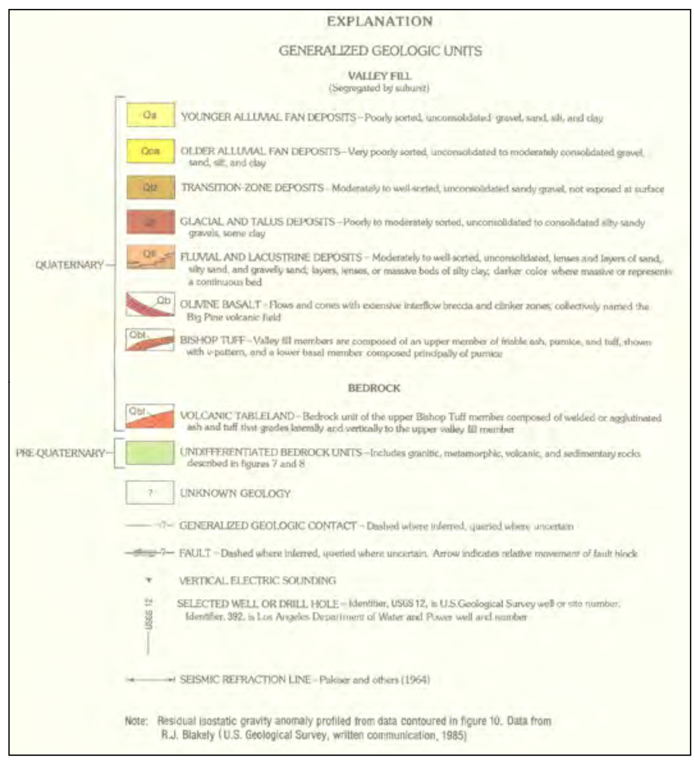
K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP_MXDS\APPENDICES\23_HCM\GEOLOGY.MXD

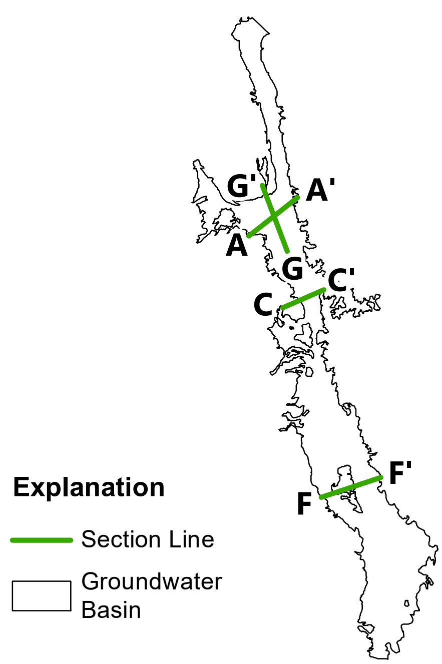












Notes:
1. Geologic sections and unit descriptions from Hollet et al.(1991)
2. Vertical Exaggeration = 13x

HYDROGEOLOGIC CONCEPTUAL MODEL
Owens Valley Geologic Cross Sections

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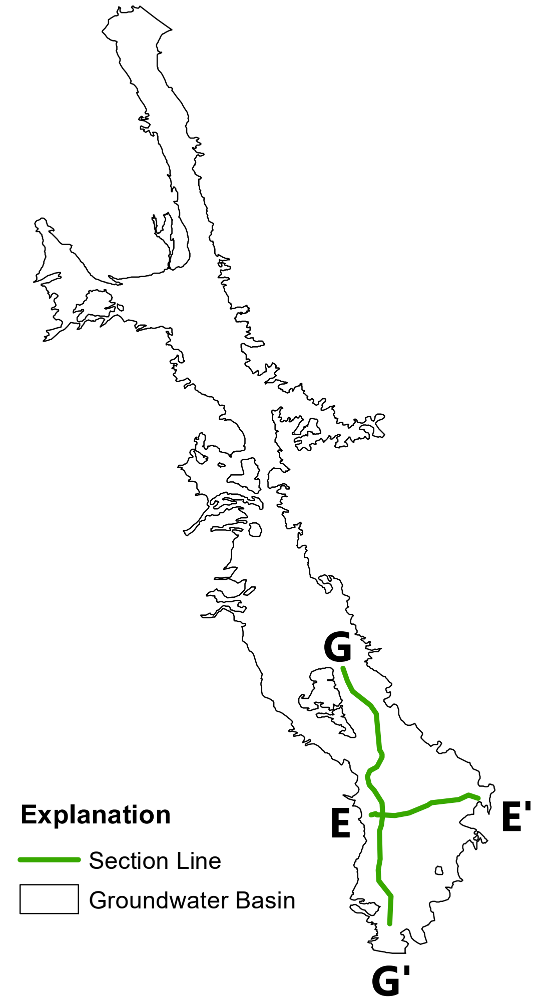
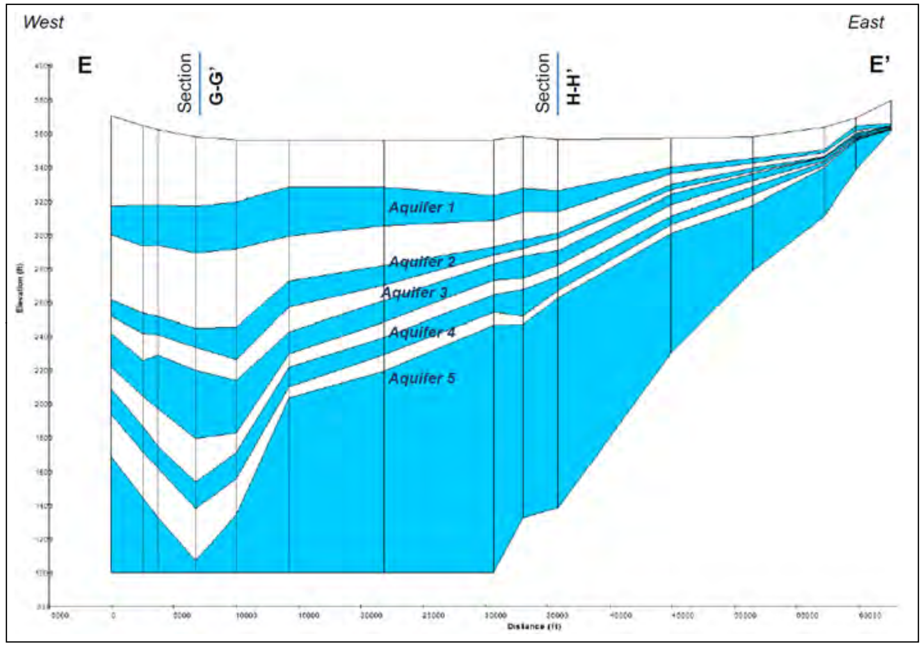
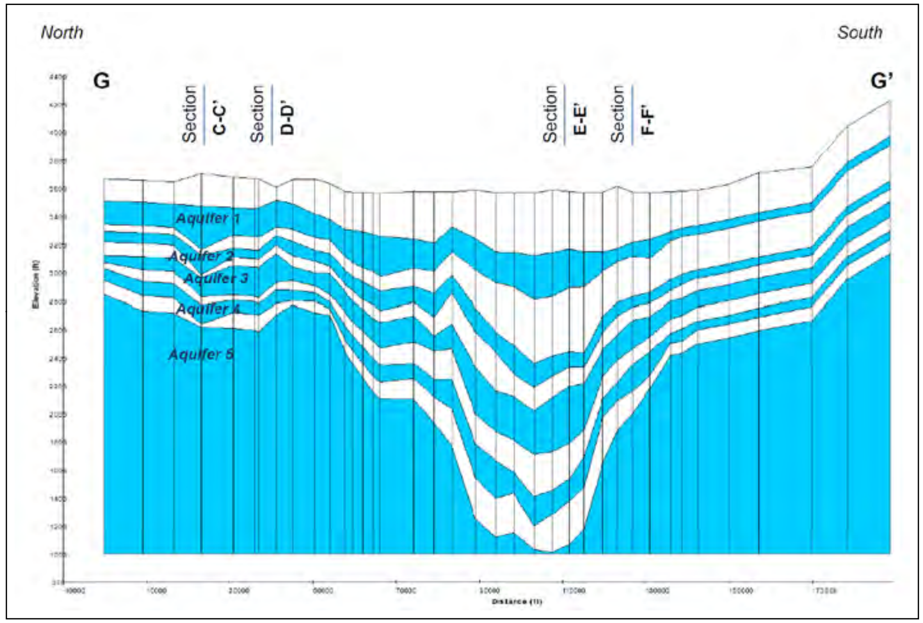
Figure 2-11

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP_MXDS\APPENDICES\23_HCM\GEOLOGIC_CROSS_SECTIONS_HOLLETT.MXD

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP_MXDS\APPENDICES\23_HCM\GEOLOGIC_CROSS_SECTIONS_MWH.MXD







Notes:
1. Section E-E' modified from Figure 11 in Appendix H of MWH (2011).
2. Section G-G' modified from Figure 13 in Appendix H of MWH (2011).
3. Vertical Exaggeration = 13x

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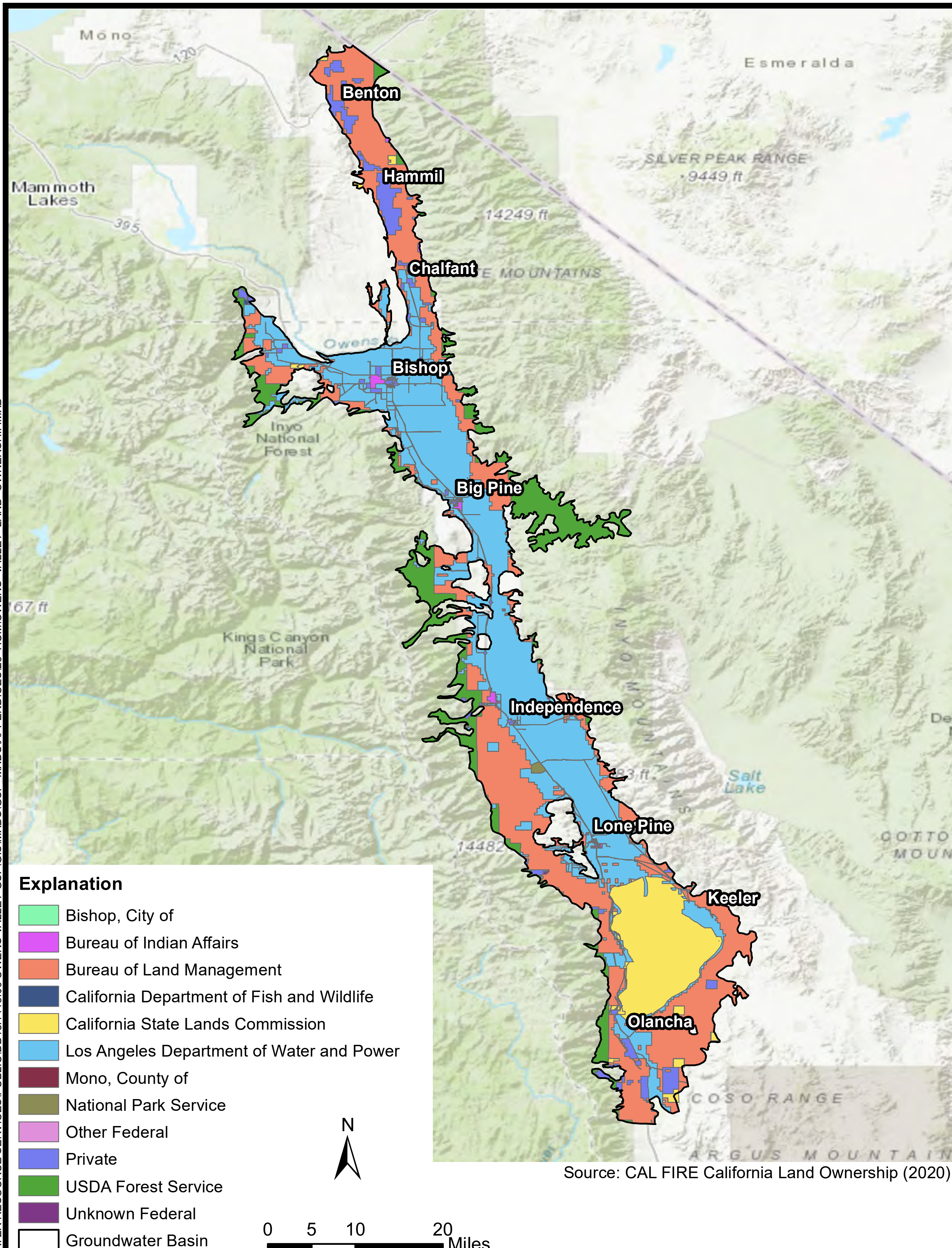
HYDROGEOLOGIC CONCEPTUAL MODEL
Owens Lake Geologic Cross Sections

Figure 2-12



Source: CAL FIRE California Land Ownership (2020)

MONITORING PLAN AND DATA GAPS ANALYSIS

Owens Valley Land Ownership

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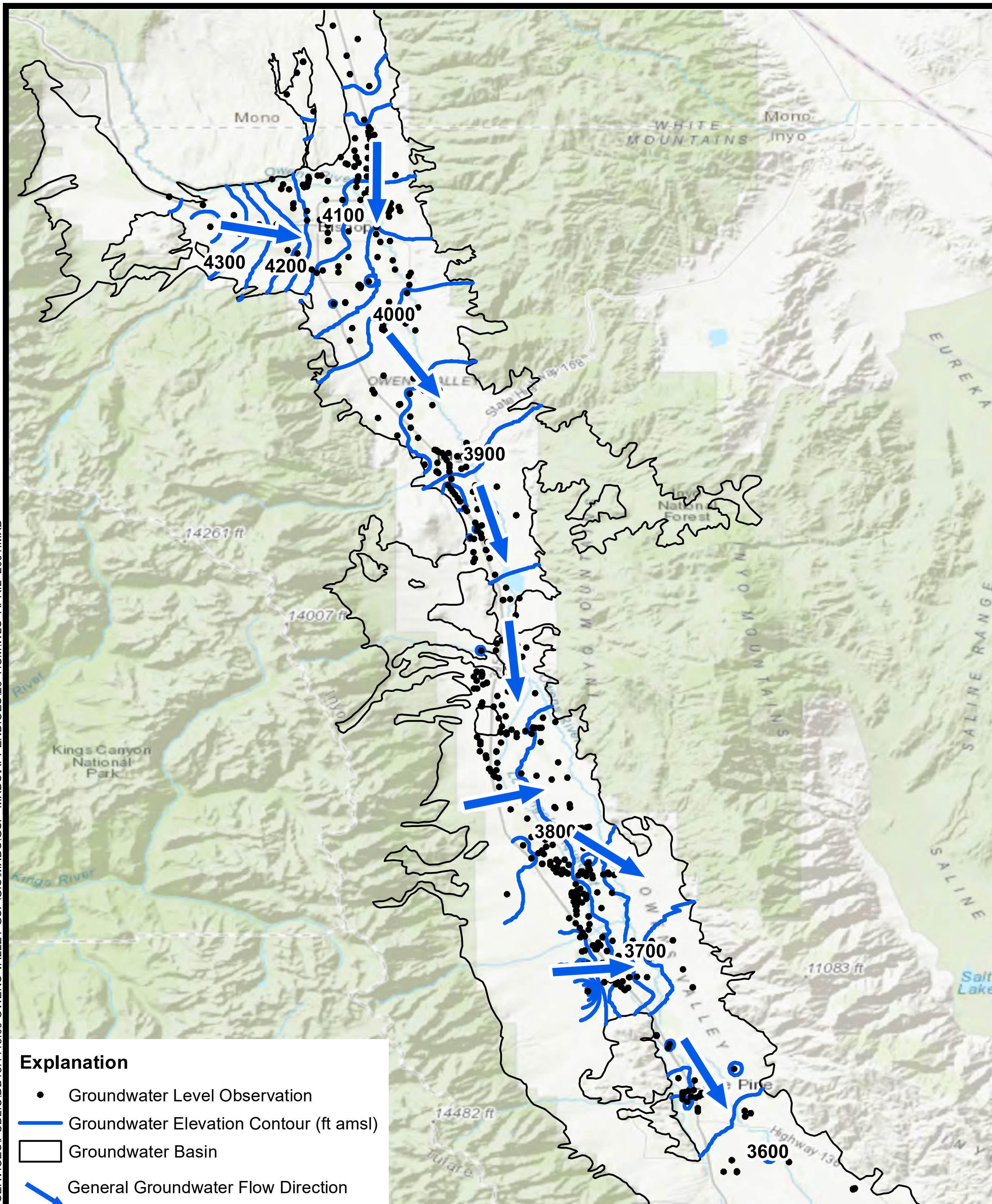
Figure 2-13

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP_MXDS\APPENDICES\23_HCM\OWENS_VALLEY_LAND_OWNERSHIP.MXD



Notes:
1. Water levels interpolated using inverse distance weighting (IDW) method)
2. 50 ft contour interval

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP_MXDS\APPENDICES\23_HCM\WLS_APRIL_2001.MXD

HYDROGEOLOGIC CONCEPTUAL MODEL

Groundwater Elevation Contours April 2001

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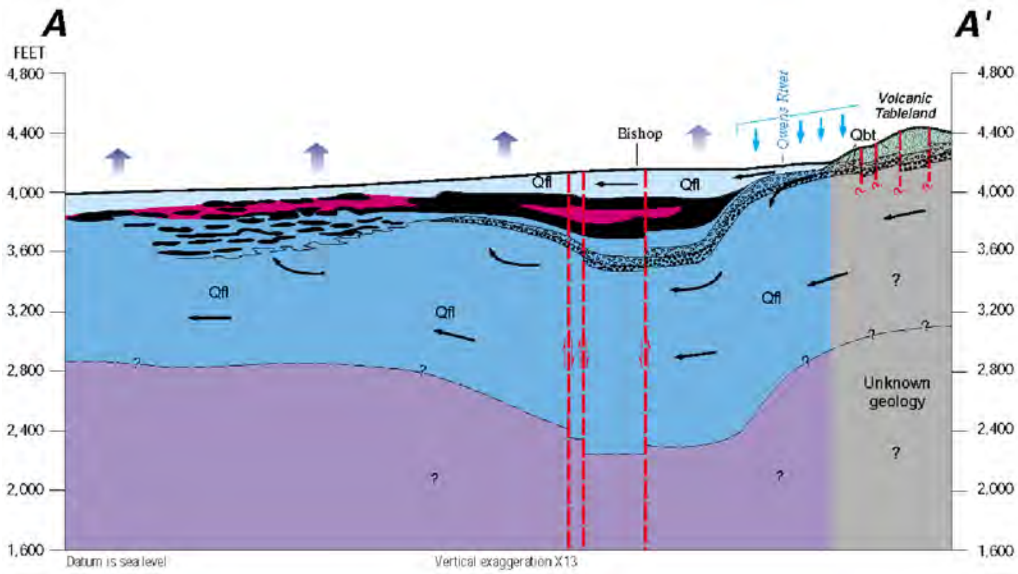
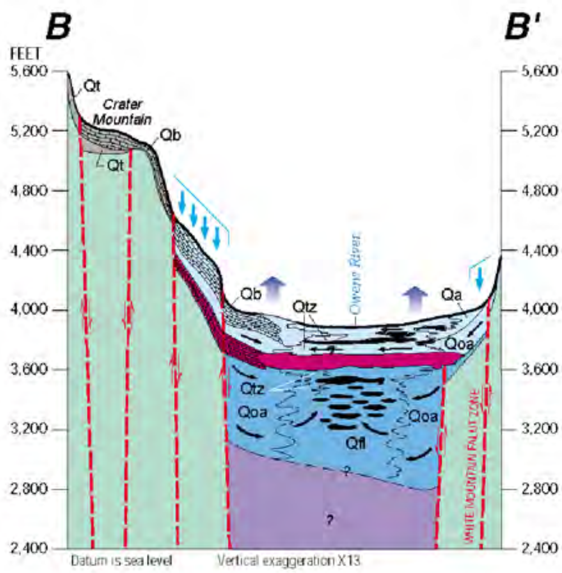
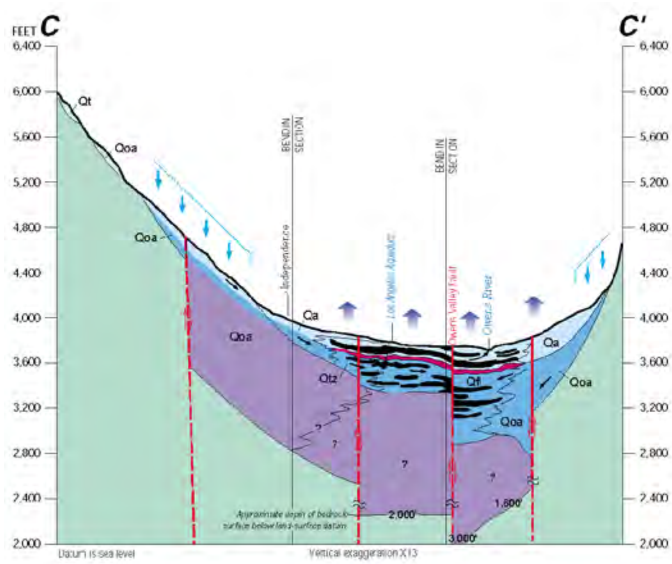
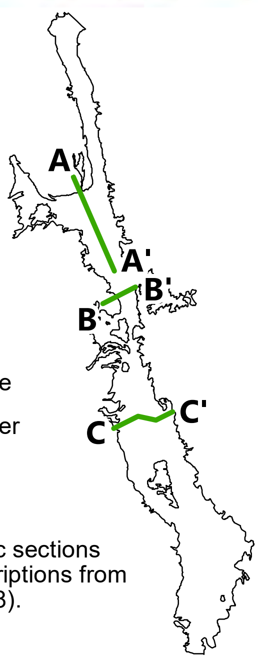
Figure 2-14







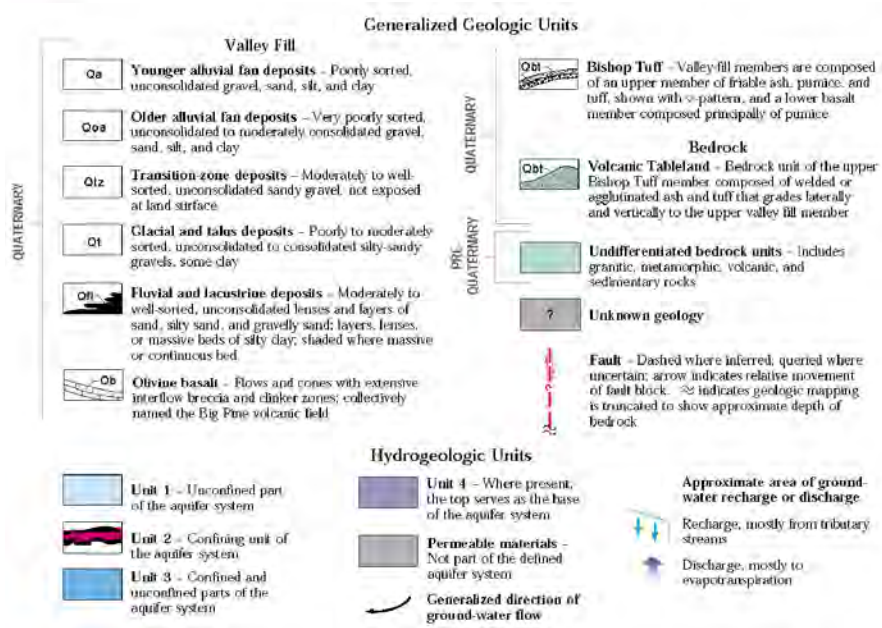


Explanation

Section Line

Groundwater Basin

Notes:
1. Hydrogeologic sections and unit descriptions from Danskin (1998).



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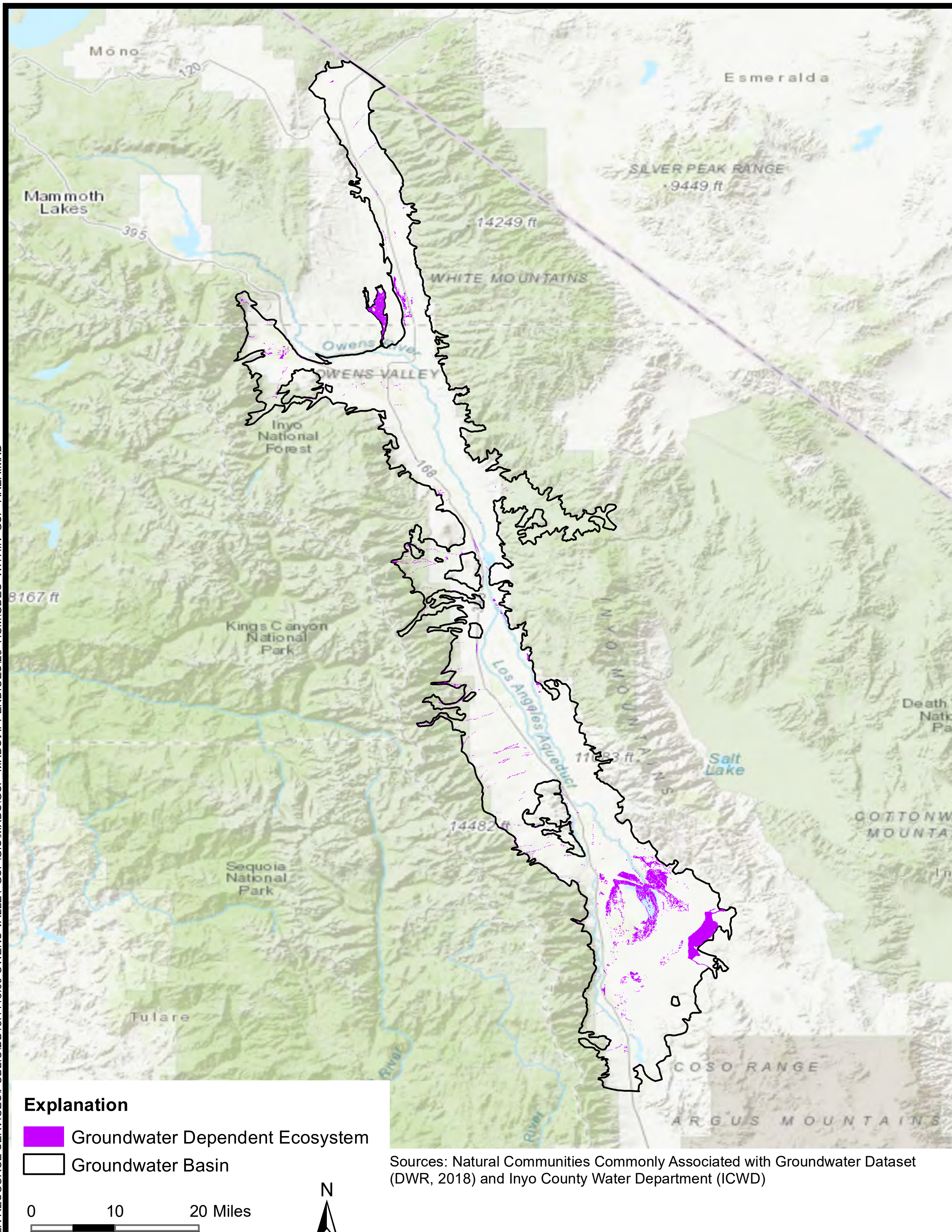
HYDROGEOLOGIC CONCEPTUAL MODEL
Hydrogeologic Cross Sections

Figure 2-15

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP MXDS\APPENDICES\V23 HCM\HYDROGEOLOGIC CROSS SECTIONS DANSKIN.MXD



Sources: Natural Communities Commonly Associated with Groundwater Dataset (DWR, 2018) and Inyo County Water Department (ICWD)

K:\PROJECTS\WATER RESOURCE SERVICES\PUBLIC\DB18.1418.00 OWENS VALLEY GSP\GIS\MXDS\GSP MXDS\APPENDICES\23 HCM\GDES WITHIN GSP AREA.MXD

HYDROGEOLOGIC CONCEPTUAL MODEL

Groundwater Dependent Ecosystems Within GSP Area

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5/20/2021 DB18.1418

Figure 2-16

Owens Valley Groundwater Basin Land Subsidence Technical Memorandum

Prepared for

Owens Valley Groundwater Authority

Prepared by

a Geo-Logic Company

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Santa Barbara, CA 93105
www.dbstephens.com

Project #DB18.1418.00

December 9, 2021

Certification

This document was prepared in accordance with generally accepted professional hydrogeologic principles and practices. This document makes no other warranties, either expressed or implied as to the professional advice or data included in it. This document has not been prepared for use by parties or projects other than those named or described herein. It may not contain sufficient information for other parties or purposes.

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Date signed: December 9, 2021

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1. Introduction

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this Owens Valley Groundwater Basin Land Subsidence Evaluation Technical Memorandum (Tech Memo) for the Owens Valley Groundwater Authority (OVGA or Agency) and is under contract to prepare a Groundwater Sustainability Plan (GSP or Plan) under the Sustainable Groundwater Management Act (SGMA) of 2014.

Land subsidence is one of six sustainability indicators defined in the SGMA legislation. This document will provide a background discussion on inelastic land subsidence (subsidence), summaries of previous investigations, a review of current data sets (e.g., geodetic monitoring, interferometric synthetic radar), and an evaluation of subsidence susceptibility for both basins.

The subsidence evaluation has been summarized, as appropriate, for each of the proposed management areas (Figure 1-1) in the basin:

- Tri Valley / Fish Slough;
- Owens Valley; and
- Owens Lake.

2. Background

Subsidence directly related to subsurface fluid extractions (e.g., groundwater and hydrocarbons) has been observed for several decades in California. Permanent compaction of fine-grained sediments occurs due to the increase in the effective stress caused by fluid removal. A detailed discussion of the geomechanics associated with subsidence is beyond the scope of this document; however, other publications describe the geomechanics associated with subsidence (e.g., Poland, 1984; Poland and Davis, 1969) and its effects (e.g., USGS, 1999, 2016).

The evaluation of subsidence for the Owens Valley basin in this document is based on review of the following lines of evidence:

- Previous investigations/evaluations;
- Geodetic surveys;
- Interferometric Synthetic Aperture Radar (InSAR) data; and

- GPS, extensometers and tiltmeters.

3. Previous Investigations/Evaluations

In 2014, California Department of Water Resources (DWR) prepared a report summarizing recent, historical, and estimated future subsidence potential for groundwater basins included in CA DWR Bulletin 118 (DWR, 2014). The stated intent of the document was to provide screening-level information with respect to subsidence. DWR lists Owens Valley basin with low potential for future subsidence. The ranking was determined from long-term water level trends (well records greater than 10 years) above historical lows and no documented subsidence.

The Inyo County and City of Bishop (2017) reports no documented subsidence in the county or City.

The County of Mono Regional Transportation Plan & General Plan Update (2015 Draft EIR), Mono County and the Town of Mammoth Lakes (2019), and https://www.monocounty.ca.gov/generalplan?tid=All&keys=subsidence reports that no subsidence has been documented due to fluid withdrawals.

4. Geodetic Surveys

UNAVCO monitors continuously operating geodetic instrument networks, including Continuous Global Positioning Systems (CGPS) stations that measure three-dimensional positions (generally every 15 or 30 seconds) of a point near earth's surface (https://www.unavco.org/instrumentation/networks/status/nota).

Several CGPS stations are found near the basin (Figure 4-1) with surface elevation data extending back to about 2007. All stations (with the possible exception of P651) are mounted outside of the alluvial basins and in bedrock, suggesting any vertical movement is likely caused by tectonic movement rather than compaction of fine-grained materials due to groundwater withdrawal.

Figure 4-1 shows locations of these CGPS stations, along with UNAVCO time-series graphs (Figure 4-2) displaying measured land displacement relative to the first measurement of each station. Data displayed in the time-series graphs are referenced to the North American tectonic plate (NAM14) reference frame and outliers with a standard deviation greater than 20mm were removed. Long-term general vertical movement rate trends were determined by applying a line of best fit to each station's entire measured timeframe of data. CGPS stations surrounding Owens Valley basin are set on bedrock or weathered bedrock (UNAVCO). None of the CGPS stations show persistent evidence of subsidence (Figure 4-2).

In addition, LADWP has a series of ground-based GPS monitoring stations in the Owens Lake area (Table 4-1; Figure 4-3). Unfortunately, these data were not available for inclusion in this technical memorandum.

GPS Survey Station ID	GPS Station Type [1]	Sensitive Infrastructure to be Monitored and/or Location Rationale	Relative Location within Lakebed	Monitoring Plan
---	*New Survey Point*	LORP Pump Station	North-central	Collect ground-based GPS survey elevation point at GPS survey stations. Measure and record elevations once prior to pumping, then annually when pumping begins.
6532	Primary	DCM Mainline	Northeast	
7012	Primary	DCMs	Northern Brine Pool	
---	*New Survey Point*	Swansea/Highway 136	Northeast edge	
7016	Back-up	DCMs	North-northeast Brine Pool	
6527	Primary	Mainline	Central northeast	
---	*New Survey Point*	Keeler/Highway 136	Central northeast edge	
6523	Back-up	Mainline	Eastern	
---	*New Survey Point*	DCMs (thickest section of clays)	Eastern central	
6521	Primary	Mainline (thickest section of clays)	Eastern	
6518	Primary	Mainline (thickest section of clays)	Central east-southeast	
7007	Primary	DCMs (thickest section of clays)	Southeast Brine Pool	
7010	Primary	DCMs (thickest section of clays)	Central southeast	
6513	Back-up	Mainline	Central southeast	
---	*New Survey Point*	Rio Tinto Facilities (thickest section of clays)	Southern Brine Pool	
6508	Primary	DCMs (thickest section of clays)	South central	
6509	Back-up	Mainline (thickest section of clays)	South central	
---	*New Survey Point*	Highway 190	Southeast edge	
7011	Primary	DCMs (thickest section of clays)	Southwest	
6503	Primary	DCMs (thickest section of clays)	Southwest	
7003	Primary	DCMs (thickest section of clays)	Southern	
---	*New Survey Point*	Highway 190 (thickest section of clays)	Southern edge	
7005	Back-up	DCMs (thickest section of clays)	Southern	
6501	Back-up	Mainline	Southwestern edge	
6372	Primary	Highway 395	Central northeast edge	
6371	Primary	Highway 395	Northeast edge	
6535	Back-up	DCMs	Northwest central	

[1] Back-ups sites will be considered if a primary site is unavailable for any reason; otherwise secondary sites will not be used for subsidence monitoring.

Table 4-1 LADWP GPS Elevation Monitoring Stations at Owens Lake (from LADWP, 2019)

5. Interferometric Synthetic Aperture (InSAR) Data

InSAR is a satellite-based remote sensing method used to map ground surface elevation change over large areas with high accuracy. Satellites emit electromagnetic pulses that produce measurements upon their return. These measurements are processed to create synthetic aperture radar images. The InSAR method calculates the change in time from one measurement to the next, providing images that estimate ground surface elevation change. In an effort to assist with technical subsidence evaluations for GSP development, DWR contracted TRE Altamira Inc. (TRE) and National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) to process InSAR data collected by the European Space Agency (ESA) Sentinel-1A satellite covering Bulletin 118 groundwater basins. The processed TRE InSAR datasets are available to the public on DWR's SGMA Map Viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub).

TRE processed InSAR point data representing average vertical movement per 100 square meter areas within the basins from June 13, 2015 to September 19, 2019. TRE also provided rasters (gridded datasets) interpolated from the point data representing annual vertical displacement and total displacement relative to June 13, 2015 (date entire CA study coverage began), both in monthly time steps. Towill Inc., contracted by DWR, conducted an accuracy study by comparing the InSAR vertical displacement data with CGPS data. The study determined that InSAR data within California provided accurate vertical displacement measurements within +/-0.05 feet (+/-0.6 inch) (Towill, 2020).

Twenty-six representative sites (Figure 5-1) in the basin were selected to show the TRE-processed InSAR-based total vertical displacement data. The sites were chosen based on a special geographical characteristics and/or hydrogeological settings and were located in areas underlain by alluvium.

Time-series graphs showing total vertical displacement from the available TRE-processed InSAR datasets are shown in Figure 5-2. The values represent the vertical elevation change for the end date of the analyzed periods between points on the graph. Total displacement shows monthly cumulative departure change from a beginning reference date of June 13, 2015 for TRE data. Annual vertical displacement shows a monthly moving window representing displacement occurring within the past 12 months. Annual vertical displacement measurements allow analysis of yearly land elevation change without seasonal variation. Vertical land surface elevation fluctuations recorded by the stations generally ranged between +0.05 feet and -0.05 feet throughout the basin. These values are less than the reliable instrumental resolution.

Three sites in the Owens Lake area (22, 23, and 24) have time series trends that show the land surface rising. At site 23 in the central portion of Owens Lake, the InSAR data suggests that the land surface has been rising since mid-2016. This apparent land surface rising may be a function actual elastic rebound of the ground associated with the recharge of the aquifers as the drought period was ending during the 2016-2019 timeframe. Elastic rebound was reported in the Owens

Lake area by previous investigators (Neponset Geophysical Corporation, 1999). Likewise, changes in land surface elevation could be attributed to land use shifts or man-made situations (e.g., construction activities), although none were reported in the Neponset study.

Sites 22 and 24 show slight increasing trends beginning in late 2019, but additional data are needed to determine if the trends are sustained. None of the measurement points indicate subsidence due to groundwater extraction is measurable.

6. Extensometers and Tiltmeters

Neponset Geophysical Corporation (1999) reported on a tiltmeter survey conducted in the northern part of Owens Lake playa. The study monitored land surface elevation changes during the performance of three short term groundwater pumping tests by the Great Basin Air Pollution Control District. Observations of land surface elevation changes were recorded while groundwater was pumped from a relatively shallow well (perforated from 143 to 230 feet below ground surface [bgs]) for 10 days, a deep well (perforated at 440-555 feet bgs) for 7 days, and when both wells were pumped concurrently for 23 days. The shallow and deep wells were pumped at approximately at 1,500 gallons/minute (gpm). The maximum measured deformation of 0.0363 feet (0.43 inches) was recorded when both the shallow and deep wells were pumped simultaneously, but resulted in only 0.0077 feet (0.09 inches) of net subsidence (inelastic subsidence) after recovery.

Los Angeles Department of Water Resources (LADWP) has proposed to install extensometers at two locations in the vicinity of Owens Lake (Figure 6-1) as part of their Owens Lake Groundwater Development Project. These locations were selected based on clay layers within the aquifers, vicinity to potential future pumping, and nearby infrastructure that could be affected by land subsidence. The extensometers have not yet been installed but could be useful monitoring points in the future.

7. Discussion

The potential for subsidence in Owens Valley basin has been evaluated for the GSP using multiple methods and data sources (Table 7-1).

Study/Investigator	Subsidence	Comments
Neponset Geophysical Corp (1999)	maximum subsidence of 0.0363 feet (0.43 inches) with 0.0077 ft (0.09 inches) of inelastic subsidence	23-day pumping test near Owens Lake
Geodetic Data	No recorded subsidence	Basin-wide data
Various Regional General Plans or Hazard Mitigation Plans	No recorded subsidence	
DWR, 2014	Low potential	Ranking for entire basin
InSAR	Less than +/-0.05 ft (land elevation changes less than instrumental resolution)	June 2015 – Sept 2019 study period / basin-wide data

Table 7-1 Summary of Subsidence Evaluations

Each of the proposed management areas has a slightly different susceptibility to subsidence that is rooted in a few key factors:

- The hydrostratigraphic setting (i.e., are the geologic units fine-grained); and
- Is the water level below, or projected to be below, the historic lows in the future?

In general, both of these factors must be present to initiate subsidence. If monitoring data or site-specific subsidence evaluations have been done, these can be used to support a subsidence susceptibility ranking.

Management Area	Hydro-stratigraphic Setting Susceptibility	Chronic Declines in Groundwater Levels	Geodetic / Extensometer / Tiltmeter Evidence of Subsidence	InSAR Evidence of Subsidence	Subsidence Susceptibility Ranking
Tri Valley & Fish Slough	Low	Yes	No	No	Low
Owens Valley	Low to Moderate	No	No	No	Low
Owens Lake	High	No	Yes	No	Moderate

Table 7-2 Summary of Subsidence Potential

Tri Valley / Fish Slough: The hydrogeologic setting in the Fish Slough and Tri-Valley management area is dominated by volcanics and alluvial fan sediments which are typically not susceptible to subsidence. Groundwater levels in this area are showing chronic declines with rates observed to be about 0.15 feet/year (Fish Slough) and 0.49 – 1.86 feet/year (Tri Valley) and are thought to be historic lows for this management area. The groundwater extractions in this management area are distributed throughout the area rather than being concentrated in small zones, so the effects of subsidence, if any, may be more area wide. Despite one of the necessary factors being present, there is no direct instrumental evidence of subsidence in the management area. Consequently, the potential for subsidence is considered low.

Owens Valley: The Owens Valley management area, in general, covers the flanks of the valley floor in the central portion of the basin (Figure 1-1). Alluvial fan deposits interbedded with basalt flows dominate the underlying geology with limited evidence of thick sequences of clays or fine-grained sediments that would be susceptible to subsidence. The southern portion of the management area may, in some locations, be underlain by fine-grained sediments/clays associated with ancestral Owens Lake when it was larger extending north of Independence. The groundwater levels in the management area are not displaying chronic declines and, similar to the Tri Valley/Fish Slough management area, groundwater extractions are distributed throughout the basin with the most concentrated zone of pumping located near population centers (e.g., City of Bishop). There is no direct instrumental evidence of subsidence in the management area, so the potential for subsidence is considered low. In the adjudicated portion of the Basin, the pumping stress is much greater and the presence of fine-grained sediments more common, but subsidence in this area also has not been reported.

Owens Lake: The Owens Lake management area is underlain by multiple aquifers separated by aquitards composed of lacustrine clays. This hydrogeologic setting is highly susceptible to subsidence, however, the lack of extensive groundwater extractions lowers the potential for the subsidence if the present pumping stress continues. There is no recent instrumental evidence of wide-spread subsidence, however, the Neoponset (1999) study did record subsidence with a relatively short-term (23 day) groundwater extraction test. The majority of the subsidence was elastic in nature. So, it is possible to have subsidence, and future groundwater extraction projects should consider the potential for those projects to initiate subsidence. As described in Section 6, LADWP has plans to install two extensometers in this management area to monitor if potential future groundwater extractions associated with their proposed project could initiate subsidence. Based on the hydrogeologic setting and demonstrated initiation of subsidence after only a short-term groundwater extraction test, the subsidence susceptibility ranking is moderate for this management area.

The generally moderate potential for subsidence to occur within the basin can be monitored by regularly reviewing the future InSAR data sets. DWR plans on continuing to provide InSAR subsidence data covering the groundwater basin, from which changes in ground surface elevation should be assessed on an annual basis under the GSP. These data sets are good monitoring tools that document subsidence (or the lack thereof) in arrears (i.e., data captures subsidence [or recovery] that has already happened), but are not suitable as early warning or real-time indicators of subsidence.

To monitor real-time subsidence or get early warnings, the installation of extensometers or additional CGPS stations within the areas underlain by alluvium/alluvial fan materials (i.e., not underlain by bedrock) would be required. Extensometers are complimentary to the CGPS and offer the added benefit of being able to be positioned in specific aquifers and develop hydrostratigraphically discrete measurements of subsidence. Future groundwater projects in the Owens Lake management area could be required to include real-time subsidence monitoring and be evaluated on a case-by-case basis to protect and sustainably manage the Basin.

Assessing potential future subsidence instigated by depressing groundwater water levels lower than the historical low value can be semi-quantitatively estimated by using analytical spreadsheet predictive tools (e.g., LRE, 2017) or the implementation of the subsidence module in future updates to groundwater flow models. At present, the need to use analytical spreadsheet tools or develop of new groundwater flow models are not warranted given the low subsidence potential and thus are outside of the scope of work for this GSP. But, the methods suggested herein could be considered in future updates to the GSP or if conditions or pumping stress changes.

8. Conclusions

After reviewing available historical reports, geodetic survey data, satellite imagery, and tiltmeter and groundwater level data, the Owens Valley basin has historically shown little to no subsidence related to groundwater withdrawal, even through multiple droughts and record low water levels. Prevention of future subsidence can be accomplished by maintaining water levels above historical lows. The overall potential for subsidence under the current groundwater management schemes is considered low; however, the geologic materials in the Owens Lake management area could be susceptible and future projects will be evaluated whether expanded or on the ground monitoring is necessary.

Groundwater extractions and/or exports from the basin are managed by various existing regulations, so the potential for over-pumping the aquifers and depressing water levels to elevations significantly below the historic low water levels (and therefore establishing conditions favorable for the initiation of subsidence) are unlikely. Changes in future land uses are not expected to result significantly greater demand for groundwater.

The recommended subsidence monitoring program can be divided into three phases:

Priority		Technique	Comments
I	In arrears	InSAR data	Low cost (data provided by others) / Good areal coverage
II	Real time or near real time	Extensometers / CGPS	Expensive to install / Ongoing maintenance costs / Site-specific data / Extensometers allow aquifer-specific measurements
III	Predictive, future subsidence	Analytical tools / subsidence groundwater flow module	Semi-quantitative results / Must have detailed lithologic data (e.g., borehole geophysical logs, well drillers reports)

Table 8-1 Recommended Subsidence Monitoring Program

It is recommended that the GSA use the InSAR data set as a primary monitoring tool for subsidence in the basin. DWR plans on continuing to provide InSAR subsidence data covering the groundwater basins, in which the OVGA will be able to monitor the changes each year. If the InSAR data identifies areas of subsidence or critical infrastructure are being impacted by subsidence, then Priority II monitoring techniques should be considered for implementation. As new groundwater models are being developed (e.g., Fish Slough and Tri-Valley management area) or the existing LADWP groundwater flow models are being updated, it is suggested that consideration be given to implementing the subsidence predictive modules associated with the model software.

9. References

California Department of Water Resources (DWR), 2014, Summary of Recent, Historical, and Estimated Future Land Subsidence in California. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/California-Groundwater-Update-2013/California-Groundwater-Update-2013---Appendix-F.pdf.

County of Mono Regional Transportation Plan & General Plan Update, 2015, Draft EIR, Mono County Community Development Department, July 31, 2015.

Inyo County and City of Bishop, 2017, Multi-Jurisdictional Hazard Mitigation Plan (Final Draft FEMA approved), December 2017.

Los Angeles Department of Power and Water, 2019, Hydrologic Monitoring, Management, and Mitigation Plan for The Owens Lake Groundwater Development Program, a Component of Owens Lake Master Project, January 2019.

LRE Water, LLC (LRE), 2017, Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping, TWD Contract Number 1648302062. https://www.twdb.texas.gov/groundwater/docs/Subsidence_Vulnerability_Report.pdf

Mono County and the Town of Mammoth Lakes, 2019, Multi-jurisdictional Hazard Mitigation Plan.

Neponset Geophysical Corporation, 1999, Tiltmeter Evaluation Project River Site Wells, Owens Lake, Inyo County, California, prepared for Great Basin Unified Air Pollution Control District.

Poland, J.F. and Davis, G.H.,1969, Land Subsidence Due to Withdrawal of Fluids. Reviews in Engineering Geology, 2, 187-269.

Poland, J.F. 1984. Guidebook to studies of land subsidence due to ground-water withdrawal. Prepared for the International Hydrological Programme, Working Group 8.4.

SGMA Data Viewer, Accessed November 2020. https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub)

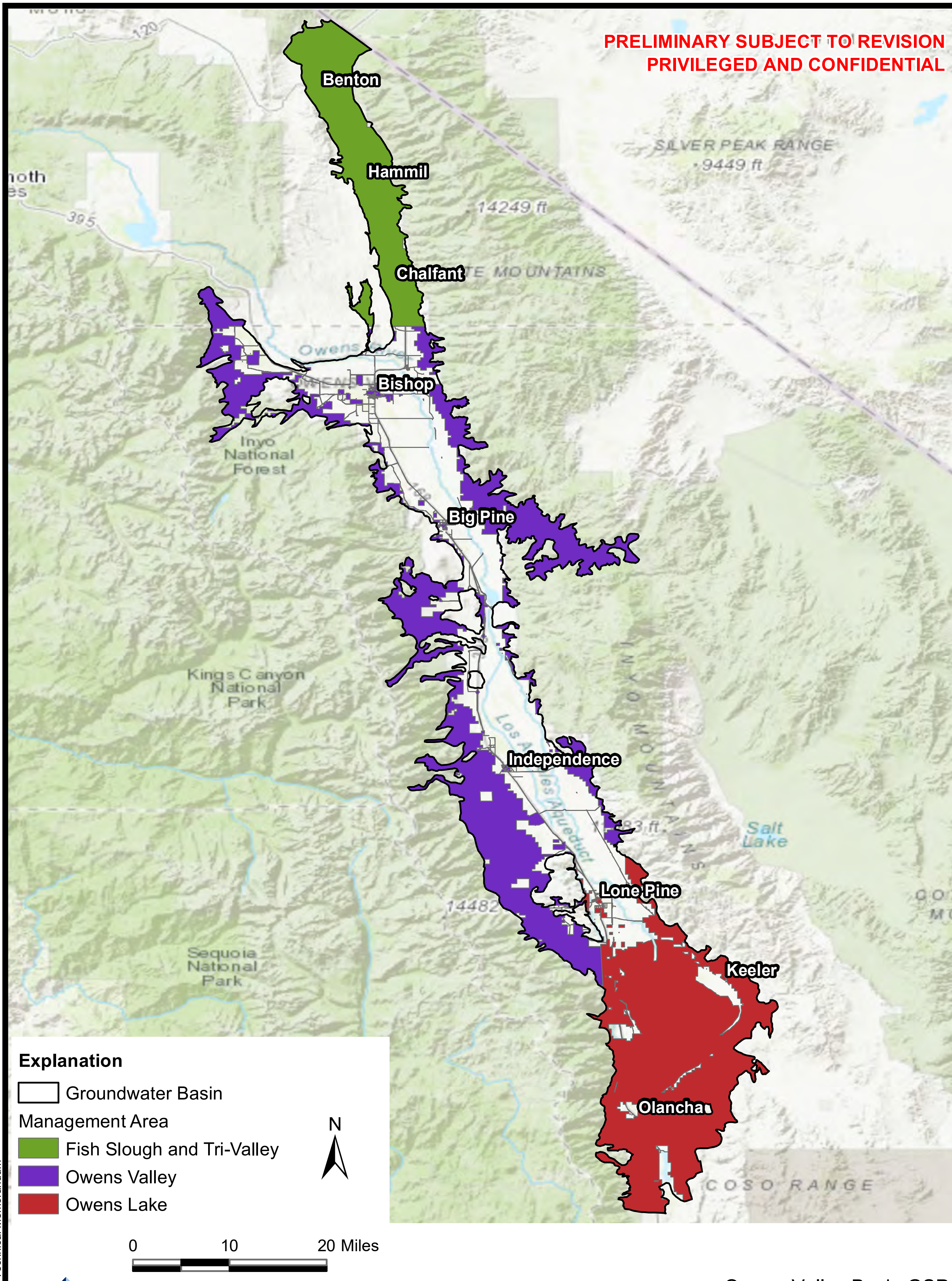
Towill, Inc., 2020, InSAR Data Accuracy for California Groundwater Basins CGPS Data Comparative Analysis January 2015 to September 2019. https://data.cnra.ca.gov/dataset/tre-altamira-insar-subsidence/resource/a1949b59-2435-4e5d-bb29-7a8d432454f5.

UNAVCO, Accessed 12/30/2020. https://www.unavco.org/instrumentation/networks/status/all.

U.S. Geological Survey, 1999, Land Subsidence in the United States, Circular 1182, Devin Galloway, David R. Jones, and S.E. Ingebritsen (eds). https://pubs.er.usgs.gov/publication/cir1182.

U.S. Geological Survey, 2016, Land Subsidence: Cause & Effect, http://ca.water.usgs.gov/land_subsidence/california-subsidence-cause-effect.html.

10. Figures and Tables

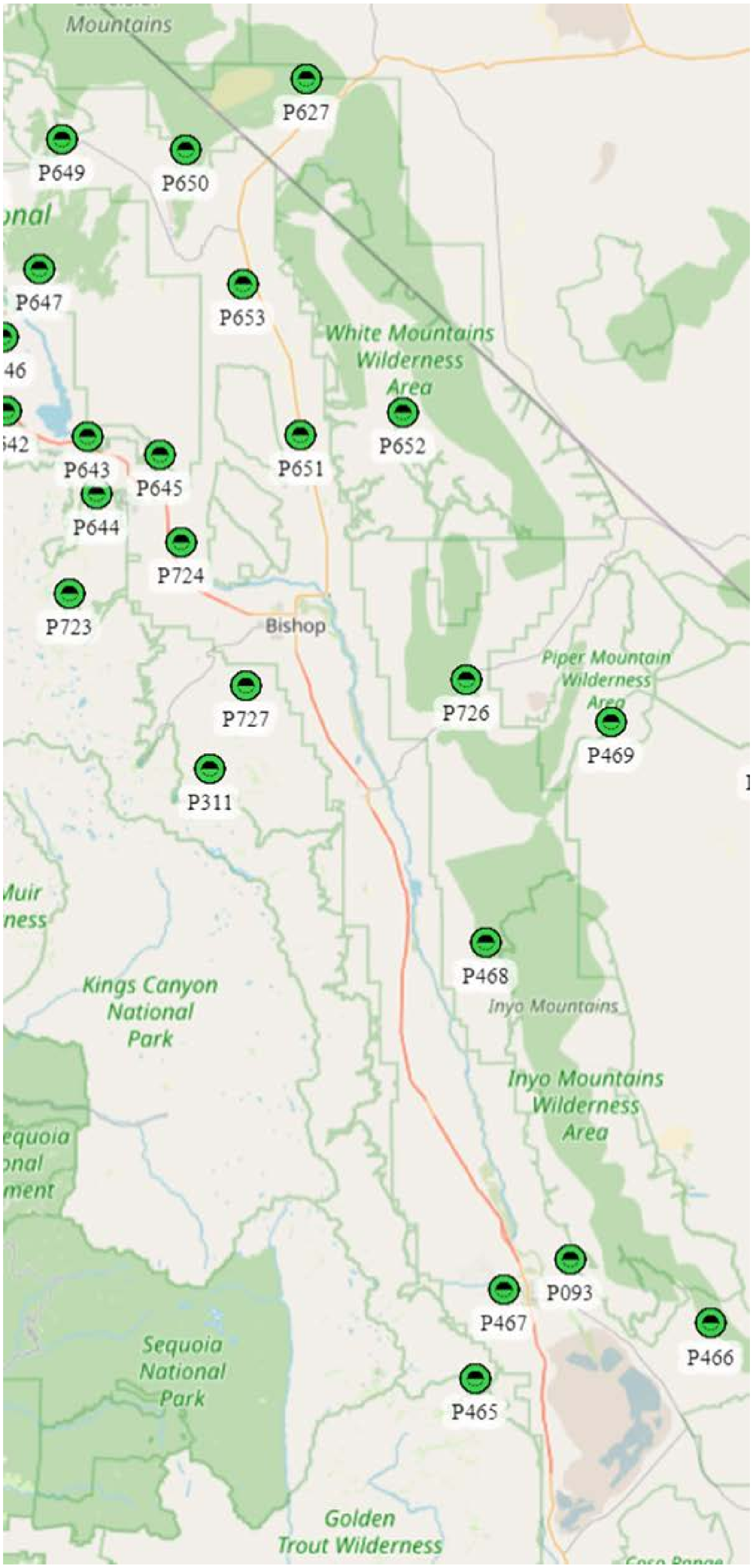


Subsidence Technical Memorandum

DBS&A
Daniel B. Stephens & Associates, Inc.
12/3/2020
DB18.1418

Owens Valley Basin GSP
GSP Management Areas

Figure 1-1



OWENS VALLEY BASIN GSP

Continuous Monitoring GPS Stations near Owens Valley Basin

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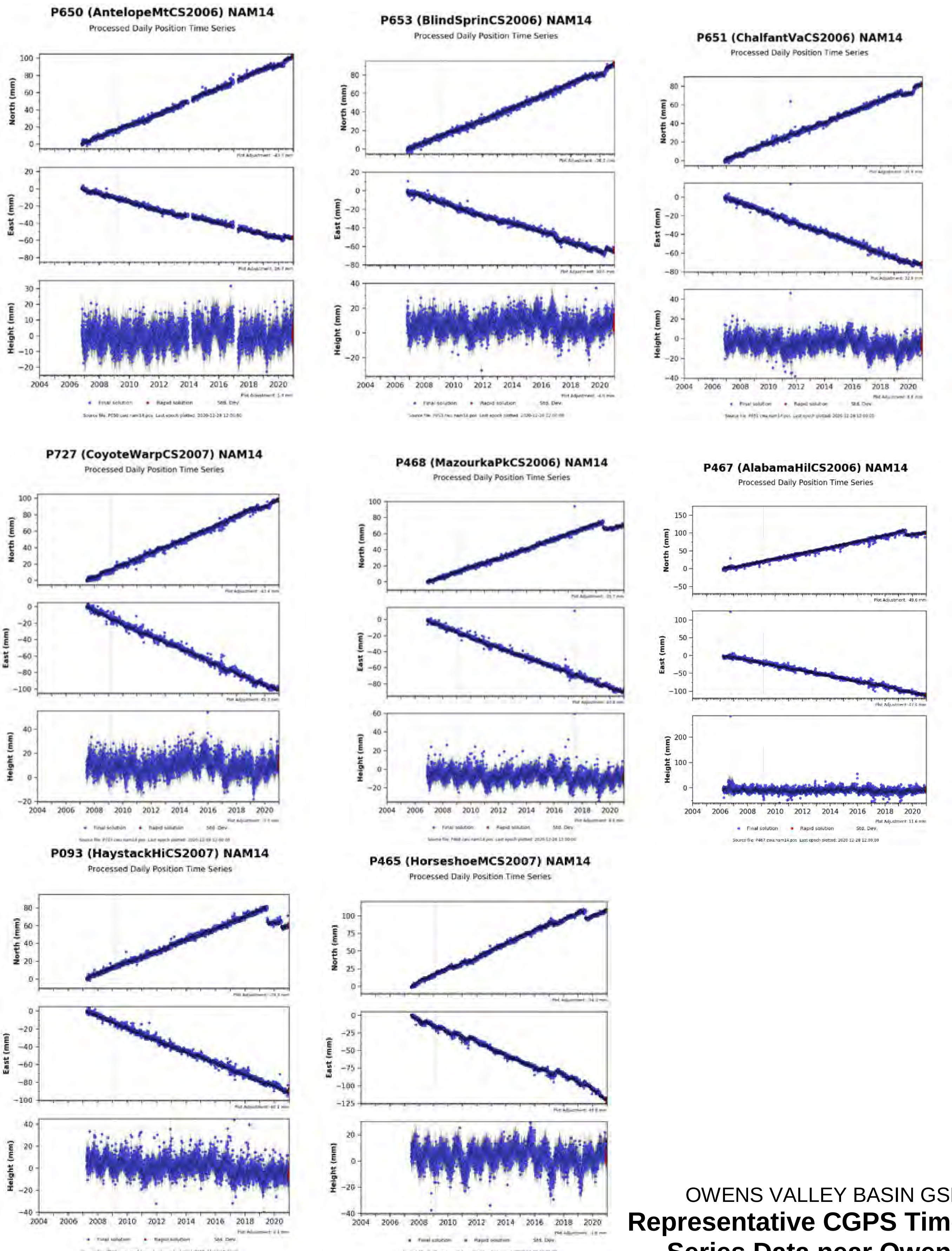
Figure 4-1



OWENS VALLEY BASIN GSP

Representative CGPS Time Series Data near Owens Valley Basin

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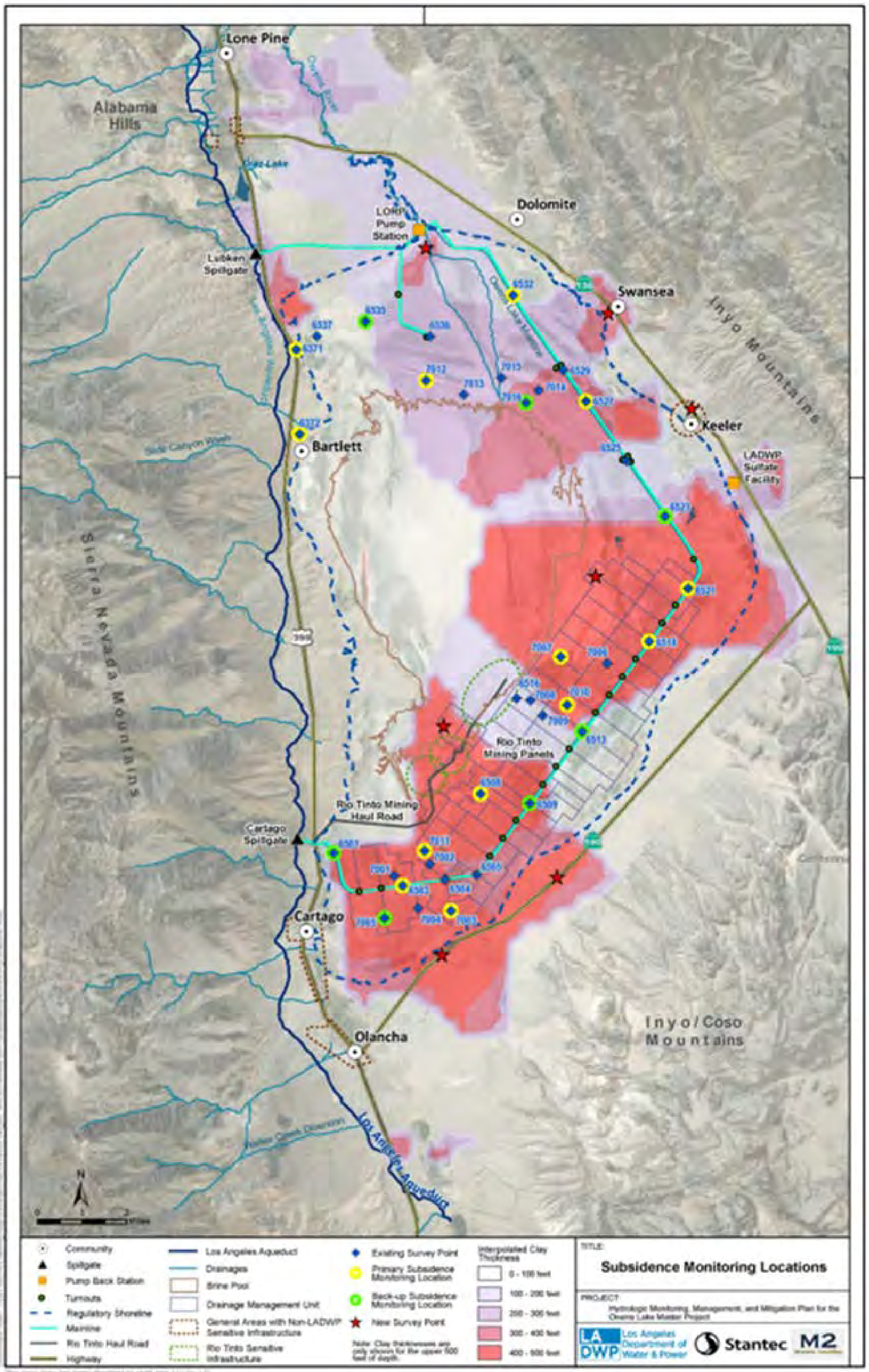
Figure 4-2



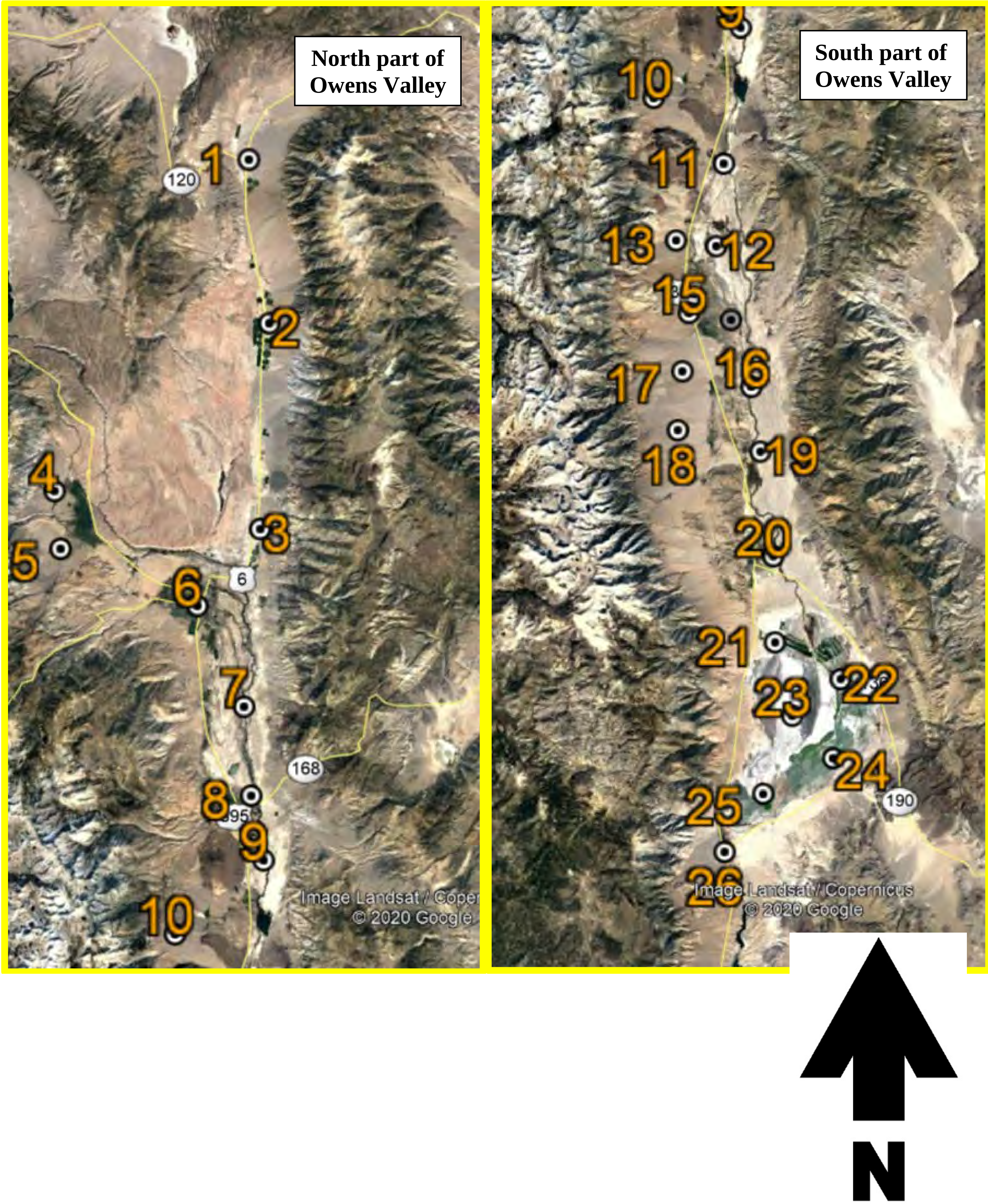
From LADWP (2019) Hydrologic Monitoring, Management, and Mitigation Plan for The Owens Lake Groundwater Development Program

OWENS VALLEY BASIN GSP

LADWP Subsidence Monitoring Stations near Owens Lake

Daniel B. Stephens & Associates, Inc.

Figure 4-3



OWENS VALLEY BASIN GSP

Representative InSAR Subsidence Monitoring Points

Figure 5-1

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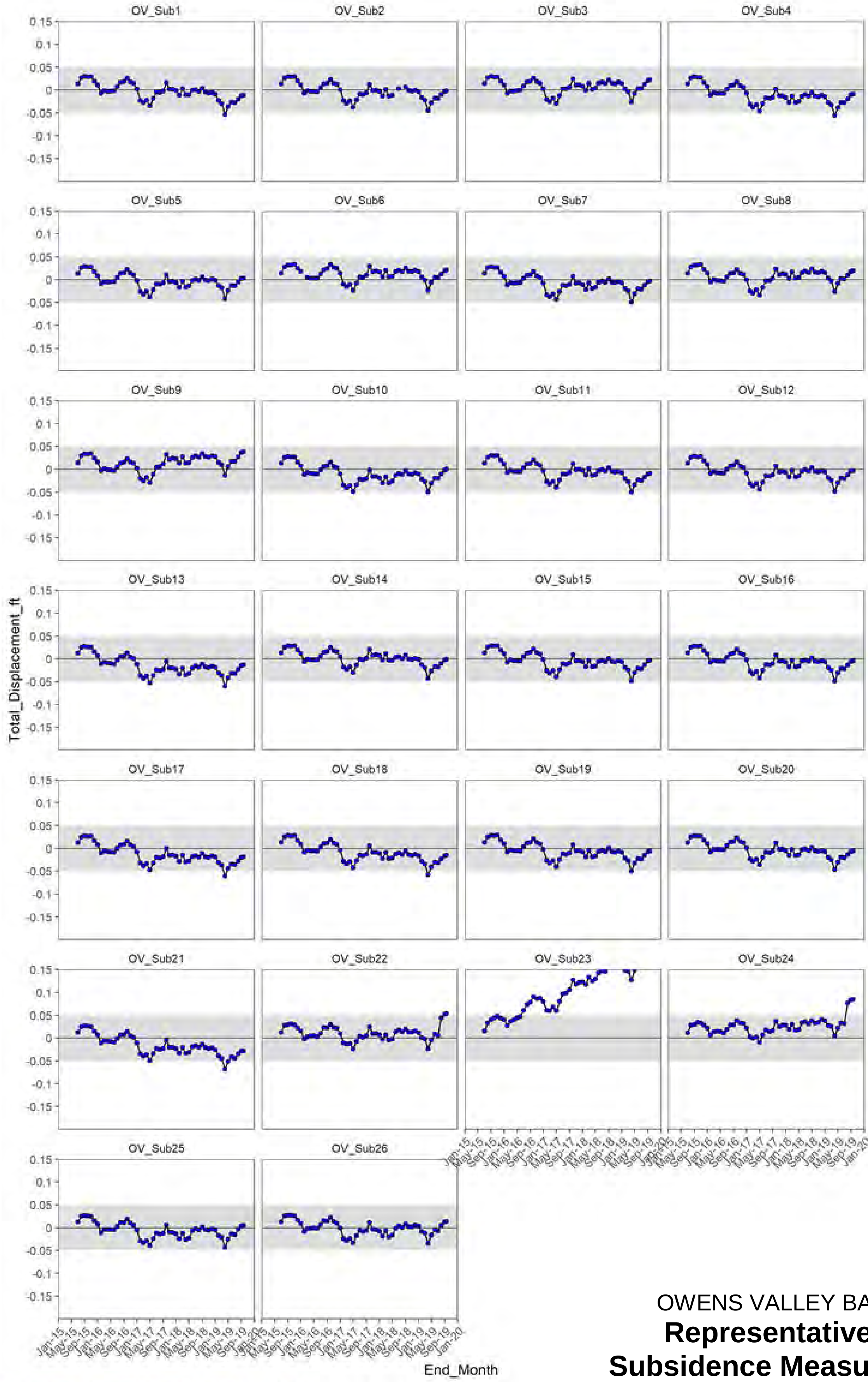

OWENS VALLEY BASIN GSP

Representative InSAR Subsidence Measurement Points

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Figure 5-2

OWENS VALLEY BASIN GSP
LADWP Proposed Extensometer Installation Locations near Owens Lake

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Figure 6-1

TECHNICAL APPENDIX ◦ FEBRUARY 2021

Assessment of Groundwater Dependent Ecosystems for the Owens Valley Basin Groundwater Sustainability Plan

PREPARED FOR

Owens Valley Groundwater Authority

PREPARED BY

Stillwater Sciences
2855 Telegraph Ave., Suite 400
Berkeley, CA 94705

Stillwater Sciences

Suggested citation:
Stillwater Sciences. 2021. Assessment of Groundwater Dependent Ecosystems for the Owens Valley Basin Groundwater Stability Plan. Technical Appendix. Prepared by Stillwater Sciences, Berkeley, California for Owens Valley Groundwater Authority.

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Appendices

1 BACKGROUND AND SETTING

This Technical Appendix to the Owens Valley Groundwater Sustainability Plan (GSP) addresses the extent and condition of groundwater dependent ecosystems (GDEs) in the Owens Valley Groundwater Basin. The Owens Valley Groundwater Basin is managed by the Owens Valley Groundwater Authority (OVGA). As part of the California's Sustainable Groundwater Management Act (SGMA), Groundwater Sustainability Agencies (GSAs) are required to consider GDEs and other beneficial uses of groundwater when developing their GSPs. SGMA defines GDEs as "ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (23 CCR § 351(m)). As described in The Nature Conservancy's guidance for GDE analysis (Rohde et al. 2018), a GDE's dependence on groundwater refers to reliance of GDE species and/or ecological communities on groundwater for all or a portion of their water needs. Mapping GDEs requires mapping vegetation that can tap groundwater through their root systems, assessing where the depth of groundwater is within the rooting depth of that vegetation, and mapping the extent of surface water that is interconnected with groundwater (Rohde et al. 2018). Once the GDEs are mapped, the occurrence of special status species can be used to assess the value of GDEs in the basin, while remote sensing measurements can be used to track the health of groundwater dependent vegetation through time. This information will be used to inform sustainable management criteria for each management unit. This appendix relies on hydrologic and geologic data presented in the GSP and its technical appendices.

The central portion of the Owens Valley Groundwater Basin contain lands owned by the City of Los Angeles where groundwater and GDEs are managed following a legal settlement and are not subject to SGMA. This area is hereafter referred to as the Adjudicated Area (Figure 1.1-1). Groundwater pumping in the Adjudicated Area is managed jointly by Inyo County and the City of Los Angeles to maintain vegetation cover at 1984–1987 levels (Groenveld 1992). This technical appendix to the Owens Valley GSP addresses GDEs in the Owens Valley Groundwater Authority (OVGA) Assessment Area (Figure 1.1-1) which includes all lands outside of the Adjudicated Area. While this technical appendix focuses on the OVGA Assessment Area, groundwater and vegetation data gathered in the Adjudicated Area were used to inform and provide context to our analysis. The Owens Valley Groundwater Basin was classified as a low-priority basin by the California Department of Water Resources (DWR 2020a). The GSP and the approach outlined below was presented during public meetings of the OVGA.

The Owens Valley basin has characteristics that make GDE assessment difficult. The basin is over 125 miles long and ranges in width from 2–15 miles. The basin has a total area of 1,062 square miles, 65% of which is outside of the adjudicated area (DWR 2020a). The adjudicated area extends across the center of the Owens Valley from Bishop downgradient to the Owens Lake area. The elongate shape, coupled with a strong gradient in runoff from west to east creates diverse habitats.

1.1 Physiography, Geology, and Soils

This section includes a brief discussion of the physiography, geology, and soils. These data are presented in more detail in Section 2.1 of the GSP. The Owens Valley Groundwater Basin underlies alluvial sediments in Benton, Hammil, and Chalfant valleys (hereafter the Tri-Valley Area) in Mono County and Round Valley, Owens Valley and Owens Lake in Inyo County (CA Department of Water Resources 2016, Figure 1.1-2). The basin is bounded to the north by the Benton Range and the Bishop Tuff, to the west by the Sierra Nevada, to the southeast by the Coso Range, and to the east by the Inyo and White mountains (Figure 1.1-1). The southern extent of the alluvial basin is marked by the groundwater and topographic divide at Hawiee Reservoir. It is approximately 130 miles long and varies in width from approximately 1 mile between Big Pine and Poverty Hills to approximately 15 miles at Owens Lake. The basin surface is a high desert rangeland valley that ranges in altitude from about 3,500 feet above sea level at Owens Lake to about 4,500 feet north of Bishop (Danskin 1998).

Water in the basin originates in the Sierra Nevada and White/Inyo Mountains. The basin is drained by the Owens River which originates south of Mono Lake and terminates in Owens Lake, a closed basin at the downstream end of the groundwater basin. The primary water-bearing unit in the basin is the Quaternary sediment that fills the valley (Figure 1.2-1). Numerous tributaries drain the Sierra Nevada, forming extensive coalesced alluvial fans that extend nearly to the valley axis on the west side. The Sierra Nevada creates a rain-shadow effect for the Owens Valley and the White and Inyo ranges. Runoff and associated alluvial fans at the base of the drier White and Inyo mountain are therefore less extensive. Although valley fill material is heterogeneous, in general, sediment at the basin boundaries is unconsolidated, coarse, permeable alluvial fan material, grading into fluvial and lacustrine sand and silt deposits toward the valley axis.

The majority of soils in the Owens Valley Basin are alluvial or eolian in origin. The geologic complexity of the region results in a wide variety of parent materials; over 200 soils are mapped in the basin. Soils on the valley floor are typically alkaline (Tallyn 2002), but the well-drained soils on the alluvial fans host vegetation that is generally intolerant of high alkalinity (Sorenson et al. 1991).

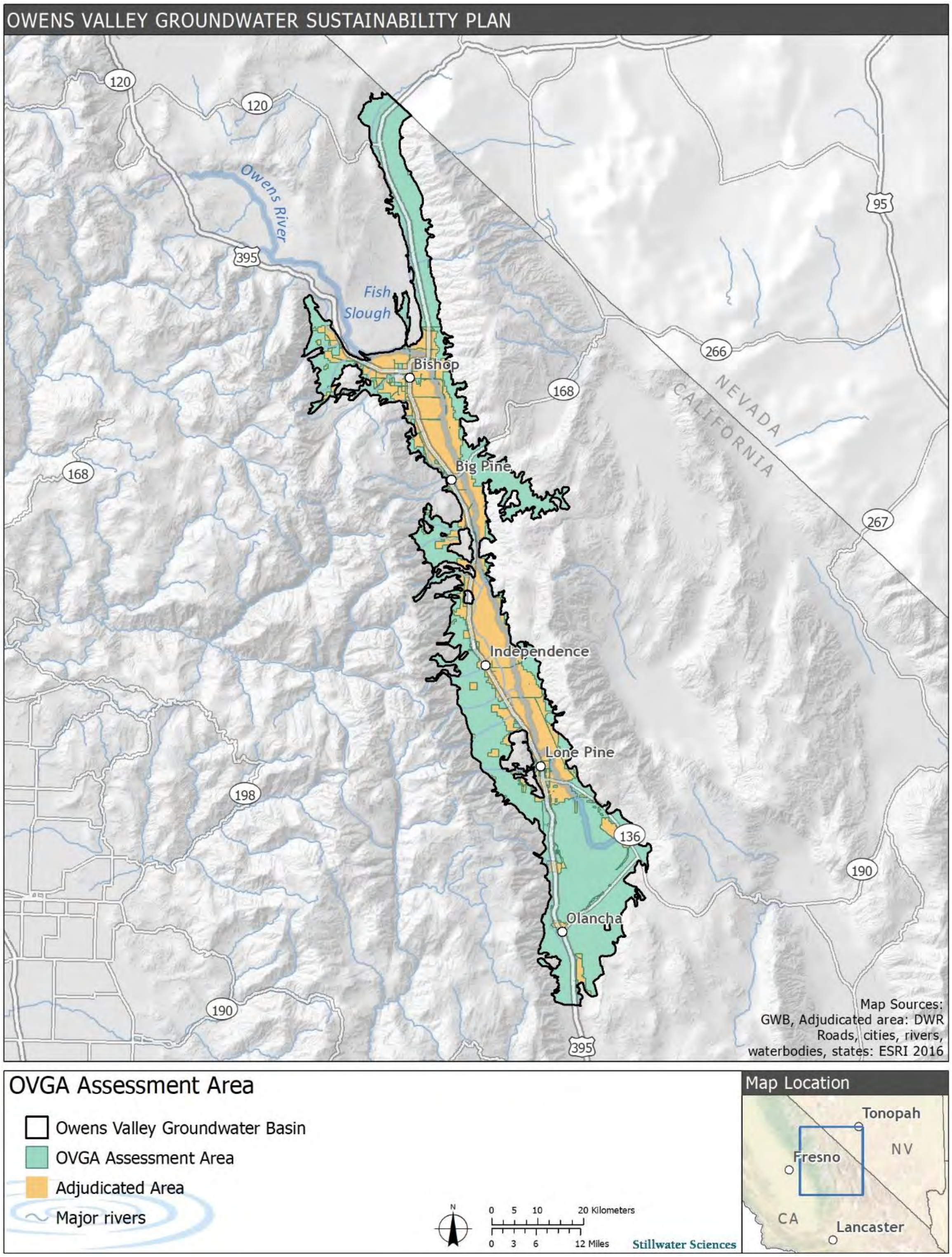

Figure 1.1-1. OVGA Assessment Area showing the exclusion of the Adjudicated Area.

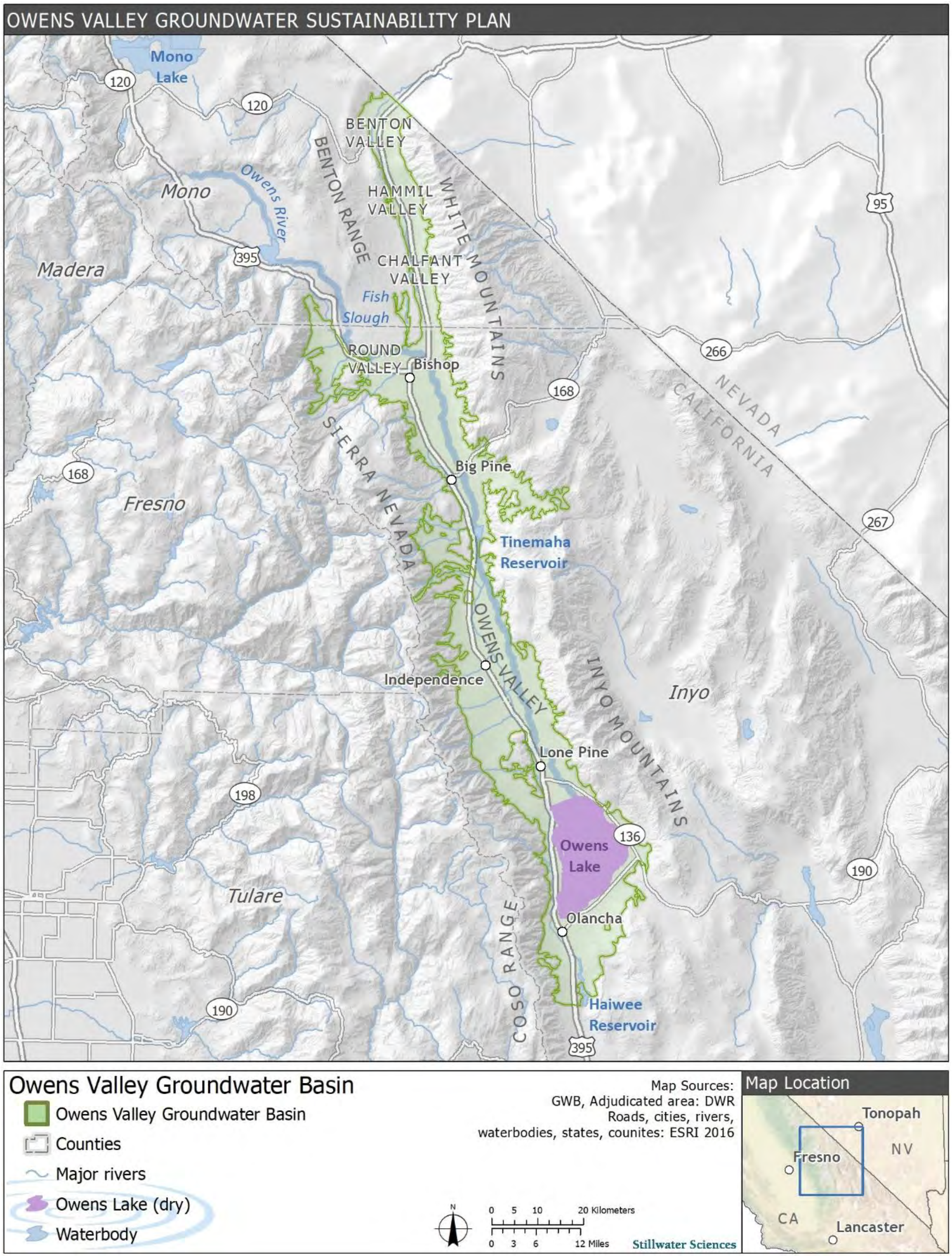

Figure 1.1-2. Owens Valley groundwater basin.

1.2 Management Areas

Based on the geology, hydrology, and pre-existing management policies, the non-adjudicated portion of the Basin (referred to herein as the OVGA Assessment Area) has been divided into three management areas: Tri-Valley and Fish Slough, Owens Valley, and Owens Lake as described in the GSP (Section 2.2.4). For the GDE analysis, the Tri-Valley area and Fish Slough will be assessed separately to account for the interconnected surface flows and rare plant and animal species unique to Fish Slough. The four management areas are shown in Figure 1.2-1 and their extent is shown in Table 1.2-1. Owens Valley is the largest management area in the OVGA Assessment Area totaling 43% of the Assessment Area, with the Owens Lake management area covering 40%. The Tri Valley management area is about 17% of the Assessment Area, with Fish Slough slightly less than 1% of the Assessment Area (Table 1.2-1).

Table 1.2-1. Area of Management Areas (area does not include the Adjudicated Area).

GDE management area	Area (acres)	% of total
Owens Valley	184,788	43.0
Owens Lake	170,491	39.6
Tri-Valley	71,839	16.7
Fish Slough	2,943	0.7
Total	**430,061**	**100**

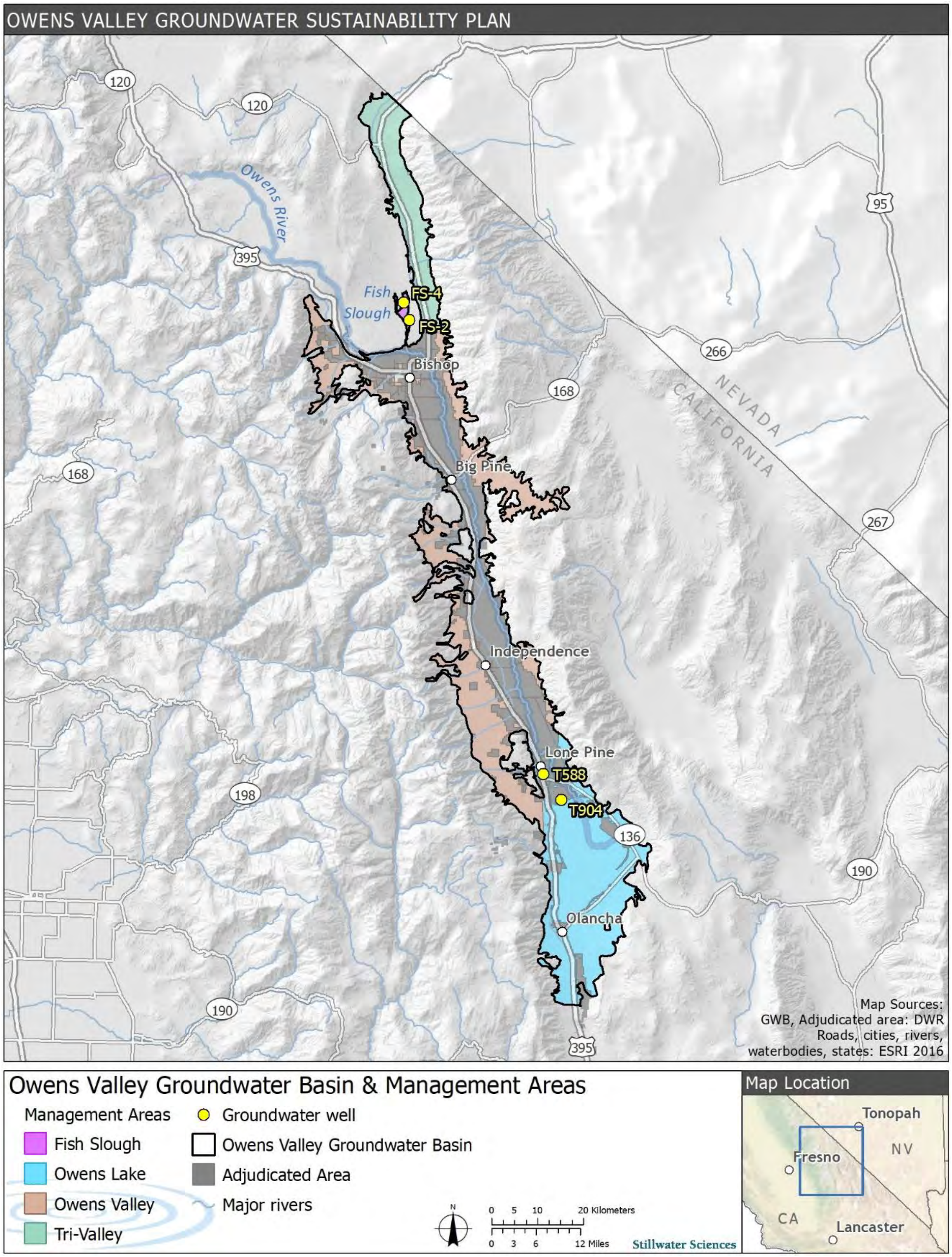

Figure 1.2-1. Owens Valley Groundwater Basin and Management Areas. The figure also shows groundwater wells discussed in the Section 1.3.

1.3 Hydrology

The physiography and geology of the Owens Valley is described in Section 2.2 of the GSP. Here we describe the surface and groundwater hydrology relevant to the GDE analysis. Much of the surface water and some of the groundwater in the Owens Valley is diverted to the Los Angeles Aqueduct. The valley has no natural surface-water outlet and water naturally drained into the Owens River, flows southward into Owens Lake, and evaporates. Flow in the Owens River upstream of the Los Angeles Aqueduct intake, located south of Poverty Hills, is controlled by releases from Lake Crowley and the Tinemaha Reservoir. Flow in the Lower Owens River, a 62-mile stretch between the aqueduct intake and Owens Lake, is controlled by releases from the river-aqueduct system and groundwater-surface water exchange (Danskin 1998). Water exports caused the lake to dry up by 1926, and it remained a playa until the early 2000s, when water application to the lake was implemented as part of the Los Angeles Owens Lake Dust Control Project (Herbst and Prather 2014). The Lower Owens River was also essentially dry until the early 2000s. In 2006, re-watering of the river and floodplain commenced with the Lower Owens River Project. Since December 2006, the river has maintained a minimum flow of 40 cfs (LADWP 2019a).

The productive aquifer unit of the valley fill is divided into three hydrogeologic units from the surface downward. Unit 1 represents the unconfined part of the aquifer system and is the unit from which most GDEs obtain their water (Danskin 1998). Unconfined conditions exist in most of the aquifer system. Unit 1 has a saturated thickness of about 100 ft. Locally, less transmissive layers of volcanic flows or fine-grained sediment (related to paleo lacustrine or fluvial conditions) can create localized confinement described as hydrologic Unit 2 by Danskin. Most of the groundwater extraction in the valley is from Unit 3, consisting of older, more consolidated alluvial sediments (Danskin 1998). This unit occurs well below the rooting depth of trees. Faults in the Owens Valley can produce springs and seeps with discharge from both Unit 1 and Unit 3. From Water Year 2000 through the first half of Water Year 2019, average annual groundwater pumping in the Owens Valley was about 73,000 acre-feet per year (LADWP 2019b).

Aquifer recharge is primarily runoff from the Sierra Nevada that infiltrates through the heads of alluvial fans and tributary stream channels. Additional recharge results from seepage from canals and ditches, precipitation on sparsely vegetated volcanic rocks, irrigation, and leakage from the Owens River-Los Angeles Aqueduct system. In general, groundwater flows horizontally through Units 1 and 3 from recharge locations at the valley margins, mainly the west margin, toward the center of the valley, and then south toward Owens Lake.

Throughout the basin, faults impede horizontal groundwater flow across the strike of the fault. For example, the Owens Valley Fault, which trends north-south along the valley axis in the Owens Valley and Owens Lake, impedes west-east flow in the southern and central parts of the basin. Faults also create relatively isolated hydrologic compartments in the basin, with recharge and discharge occurring from localized sources only, such as streams and springs or wells, respectively (Figure 1.3-1). Areas bounded by parallel faults like the Owens Valley and Owens River faults south of Lone Pine at the Owens Lake are an example of such compartments. Faulting in areas with surface and subsurface volcanic flows have created highly transmissive, preferential flow paths typically along the axis of the fault and are the sites of springs and seeps through out the basin.

Rohde et al. (2018) recommend defining vegetation as GDEs if the groundwater is within 30 feet of the ground surface. This is deeper than most roots, but accounts for differences between the location of monitoring wells and GDEs, uncertainty in groundwater modeling (if used), and uncertainty in the rooting depth. We therefore focus on shallow groundwater, where present, in our assessment of groundwater in the basin. Trends in groundwater are explored in Appendix XX Monitoring Plan and Data Gap Analysis and are only briefly described here. We also explore the extent of interconnected surface water in each management area. Because this analysis of the GSP does not include a groundwater model, we explore past trends in hydrology using the identified monitoring wells in the four analysis areas. Where possible, we use shallow water wells identified as monitoring wells in Appendix XX Monitoring Plan and Data Gap Analysis.

There are numerous seeps and springs mapped in the OVGA Management Area (Figure 1.3-1). Seeps and springs are located along faults and at geologic contacts. LADWP gages springs with significant flows in the Owens Valley (primarily in the Adjudicated Area (Aaron Steinwand, personal communication. Below we focus on flows in Fish Slough, which is almost entirely spring fed. Additional details on spring flows are available in Appendix XX Monitoring Plan and Data Gap Analysis.

For the remainder of this report, shallow groundwater refers to groundwater accessible by roots (< 15 below the ground surface [bgs]). Changes in groundwater through time are investigated in Appendix XX Monitoring Plan and Data Gap Analysis

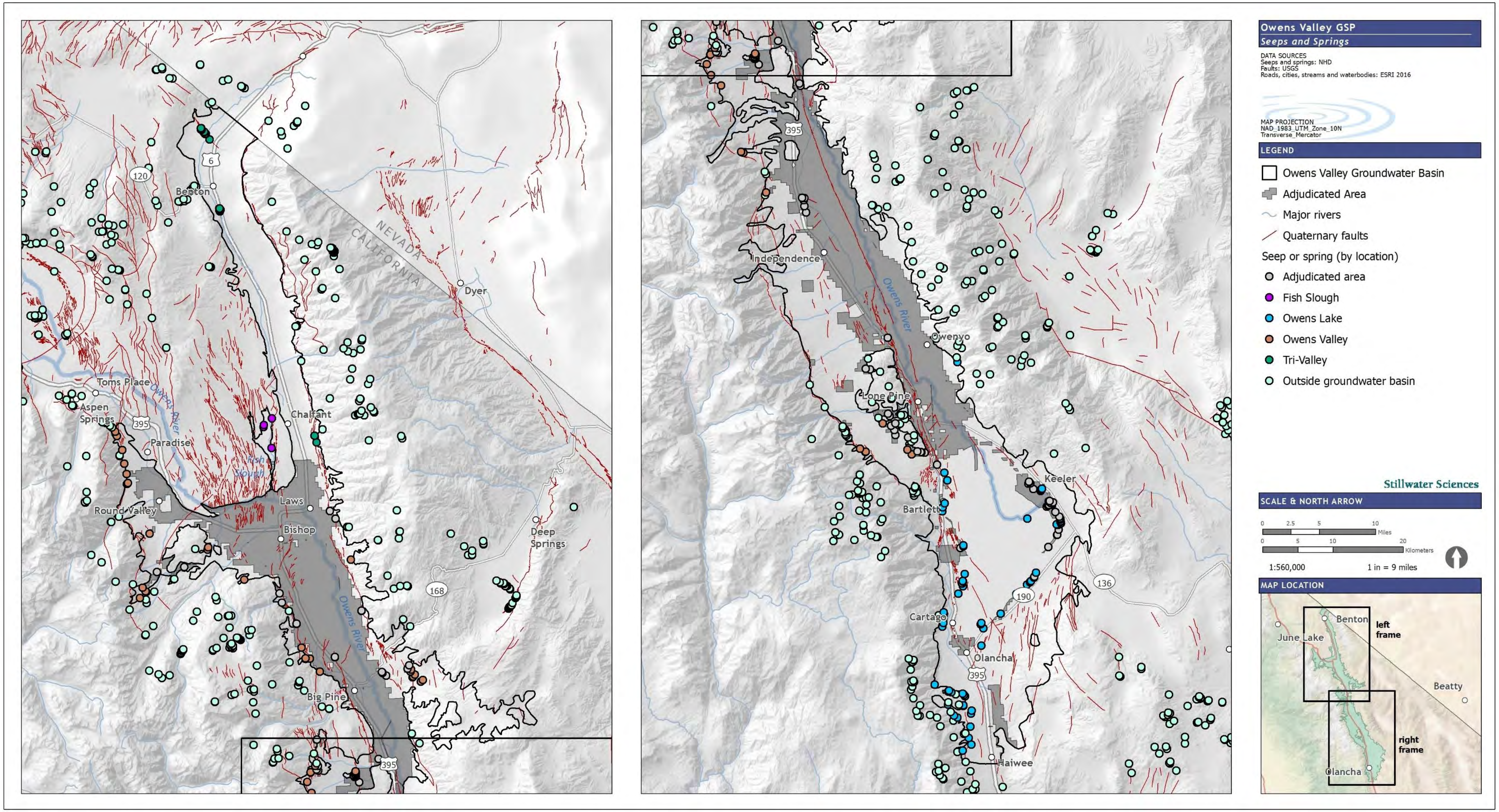

Figure 1.3-1. Seeps and Springs in the Owens Valley Groundwater Basin and vicinity.

1.3.1 Owens Valley

The Owens Valley management area contains numerous tributaries and seeps and springs that on the valley floor are typically associated with faults (Danskin 1998). Because there are few wells within the potential GDE areas, monitoring wells in the Adjudicated Area are used in places to evaluate long term trends in groundwater levels. As discussed in the Monitoring Plan and Data Gap Analysis Technical Appendix, shallow wells located in the Adjudicated Area in the Owens Valley Management Unit have depths to water that are generally < 20 ft below ground surface (bgs). Within a given year, groundwater depths are typically shallower in the winter and spring and deeper in summer and fall. Over longer timescales, groundwater depths decline during droughts but recover during wetter years. In general groundwater is closer to the ground surface in the center of the basin than at the edge, near the alluvial fans where depth exceeded 30 feet bgs during the 2012–2016 drought but recovered after 2017.

The Owens River is connected to groundwater in places within the Adjudicated Area (Danskin, 1998). Outside of the Adjudicated Area, however, the extent of interconnected surface waters is unknown in the Owens Valley management area. It is, however, likely that flowing interconnected surface water is relatively rare outside of the Adjudicated Area because groundwater depths generally increase toward the mountains due to the steep, upsloping topography and the tributaries are known losing reaches and not groundwater discharge zones (Aaron Steinwand, personal communication). Because shallow groundwater measurements are sparse, we rely on local expertise to assess the extent of interconnected surface water at tributaries. Given that vegetation tends to occur in narrow bands along the tributaries, sufficiently shallow groundwater to maintain a connection with surface water is unlikely. Local interconnected water does occur where groundwater emerges at springs (Danskin 1989).

1.3.2 Owens Lake

As discussed in the Monitoring Plan and Data Gap Analysis Technical Appendix, the Owens Lake management area includes five confined aquifer layers with aquifer numbers increasing with deeper stratigraphic positions. In general, the units grade from coarser, permeable materials in the delta area north of Owens Lake to clays near the center of the lake (LADWP and MWH 2011). Monitoring well data for the Owens Lake Management Area presented in the Monitoring Plan and Data Gap Analysis Technical Appendix show generally stable shallow groundwater elevations, with short term fluctuations corresponding to water year type (Figure 1.3-2). Groundwater levels in Aquifer Unit 1 are within the maximum rooting depth of many GDEs (~10ft). The location of wells in Figure 1.3-2 are shown on Figure 1.2-1.

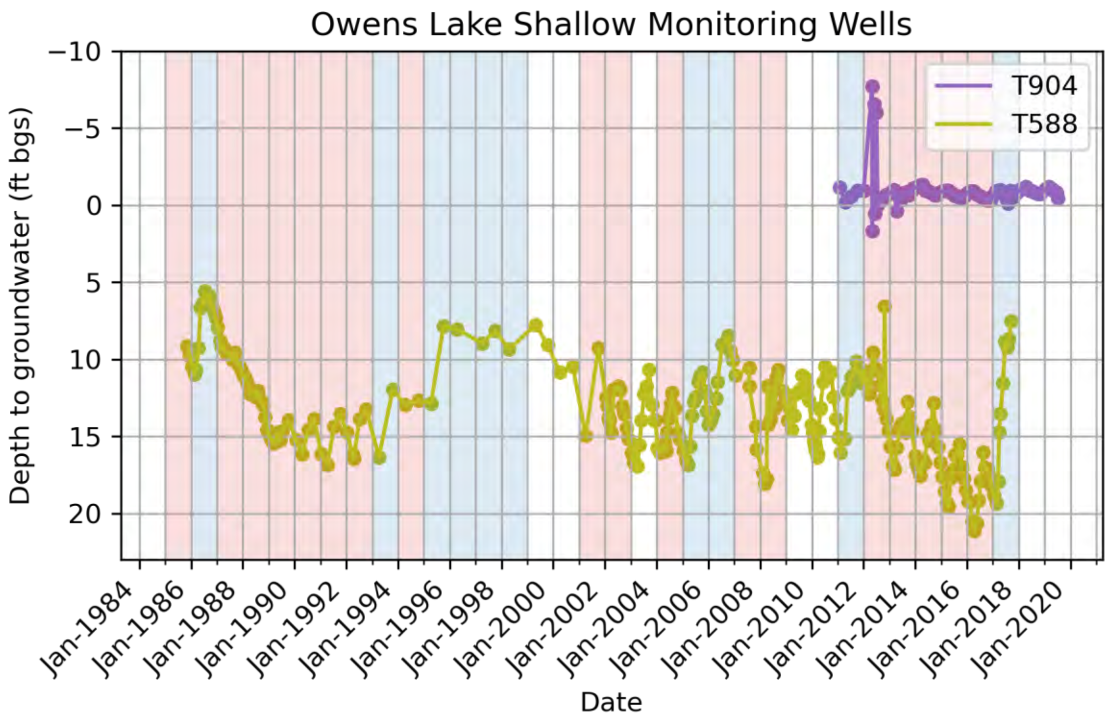

Figure 1.3-2. Changes in depth to shallow groundwater in Owens Lake monitoring wells. Red shading indicates dry years and blue indicates wet years.

Owens Lake is currently managed to limit air pollution from dust. This management includes ongoing and planned restoration to improve plant and bird habitat including groundwater-dependent plants. Dust management primarily involves diverting surface water from the Los Angeles Aqueduct to the lake surface (LADWP 2010, National Academy of Sciences 2020). As part of the ongoing Owens Lake Groundwater Development Program, LADWP is investigating the impacts of deep groundwater extraction from beneath Owens Lake to supplement dust control water demand. To date, groundwater levels have remained relatively stable and shallow groundwater salinity has not increased (LADWP 2010, LADWP 2021, LADWP and MWH 2011, National Academy of Sciences 2020).

The Lower Owens River is located within the Adjudicated Area prior to entering the lake and is generally a gaining reach. Seeps and spring have been mapped along the margin of the lake bed and south of Olancha along the western margin of the Owens Lake management area (Figure 1.3-1). GDEs likely derive their water from the confined aquifers where faulting or stratigraphy allow upward groundwater flow and discharge at seeps or springs.

1.3.3 Tri-Valley

The Tri-Valley management area differs from the Owens Valley and Owens Lake management areas in that none of its water is derived from the Sierra Nevada. Water in the Tri-Valley area originates from the relatively low-lying Volcanic Tablelands consisting of the Bishop Tuff pyroclastic flow to the west and the Mesozoic granites and sedimentary rocks of the White Mountains to the east. Large alluvial fans extend from the White Mountains into the Tri-Valley area, overlying and to the west of these fans is the Bishop Tuff. Both the Volcanic Tablelands and the White Mountains are in the rain-shadow of the Sierra and consequently received significantly less precipitation. Small tributaries drain out of the White Mountains but the water infiltrates into the groundwater system, is used for irrigation, or evaporates and there is little surface water connection with other parts of the basin except for an ephemeral wash that flows only after extreme precipitation events. The White Mountain fault extends along the base of the White Mountains on the east side of the Tri-Valleys.

Depth to water in monitoring wells in the Tri-Valley area are typically greater than 85 feet below the ground surface, and the presence of shallow groundwater available for GDEs is not known or monitored (Figure 1.3-3). As shown in the Monitoring Plan and Data Gap Analysis Technical Appendix, monitoring wells in the Tri-Valley Management Area have been consistently declining. Because the groundwater is deep relative to the rooting depth of plants, the connection between the groundwater decline and GDEs is unknown. The presence of potential GDEs in the management unit suggest that shallow groundwater may occur in places. The linkage between GDE health and groundwater decline in the Tri-Valley Management Unit is explored in Section 4.2.

Seeps and spring have been mapped in the northwest and southeast portions of the Tri-Valley management area (Figure 1.3-1).

1.3.4 Fish Slough

The Fish Slough spring complex lies in Fish Slough Valley, north of Bishop and southeast of the Bishop Tuff Volcanic Tablelands, and consists of multiple spring systems, from small seeps to fourth-order springs (discharge of 380 L to 1700 L per minute). Because there is no upstream surface flow except infrequent ephemeral runoff, nearly all the flow in Fish Slough is derived from groundwater. Several major springs are located along the Fish Slough fault zone, a series of north-south trending normal faults. Using surface topography, faulting, and inferred subsurface geology, Hollett et al. (1991) identified the Tri-Valley area as one of the potential water sources for Fish Slough, which was supported by geochemical analysis by Zdon et al. (2019).

Fish Slough is spring fed and has interconnected surface water throughout its length. Surface flow originates from springs that drain into a perennial stream that flows south through Fish Slough to the Owens River. The combined discharge of the Fish Slough spring complex is measured at surface flow gage SW3216, on Fish Slough about two miles north of its confluence with the Owens River. Mean annual flow at SW3216 has declined over the entire period of record, from over 500 acre-feet per month in the late 1960s to less than 250 acre-feet per month in 2011 (Figure 1.3-3). From 1940 to 1965, mean annual discharge at SW3303, less than one mile upstream along Fish Slough, declined from approximately 550 acre-feet per month to 450 acre-feet per month. Mean annual discharge at SW3209, another mile upstream, declined from 55 acre-feet per month in 1990 to 30 acre-feet per month in 2001. Discharge at SW3209 stabilized between 2001 and 2010 and increased to over 80 acre-feet per month by 2016. Mean annual discharge at SW3217 in the northwestern (upstream) end of Fish Slough declined from 270 to less than 240 acre-feet per month between 1990 and 2000. Discharge at SW3217 subsequently increased and stabilized at approximately 270 acre-feet per month between 2014 and 2017. Mean annual discharge at SW3208 in the northeastern (upstream) end of Fish Slough has declined from 90 acre-feet per month in 1990 to less than 10 acre-feet per month in 2017, a decrease of almost 90 percent. The origins of this decreased surface flow in Fish Slough are explored in more detail elsewhere in this GSP.

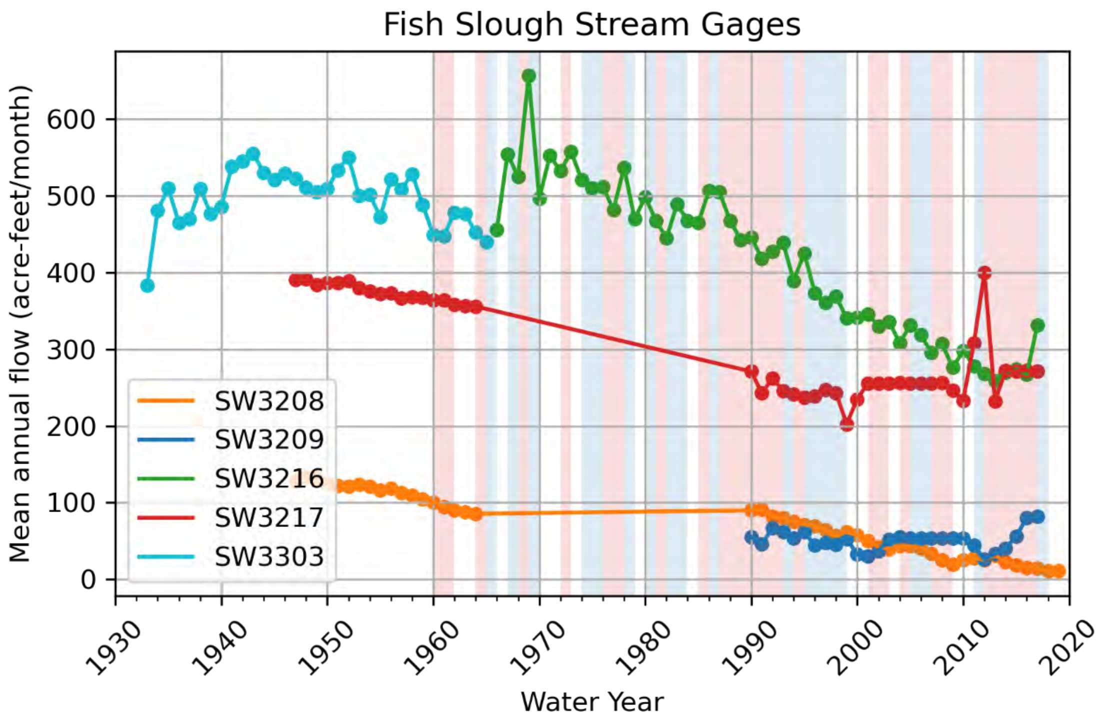

Figure 1.3-3. Mean annual surface water flows (acre-feet per month) for gages in Fish Slough. Red shading indicates dry years and blue indicates wet years.

Groundwater levels in the Fish Slough monitoring wells have also declined (see the Monitoring Plan and Data Gap Analysis Technical Appendix). Well FS2 has steadily declined with time and has dropped about 1 ft from 2000–2017 (with annual variability of 0.5–1 ft).

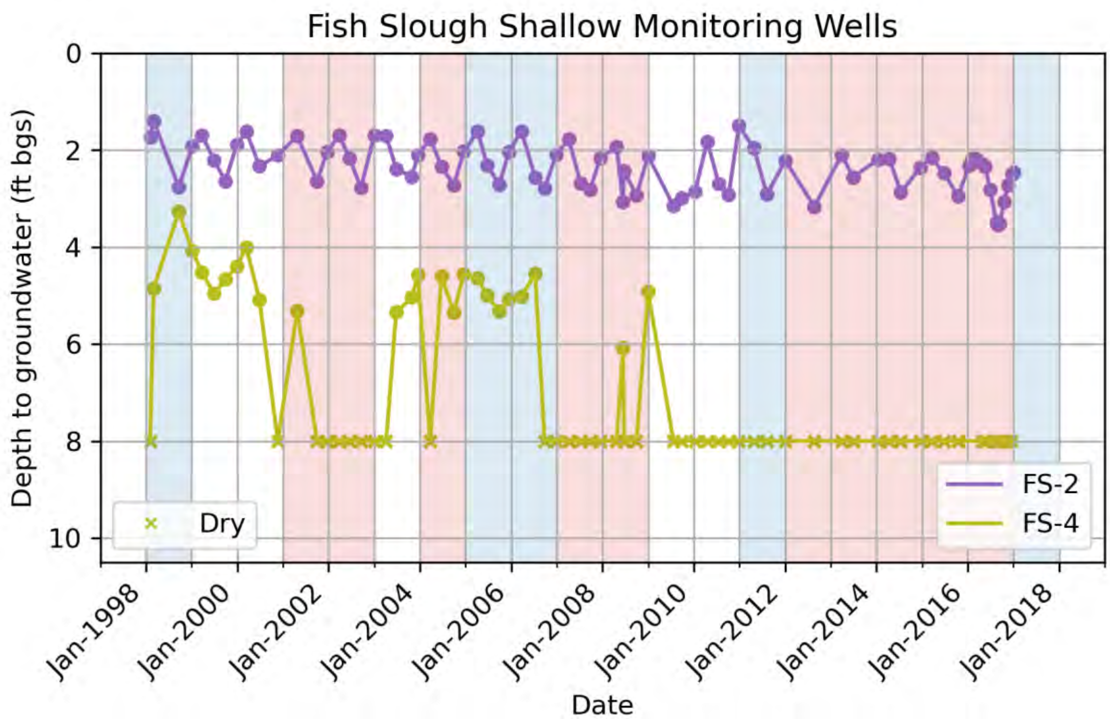

Figure 1.3-4. Changes in depth to groundwater in shallow Fish Slough monitoring wells. Red shading indicates dry years and blue indicates wet years.

1.3.5 Hydrology summary

The OVGA Assessment Area is extensive and shallow wells outside of the Adjudicated Area are uncommon. Nevertheless, we can make some generalizations about groundwater and interconnected surface water. Interconnected surface waters are likely absent in the Owens Valley management area. Groundwater flow models (e.g., Danskin 1998) and limited groundwater data outside the Adjudicated Area suggest that the tributaries are not interconnected with groundwater (except maybe at their extreme downstream ends, suggesting that they are unlikely to be connected upstream where the groundwater is typically deeper. The connection between groundwater and flowing surface water in the Owens Lake management area has not been assessed. Surface water releases to the lake are highly managed, but some groundwater wells suggest the lake, at least, is connected to shallow groundwater. There is no evidence of interconnected surface water in the Tri-Valley management area. Interconnected surface water is present in the Fish Slough management area and surface water flows have been declining for some time.

Groundwater levels in the Owens Valley management area generally rise and fall depending on recharge, with declining groundwater often occurring during droughts and rising groundwater occurring during wetter years. There is no evidence that groundwater is systematically falling, but shallow wells are relatively sparse and further investigation might be warranted if GDE health is declining. Similarly, groundwater levels have been steady in the Owens Lake management area, with short-term changes due to wet and dry years, but no discernable trend in groundwater elevation changes. Groundwater levels have been steadily declining in the Tri-Valley management area. Finally, groundwater elevation has been steadily dropping in the Fish Slough management area. Because surface flow in Fish Slough is almost entirely derived from groundwater, the declining groundwater elevations are linked to the observed decline in surface flows. The trends in interconnected surface water and groundwater in the four management areas are summarized in Table 1.3-1.

Table 1.3-1. Summary of groundwater and interconnected surface water in the OVGA Assessment Area.

Management area	Shallow groundwater change	Interconnected surface water change
Owens Valley	Stable, within baseline range	Not present
Owens Lake	Stable, within baseline range	Managed flows, Lake connects with shallow aquifer
Tri-Valley	Unknown, groundwater declining	No interconnected surface water present
Fish Slough	Declining	Declining

2 GDE IDENTIFICATION

In this section, we detail the information sources used, new information gathered, and methods applied to make determinations and to describe the conditions of GDEs identified in the OVGA Assessment Area. Methods established by Rohde et al. (2018) as well as the text of SGMA itself were used as primary guides.

2.1 Vegetation Communities

Potential GDE units in the Owens groundwater basin were identified using the California Department of Water Resources' (DWR) indicators of groundwater dependent ecosystems (iGDE) database. The database, which is published online and referred to as the Natural Communities Commonly Associated with Groundwater dataset (DWR 2020b), includes vegetation and wetland natural communities. These data were reviewed and augmented with additional vegetation mapping datasets to produce a revised map of GDEs; additional information on vegetation community composition, aerial imagery, depth to groundwater from local wells (where available), plant and species distributions in the area, plant species rooting depths, and local observations from Inyo County Water Department (ICWD 2020) were also reviewed to support this determination.

2.1.1 Data sources

This section includes brief descriptions of the vegetation community data and other information sources used to identify and aggregate potential GDEs into final GDE units.

The iGDE database (DWR 2020b) was reviewed in a geographic information system (GIS) and used to generate a preliminary map to serve as the primary basis for initial identification of potential GDEs. This dataset is a combination of the best available data obtained from publicly available sources and uses the following sources to identify potential GDEs in the Owens groundwater basin:

- Vegetation Classification and Mapping Program (VegCAMP), California Department of Fish and Wildlife

- Central Mojave Vegetation Database (United States Geologic Survey [USGS] 2002)
- Fish Slough (California Department of Fish and Wildlife [CDFW] 2014)
- Manzanar National Historic Site (United States National Park Service 2012)
- Classification and Assessment with Landsat of Visible Ecological Groupings (CalVeg) – United States Department of Agriculture - Forest Service (USDA 2014)
- Fire and Resource Assessment Program (FRAP) – California Department of Forestry and Fire Protection (CalFire 2015)
- National Wetlands Inventory - Version 2.0 (NWI v2.0), U.S. Fish and Wildlife Service (USFWS 2018)
- National Hydrography Dataset (NHD) – Springs and seeps, USGS (USGS 2016)

In addition to the sources identified by the iGDE database listed above, the final GDE map includes vegetation data from the following sources:

- Vegetation Classification and Mapping Program (VegCAMP), California Department of Fish and Wildlife
    - Vegetation Mapping and Classification of the Jawbone Canyon Region and Owens Valley (Menke et al. 2020)
- Delineation of Waters of the United States for the Owens Lake Playa (Jones and Stokes and Great Basin Unified Air Pollution Control District [GBUAPCD] 1996).

The extent of the integrated data sources is shown in Table 2.1-1 and Figure 2.1-1.

Table 2.1-1. Vegetation sources for Owens Valley GDE management areas.

Data source	Mapped area (acres)				
	Fish Slough	**Owens Lake**	**Owens Valley**	**Tri-Valley**	**Total**
Vegetation					
CalVeg	446	8,722	109,527	71,637	190,332
FRAP	-	11,446	377		11,822
VegCAMP – Fish Slough	2,497	-	153	177	2,827
VegCAMP – Mojave	-	21,277	1	-	21,279
VegCAMP – Jawbone Canyon Region and Owens Valley	-	128,850	74,113	-	202,963
Wetland					
GBUAPCD – Waters of the U.S.	-	160	1	-	161
NHD	-	3	7	4	14
NWI	-	32	608	20	661
Total[1]	**2,943**	**170,491**	**184,788**	**71,839**	**430,061**

[1] Totals may not appear to sum exactly due to rounding error.

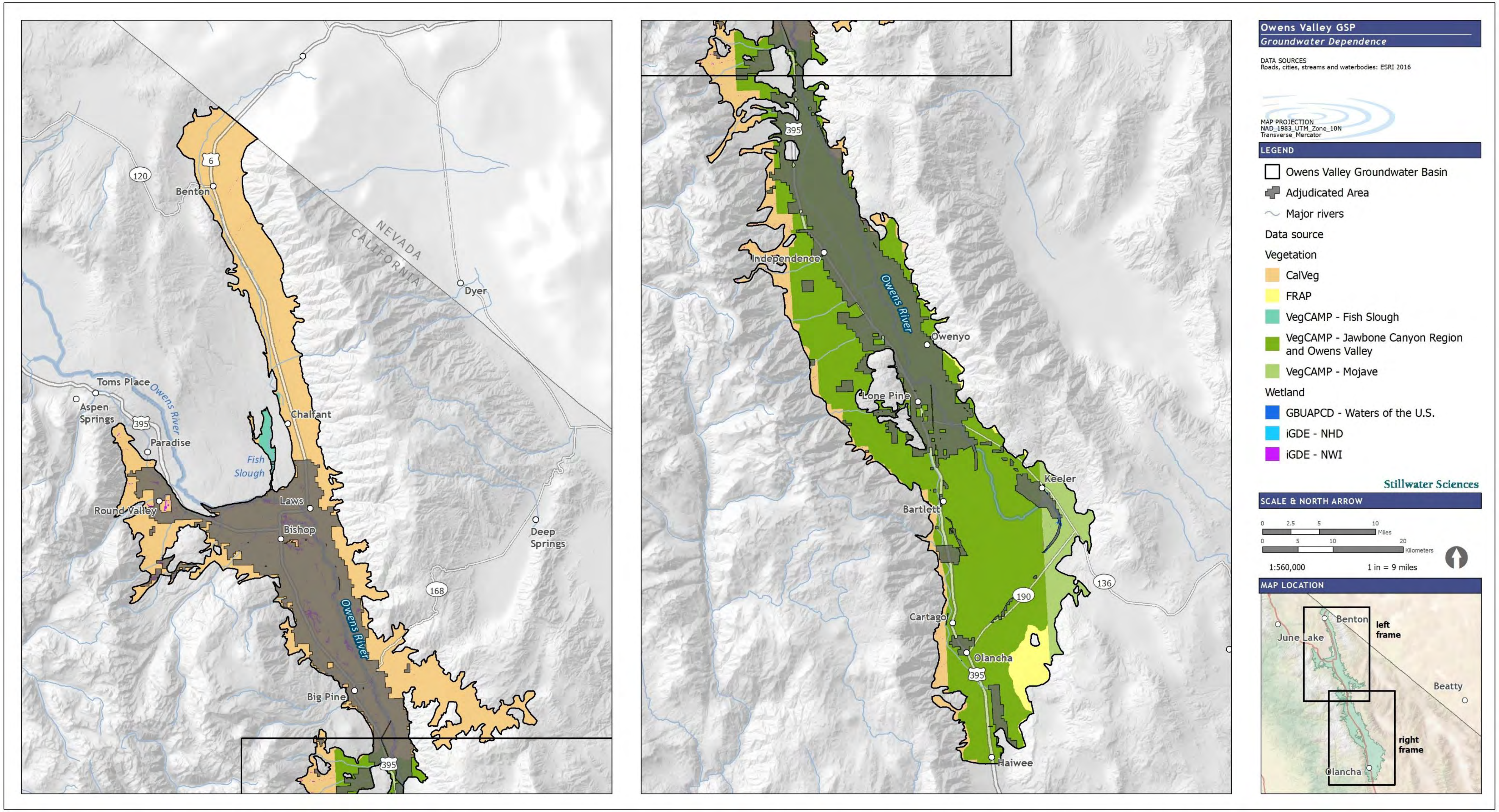

Figure 2.1-1. Wetland and vegetation data sources used for the final GDE map.

2.1.2 Procedure

Rohde et al. (2018) outline steps for defining and mapping GDEs and these were used as a guideline for this process. A decision tree was applied to determine when species or biological communities were considered groundwater dependent based on definitions found in SGMA and Rohde et al. (2018). This decision tree, created to systematically and consistently address the range of conditions encountered, is summarized below, where the term 'unit' refers to an area with consistent vegetation and hydrology:

The unit is a GDE if groundwater is likely:

1. An important hydrologic input to the unit during some time of the year, AND
2. Important to survival and/or natural history of inhabiting species, AND
3. Associated with:
    a. A regional aquifer used as a regionally important source of groundwater OR
    b. A perched/mounded unconfined aquifer.

The unit is not a GDE if its hydrologic regime is primarily controlled by:

1. Surface discharge or drainage from an upslope human-made structure(s), such as irrigation canal, irrigated fields, reservoir, cattle pond, water treatment pond/facility.
2. Precipitation inputs directly to the unit surface. This excludes vernal pools from being GDEs where units are hydrologically supplied by direct precipitation and very local shallow subsurface flows from the immediately surrounding area.

Rohde et al. (2018) recommend that maps of likely GDEs be compared with local groundwater elevations to determine where groundwater is within the rooting depth of potential GDEs. Given uncertainties in extrapolating well measurements to GDEs and differences in surface elevation of wells and GDEs, Rohde et al. (2018) recommend assigning GDE status to vegetation communities within 30 feet of the ground surface, or where interconnected surface waters are observed. This is not possible in the OVGA basin where groundwater data were relatively sparse outside of the adjudicated area. Instead, we follow Rohde et al. (2018) and rely on a combination of local expertise of ICWD and literature on groundwater dependence of plant communities in the Owens Valley as described above. The extensive history of studies of GDEs in the valley to manage LADWP's groundwater pumping had previously established the typical DTW ranges for plant communities that are unavailable elsewhere.

The additional vegetation community mapping data sources identified in Section 2.1.1 were combined in GIS to create a groundwater basin-wide vegetation map. Consistent with Klausmeyer et al. (2018), the most recent and highest resolution mapping was prioritized over earlier and coarser scale datasets. The datasets were prioritized in the following order, with the highest priority data sources listed first: VegCAMP (CDFW 2014, Menke et al. 2020, USGS 2002), CalVeg, Delineation of Waters of the United States for the Owens Lake Playa (Jones and Stokes and GBUAPCD 1996), and FRAP.

Finally, additional wetland mapping was incorporated where vegetation data were coarse and did not accurately capture wetland features. These additional wetland data sources were incorporated unilaterally across the selected vegetation data source and were chosen to represent the best available data for the extent of each vegetation data source. CalVeg and FRAP were supplemented with the iGDE wetland mapping (DWR 2020b) which is derived from the National Wetlands Inventory (USFWS 2018) and National Hydrography Dataset (USGS 2016). The

VegCAMP Mojave dataset was supplemented using the Delineation of Waters of the United States for the Owens Lake Playa. The Jawbone Canyon Region and Owens Valley and Fish Slough VegCAMP datasets were mapped to a scale that did not require supplemental wetland data.

2.1.3 Refine potential GDE map

To inform the assessment of GDE condition and potential effects (Sections 3 and 4), the basin-wide vegetation and wetland map was reviewed and each community was assigned a groundwater dependence category (i.e., unlikely, likely, certain). This determination was based on species composition and the groundwater dependency of dominant species, whether they were considered groundwater dependent either by the iGDE database (DWR 2020b) or by Mathie et al. in their review of phreatophytic vegetation in the Great Basin Ecoregion (Mathie et al. 2011), and wetland indicator status (Lichvar et al. 2016). Although Klausmeyer et al. (2018) includes species with upland facultative wetland indicator status (Lichvar et al. 2016) in their list of groundwater dependent mapping units, based on feedback from ICWD and the position of these upland facultative species on the landscape (i.e., at the top of alluvial fans on the fringe of the basin), these vegetation types were classified as unlikely to be groundwater dependent. Plant communities classified as certain GDEs would generally be expected to have greater water requirements than communities classified as likely GDEs. Section 3.1 discusses the vegetation communities that were identified as certain or likely to depend on groundwater.

In addition to the species-based groundwater dependency determination discussed above, a preliminary map with these determinations was reviewed by ICWD to help determine which vegetation communities included by the iGDE database (DWR 2020b) are likely to be GDEs in the Owens Valley based on the type of vegetation. ICWD has been assessing the groundwater dependence of plant species, primarily those found within the adjudicated area of the Owens Valley, since the 1980s (Inyo County/City of Los Angeles Technical Group 1990). The ICWD analysis focused on species composition (e.g., whether units contained phreatophytes) rather than the likelihood of groundwater connection. ICWD has extensive data linking groundwater depth and species occurrence (e.g., Manning 1997) as well as measurements of evapotranspiration (ET) using measurements of stomatal conductance (Steinwand et al. 2001) and eddy covariance (Steinwand et al. 2006). These ET measurements can be compared with measurements of local rainfall to determine the portion of the plants water needs are supplied by groundwater (Steinwand et al. 2006). As a result, ICWD has a strong local understanding of what plant species and vegetation communities are likely to be GDEs and those that are likely not connected to groundwater. ICWD's assessment and revisions were completed using the iGDE database, which identifies possible groundwater dependence areas based on Calveg, FRAP, and the Mojave and Fish Slough VegCAMP vegetation map sources. The Jawbone Canyon Region and Owens Valley map (Menke et al. 2020) was obtained after the ICWD review and predominantly replaced FRAP. ICWD's review of the FRAP data was used to inform the GDE determination of the Jawbone Canyon and Owens Valley map based on species composition and landscape position, but the size and location of the mapped polygons differed between the two map sources. Although models suggest that tributaries to the Owens Valley are disconnected from groundwater, potential GDEs along the tributaries were not removed due to uncertainty about their groundwater connection at their downstream ends and sparse groundwater data upstream.

Figure 2.1-2 shows the iGDEs database and the assessment by ICWD. ICWD removed 63.9% of the vegetation iGDEs originally identified by DWR (2020) (Table 2.1-2); ICWD's analysis did not address wetland data from the iGDE database. In the northern half of the OVGA Assessment Area, approximately 89% of the iGDEs identified using CalVeg as a map source were removed by ICWD. Nearly all (96% [~31,000 acres]) of the CalVeg iGDEs removed were Alkaline Mixed Scrub (Figure 2.1-2) which are primarily located on alluvial fans bordering the White/Inyo mountains (Figure 2.1-1). ICWD removed 30% of iGDEs mapped using FRAP as a data source; these were predominantly Alkali Desert Scrub (4,800 acres), which has a similar composition to the CalVeg Alkaline Mixed Scrub type. Together, these two iGDEs represent 90% of the vegetation removed by ICWD. The remaining vegetation removed from the GDE map were approximately 34% of the Iodine Bush-Bush Seepweed map units, 100% of the Alluvial Fan Scrub, and 100% of the Mid-Elevation Wash System vegetation unit (Figure 2.1-3). The ICWD analysis was used wherever the final assessment was based on CalVeg, FRAP, or VegCAMP (Mojave VegCAMP or Fish Slough).

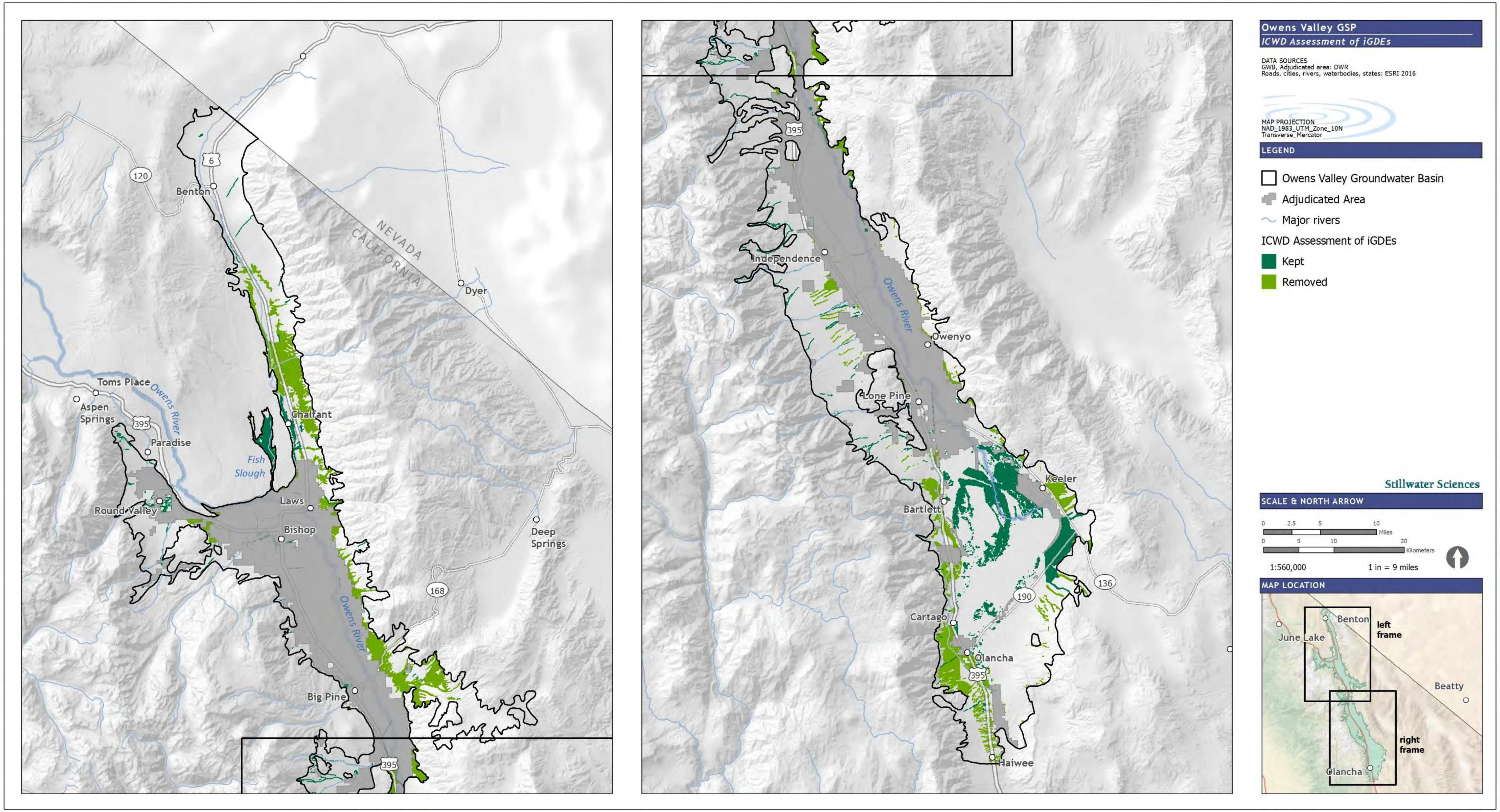

Figure 2.1-2. Revised iGDE map including vegetation polygons kept and removed by ICWD.

Table 2.1-2. Changes to the iGDE map based on ICWD recommendations.

Source	Initial area (acres)	After ICWD (acres)	Area removed (acres)	% removed
VegCamp (Fish Slough and Mojave)	9,917	6,959	2,958	29.8
CalVeg	35,718	4,033	31,685	88.7
FRAP	16,165	11,317	4,848	30.0
Total	**61,800**	**22,308**	**39,491**	**63.9**

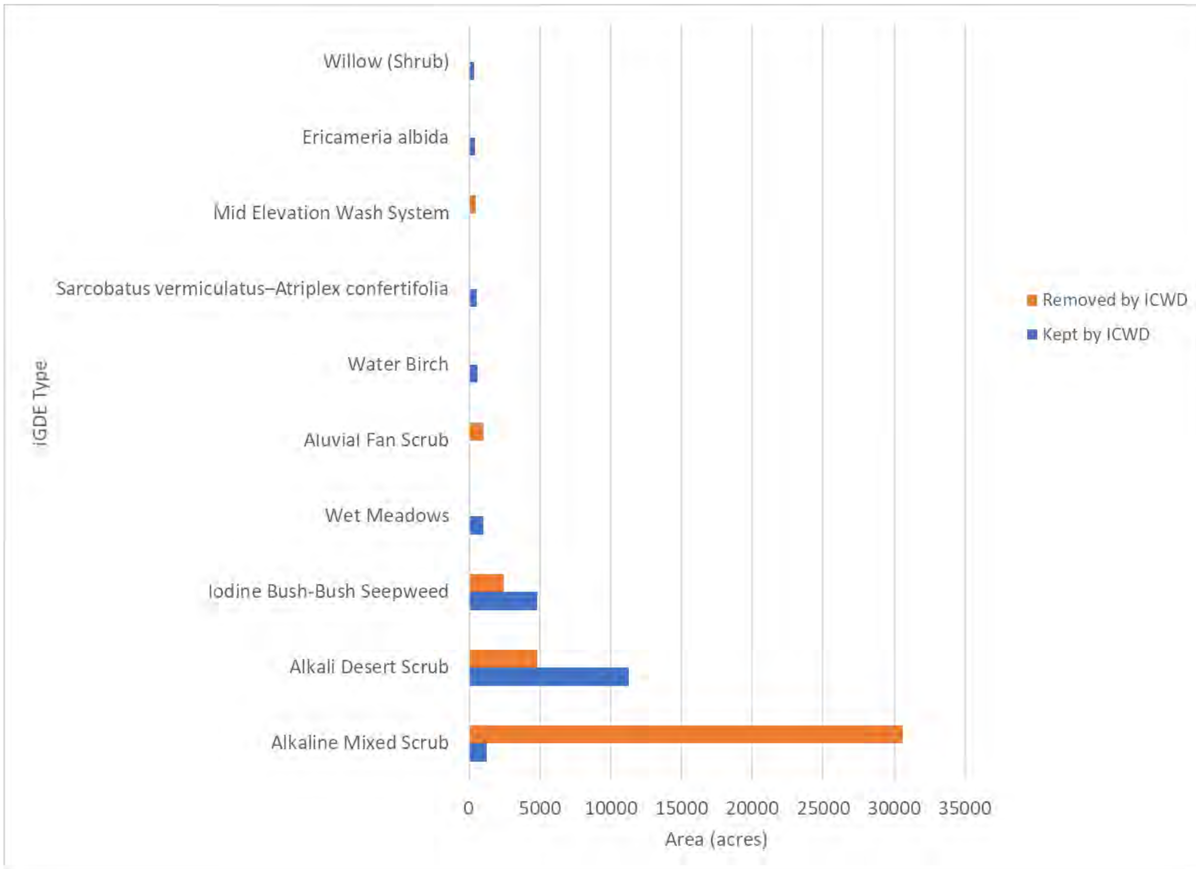

Figure 2.1-3. ICWD changes by vegetation type for the ten most extensive vegetation types in the iGDE database (DWR 2020). This database does not include Great Basin Wetlands mapping or the Jawbone Canyon Region and Owens Valley vegetation maps, which were obtained after ICWD's assessment.

2.2 Special-status Species

As part of the ecological inventory, special-status species, sensitive species, and ecological community types that are potentially associated with GDEs in the OVGA Assessment Area were identified. For the purposes of this memorandum, special-status species are defined as those:

- listed, proposed, or under review as endangered or threatened under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA);

- designated by CDFW as a Species of Special Concern;
- designated by CDFW as Fully Protected under the California Fish and Game Code (Sections 3511, 4700, 5050, and 5515);
- designated as Forest Service Sensitive according to the Regional Forester's Sensitive Species Management Guidelines listed per USFS Memorandum 2670 (USFS 2011);
- designated as Bureau of Land Management (BLM) sensitive;
- designated as rare under the California Native Plant Protection Act (CNPPA); and/or
- included on CDFW's most recent Special Vascular Plants, Bryophytes, and Lichens List (CDFW 2020a) with a California Rare Plant Rank (CRPR) of 1, 2, 3, or 4.

In addition, sensitive natural communities are defined as vegetation communities identified as critically imperiled (S1), imperiled (S2), or vulnerable (S3) on the most recent California Sensitive Natural Communities List (CDFW 2020b).

2.2.1 Data Sources

Stillwater ecologists queried existing databases on regional and local occurrences and spatial distributions of special-status species within the OVGA Assessment Area. Spatial database queries included potential GDEs plus a 0.5-mile buffer. Databases accessed include:

- California Natural Diversity Database (CNDDB) (CDFW 2019),
- California Native Plant Society (CNPS) Manual of California Vegetation (2019),
- eBird (2020), and
- the Nature Conservancy (TNC) freshwater species lists that were generated from the California Freshwater Species Database (CAFSD) (TNC 2019a).

2.2.2 Procedure

Stillwater reviewed the database query results and identified species and community types with the potential to occur within or be associated with the vegetation and aquatic communities in or immediately adjacent to the potential GDEs. Stillwater ecologists then consolidated a list of these special-status species and sensitive community types, along with summaries of habitat preferences, potential groundwater dependence, and reports of any known occurrences. Wildlife species were evaluated for potential groundwater dependence using determinations from the Critical Species Lookbook (Rohde et al. 2019) or by evaluating known habitat preferences, life histories, and diets. Species GDE associations were assigned one of three categories:

- Direct—species directly dependent on groundwater for some or all water needs (e.g., cottonwood with roots in groundwater, Owens pupfish in a spring-fed pool).
- Indirect—species dependent upon other species that rely on groundwater for some or all water needs (e.g., riparian birds).
- No known reliance on groundwater.

2.2.3 Refine potential use of GDE habitat

Database query results for local and regional occurrences were combined with known habitat requirements of identified special-status species to develop a list of groundwater dependent special-status species that satisfy the following criteria: (1) documented occurrence within the management area, or (2) known to occur in the region and suitable habitat is present in the GDE unit.

The special-status species evaluation for the OVGA Assessment Area included a large spatial area with diverse habitat types and numerous species. Data limitations during the scoping effort included: spatial data that were old or included non-specific locations for species sightings, limited information on habitat quality in the mapped GDEs, and lack of data on the species reliance of groundwater solely within the mapped GDE units or other waterbodies included in the adjacent adjudicated areas. To address these data limitations, special-status species monitoring is recommended, described in Section 6 GDE Monitoring.

3 GDE CONDITION

This section characterizes the Owens Lake, Owens Valley, Tri-Valley, and Fish Slough management areas based on its hydrologic and ecological conditions and assign a relative ecological value to the unit by evaluating its ecological assets and their vulnerability to changes in groundwater (Rohde et al. 2018).

3.1 Ecological Conditions

GDEs included terrestrial and aquatic habitat and other open water aquatic habitats (Table 3.1-1). The linkage between groundwater and surface water is not known for much of the OVGA Assessment Area (e.g., for many of the tributaries flowing over alluvial fans into the Owens Valley). We concentrated our interconnected surface water investigation on Fish Slough and parts of Owens Lake. Other tributaries were not included due to their position on the landscape and the depth of groundwater wells where the tributaries enter the Adjudicated Area. It is possible that interconnected surface waters may occur in the Tri-Valley area and the fringes of Adjudicated Area, but data to support this analysis was not available and it should be investigated during the 5-year update. Waterbodies like springs and sloughs that are directly fed by groundwater are considered a component of GDEs that are defined more broadly by vegetation community classification.

Table 3.1-1. Extent of GDEs by management area.

Management area	Owens Valley	Owens Lake	Tri-Valley	Fish Slough	Total
Total Area (acres)	184,788	170,491	71,839	2,943	**430,061**
GDE extent (acres)	6,115	46,129	1,033	2,191	**55,468**
Percent of area composed of GDEs (%)	3.3	27.1	1.4	74.4	**12.9**

The GDE determination (certain, likely, unlikely) is shown in Figure 3.1-1 and the final GDE map by management area is shown in Figure 3.1-2.

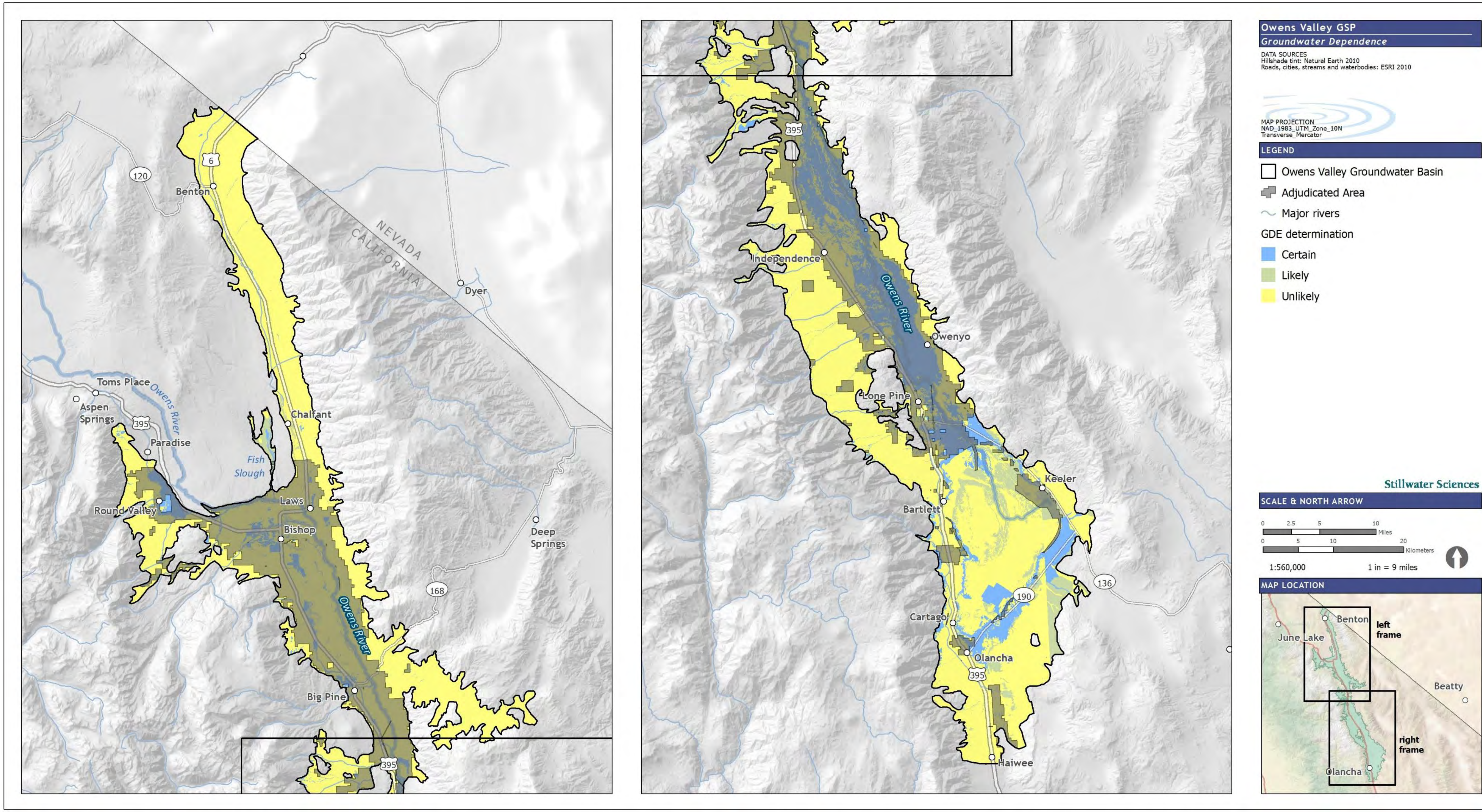

Figure 3.1-1. Final GDE determination based on the methods outlined in Section 2.2.

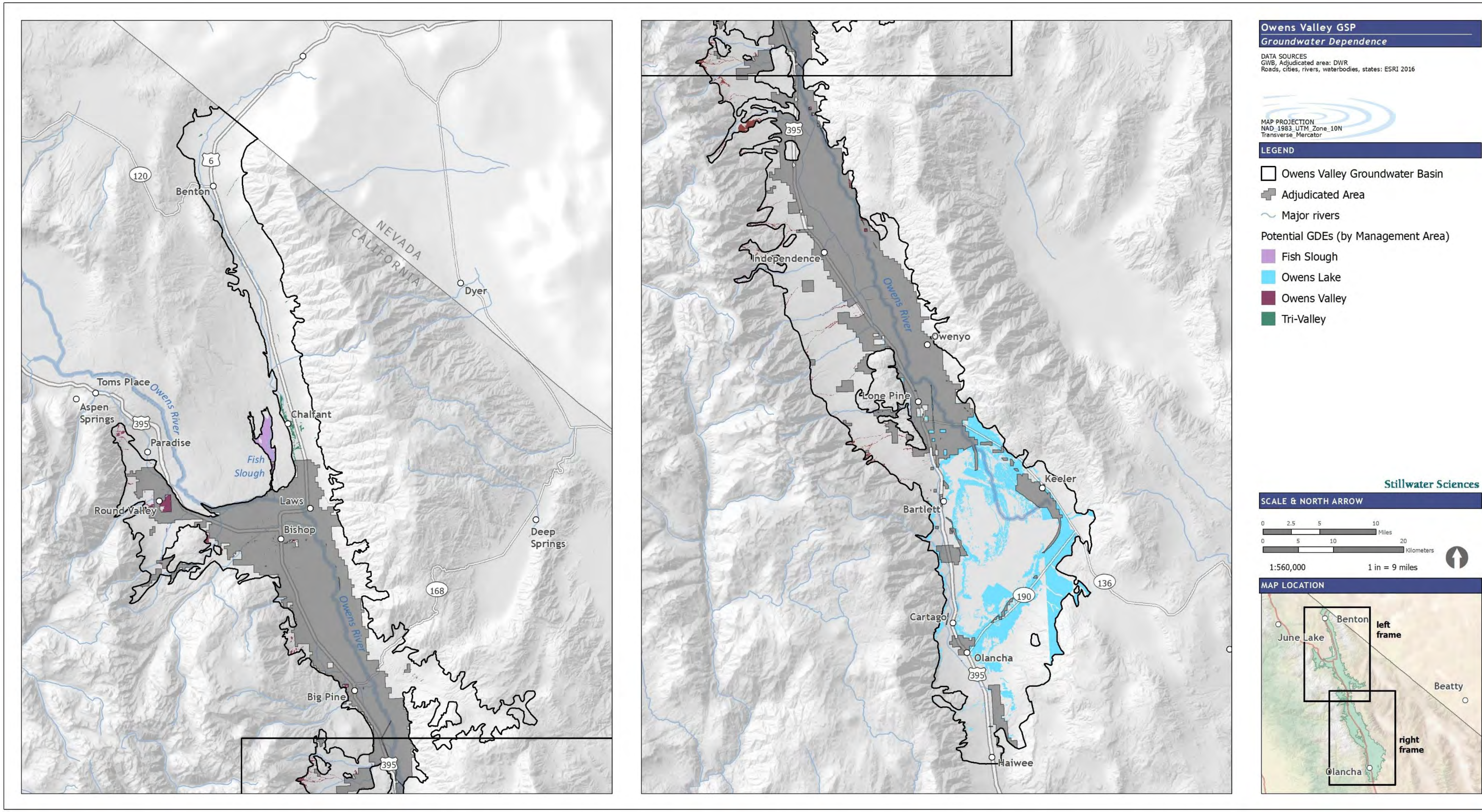

Figure 3.1-2. Potential GDEs identified by management area.

3.1.1 Vegetation communities and GDE habitats

3.1.1.2 Owens Valley

The Owens Valley management area covers 43% of the OVGA Assessment Area and has 11% of the total GDE acreage across the entire area. It contains 6,115 acres of mapped GDEs which compose 3.3% of the total area of the unit. The most prevalent vegetation community is the shrub willow alliance which makes up 18.8% of all mapped GDEs in the unit; other dominant communities include wet meadow, willow, riparian mixed hardwood, Freemont cottonwood, and water birch alliances (Figure 3.1-3). These dominant vegetation communities are associated with riparian zones along perennial drainages located predominantly on the west side of Owens Valley draining the eastern slopes of the Sierra Nevada. Based on the data available, it is not clear if vegetation along tributaries to the Owens River (e.g., much of the water birch alliance and Fremont cottonwood alliance) are connected to groundwater, and this connection should be explored during the 5-year update.

Aquatic habitat within the Owens Valley management area mapped GDEs includes: seasonally flooded wetlands (307 acres), wet meadows (1,083 acres), riverine (73.2 acres), tule-cattail dominated waterbodies (17.6 acres), and seeps and springs (7.2 acres) (USDA 2008, 2009, 2014; USGS 2016; USFWS 2018) (Appendix A). These waterbodies include riparian habitat (e.g., cottonwood, willow, and alders) (Appendix A). Terrestrial habitat within the mapped GDEs include: sparsely vegetated playa (11 acres), alkaline mixed scrub (131 acres), irrigated pastures (27.6 acres), and grassland (12 acres) (USDA 2008,2009, 2014; Menke et al. 2020) (Appendix A).

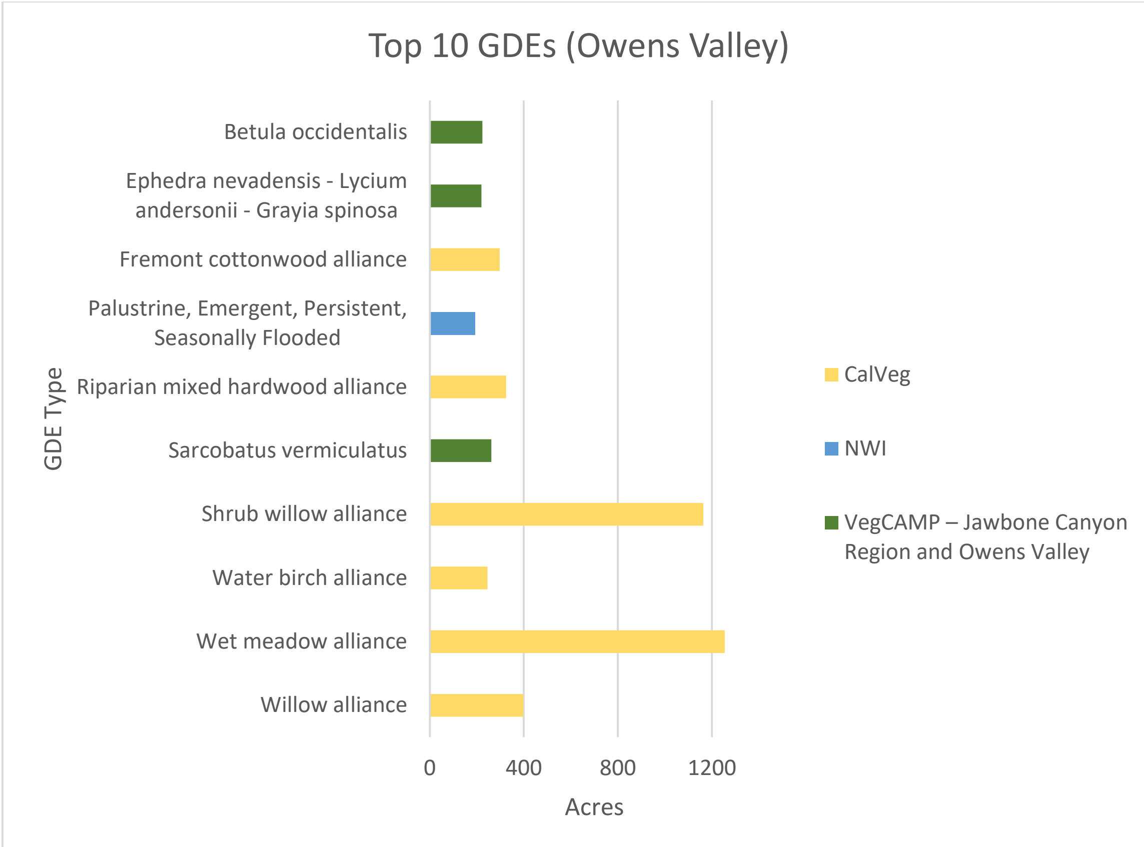

Figure 3.1-3. Ten most common GDEs within the Owens Valley Management area, by source.

3.1.1.3 Owens Lake

The Owens Lake management area covers 40% of the OVGA Assessment Area and has 83% of the total GDE acreage across the entire area. It contains 46,129 acres of mapped GDEs which compose 27.1% of the total area of the unit (Table 3.1-3). The most prevalent vegetation community is *Sarcobatus vermiculatus* (black greasewood) which makes up 22.9% of all mapped GDEs in the unit; other dominant communities include sparsely vegetated playa (ephemeral annuals), *Distichlis spicata* (salt grass), and iodine bush-bush seepweed (Figure 3.1-4). These dominant vegetation communities are tolerant of the alkaline conditions and predominantly occur in the sediments deposited by Owens Lake and surrounding areas.

Historically Owens Lake was a 70,400-acre saline lake until water exports dried up the main body of the lake by 1926 (Orme and Orme 2008). The bed of Owens Lake remains predominantly dry and the wetted area has been reduced to 75% of its historic area (LADWP 2010). Aquatic habitats within the Owens Lake management area are created by groundwater discharge onto the lakebed, surface water flows across the lakebed, and the implementation of water-based dust control measures (LADWP 2010). Aquatic habitat within the Owens Lake management area includes water impoundments (166 acres), wetlands (158 acres), tule-cattail dominated waterbodies (235 acres), wet meadow (13.6 acres), riverine (8 acres), springs and seeps (2.5 acres), and canals (0.1 acre) (USGS 2016; USDA 2008, 2009, 2014; Jones and Stokes and GBUAPCD 1996; USGS 2016; USFWS 2018) (Appendix A). Riparian habitat includes cottonwoods, willows, and emergent plants (Appendix A). Salinity in aquatic habitats range from freshwater to hypersaline.

Terrestrial habitat within the mapped GDEs includes sparsely vegetated playa (5,479 acres), alkaline mixed scrub (783 acres), montane riparian (18.7 acres), and grassland (22.2 acres) (USDA 2008, 2009, 2014; CalFire 2015; Menke et. Al. 2020) (Appendix A).

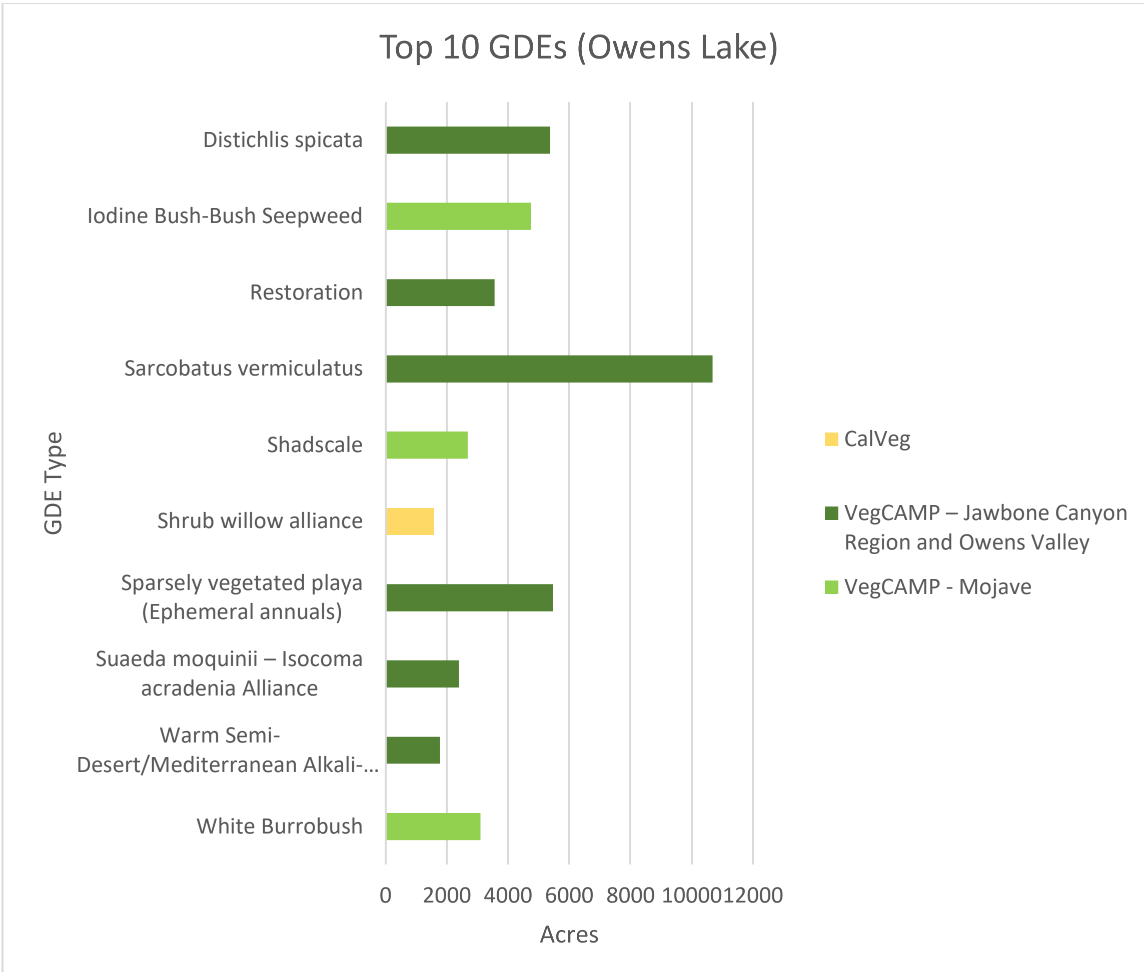

Figure 3.1-4. Ten most common GDEs within the Owens Lake management area, by source.

3.1.1.4 Tri-Valley

The Tri-Valley management area covers 17% of the OVGA Assessment Area and has 2% of the total GDE acreage across the entire area. It contains 1,033 acres of likely GDEs, which cover 1.4% of the Tri Valley Area. These GDEs include alkaline mixed scrub alliance which makes up 75.8% of all mapped GDEs in the unit (Figure 3.1-5) and occur at the alluvial fan front located along tributaries to the valleys and shrub willow alliance along tributaries to the valley and wet meadows along the distal edge of fans.

Tri-Valley management area contains the smallest acreage of aquatic habitat within OVGA Assessment. Groundwater dependent aquatic habitats within mapped GDEs include the following: wet meadow (113 acre), seep or springs (4.1 acres), riverine (1.4 acres), and seasonally flooded wetlands (14.2 acres) (USGS 2016, USFWS 2018) (Appendix A). Riparian habitat includes willows and cottonwoods. Terrestrial habitat within the mapped GDEs include: alkaline mixed scrub (783 acres) (USDA 2008, 20092014) (Appendix A).

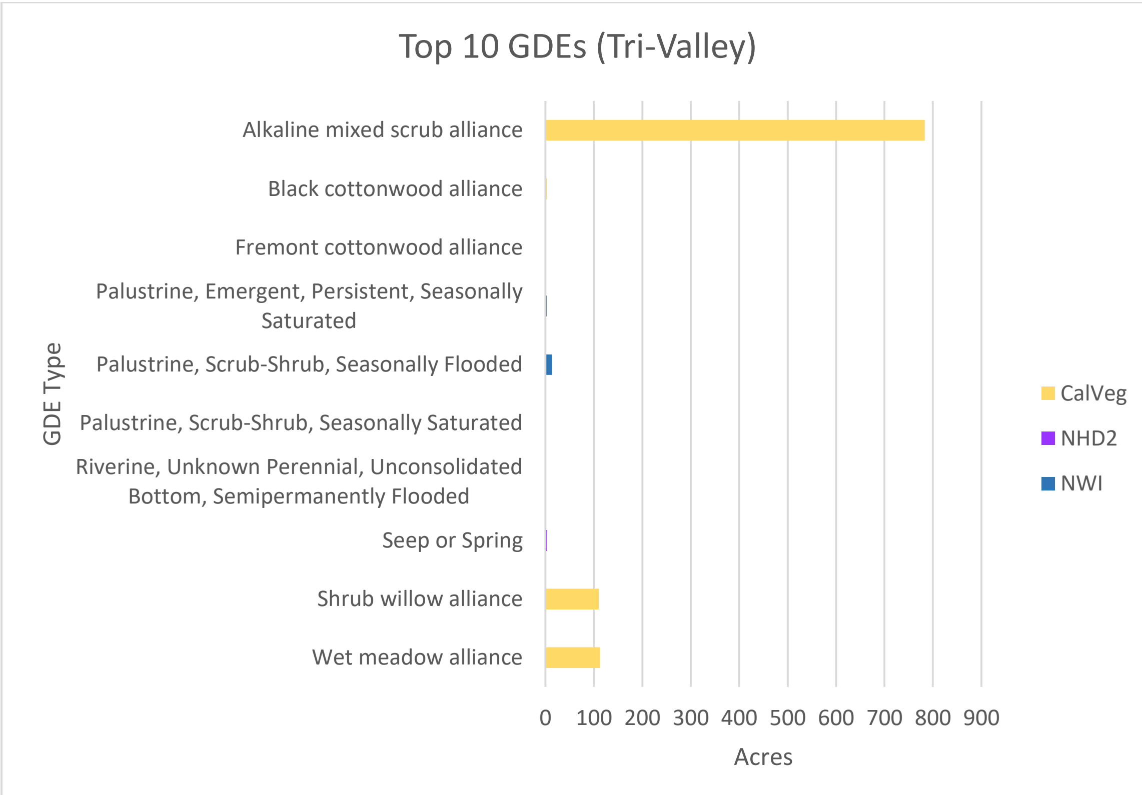

Figure 3.1-5. Ten most common GDEs within the Tri-Valley management area, by source.

3.1.1.5 Fish Slough

The Fish Slough management area covers 1% of the OVGA Assessment Area and has 4% of the total GDE acreage across the entire area. It contains 2,191 acres of mapped GDEs which compose 74.4% of the total area of the unit. Fish Slough is a spring-fed wetland complex and as such much of the vegetation present is groundwater dependent. The most prevalent vegetation communities are alkaline mixed scrub and greasewood which each make up 26.2% of all mapped GDEs in the unit; other dominant communities included alkaline mixed grasses and forbs, tule-cattail, alkaline mixed scrub and rabbitbrush (Figure 3.1-6). Many of the dominant vegetation communities are tolerant of the alkaline conditions present.

Fish Slough is a spring-complex with interconnected surface water that is primarily sourced from groundwater, either directly through spring discharge or the shallow water table. Aquatic habitats within the Fish Slough management area mapped GDEs include open-water channel habitat (9.6 acres) and tule-cattail dominated waterbodies (276 acres) (CDFW 2014) (Appendix A). Riparian habitat includes willows and cottonwood (Appendix A). Terrestrial habitats within the mapped GDEs include alkaline mixed scrub (574 acres) and alkaline mixed grasses and forbs (CDFW 2014) (Appendix A).

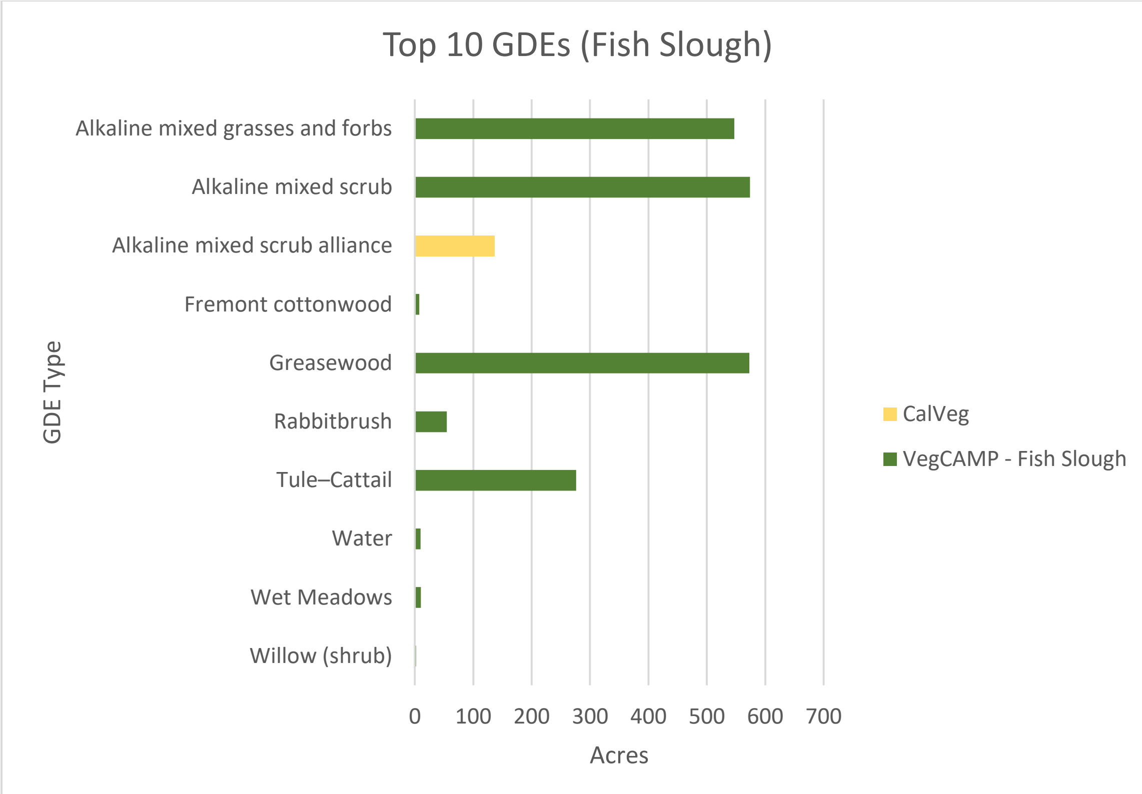

Figure 3.1-6. Ten most common GDEs within the Fish Slough management area, by source.

3.1.2 Beneficial uses

The Water Quality Control Plan (Basin Plan) for the Lahontan Region (Lahontan RWQCB 2016) identifies the surface waters in the management areas as having a variety of beneficial uses pertaining to fish, wildlife, and GDEs. Most of these beneficial uses apply to aquatic features that are fed by groundwater such as Fish Slough and Owens Lake. The beneficial uses for aquatic features in the Owens Hydrologic Unit vary and include:

- Freshwater replenishment (FRSH);
- Warm freshwater habitat (WARM);
- Cold freshwater habitat (COLD);
- Wildlife habitat (WILD);
- Preservation of biological habitats of special significance (BIOL);
- Support of habitat for rare, threatened, or endangered species (RARE);
- Aquatic organism migration habitat (MIGR); and
- Aquatic spawning habitat (SPWN).

Beneficial uses include those that directly benefit groundwater conditions (e.g., groundwater recharge [GWR]) and those supported directly by groundwater via interconnected surface waters (e.g., freshwater replenishment [FRSH]; support of rare, threatened, or endangered species [RARE]).

3.1.3 Special-status species

The Owens Valley Basin is ecologically diverse and includes numerous species that are groundwater dependent. Within the four management areas, 36 special-status terrestrial and aquatic wildlife species were identified as indirectly or directly groundwater dependent (Table 3.1-2). Species endemic to Owens Valley that are likely to be found within one or more of the management areas include: Owens pupfish (*Cyprinodon radiosus*), Owens tui chub (*Siphateles bicolor snyderi*), Owens speckled dace (*Rhinichthys osculus ssp*), Owens Valley vole (*Microtus californicus vallicola*), and Owens Valley springsnail (*Pyrgulopsis owensensis*). Appendix B provides additional information on special-status terrestrial and aquatic animal species that may occur in the OVGA Assessment Area, including regulatory status, habitat associations, and likelihood to occur in management areas. In addition, 25 special-status plant species were documented within the Owens Valley Basin, 18 of which are identified as certain or likely to be dependent on groundwater. Table 3.1-3 lists the special-status plant species and natural communities with known occurrence in GDEs.

Owens Valley, Owens Lake, and Fish Slough management areas overlap with USFWS-designated critical habitat for four federally listed species: Fish Slough milk-vetch (*Astragalus lentiginosus* var. *piscinensis*), Sierra Nevada bighorn sheep (*Ovis canadensis sierrae*), Sierra Nevada yellow-legged frog (*Rana sierrae*), and yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (USFWS 2005, USFWS 2008, USFWS 2016, USFWS 2020). The acreage of critical habitat for each species within the Owens Valley, Owens Lake, Tri-Valley, and Fish Slough management areas are summarized in **Error! Reference source not found.**.1-4 and shown in Figure 3.1-7. The Sierra Nevada bighorn sheep critical habitat occurs along the western margin of the OVGA basin. The Sierra Nevada yellow-legged frog critical habitat occurs in the fringe of the basin along Independence Creek are primarily located on the fringe of the OVGA area.

Habitat management and special-status species recovery plans have been implemented in the Owens Valley Basin and include protections for special-status species and associated habitats. These plans include *Owens Basin Wetland and Aquatic Species Recovery Plan Inyo and Mono Counties, California* (USFWS 1998), *Owens Lake Habitat Management Plan* (LADWP 2010), *Owens Valley Land Management Plan* (LADWP and Ecosystem Sciences 2010), and the *LADWP Habitat Conservation Plan* (LADWP 2015).

Table 3.1-2. Dependence on groundwater for special-status terrestrial and aquatic animal species documented to occur in the management areas.

Common name (*Scientific name*)	Documented to occur and dependence on groundwater in each management area			
	Owens Valley	Owens Lake	Tri-Valley	Fish Slough
Mammals				
Long-legged myotis (*Myotis Volans)*	I	I		
Mohave ground squirrel (*Xerospermophilus mohavensis)*		I		
Owens Valley vole (*Microtus californicus vallicola)*	I	I	I	I
Sierra Nevada bighorn sheep (*Ovis canadensis sierrae)*	I, CH	I, CH		
Sierra Nevada red fox (*Vulpes vulpes necátor)*	I			
Spotted bat (*Euderma maculatum)*	I	I		
Townsend's big-eared bat (*Corynorhinus townsendii)*	I	I		I
Western small-footed myotis (*Myotis ciliolabrum)*	I			
Yuma myotis (*Myotis yumanensis)*		I		
Birds				
American white Pelican (*Pelecanus erythrorhynchos)*	I	I		I
Bald eagle **(***Haliaeetus leucocephalus)*	I	I	I	
Bank swallow (*Riparia riparia)*	I	I	I	I
Black tern (*Chlidonias niger)*	I	I		I
Least bittern (*Ixobrychus exilis)*	I	I		
Long-eared owl (*Asio otus)*	I	I	I	I
Lucy's warbler (*Oreothlypis luciae)*	I	I		I
Northern harrier (*Circus hudsonius)*	I	I	I	I
Redhead (*Aythya americana)*	I	I		I
Southwestern willow flycatcher (*Empidonax traillii extimus)*	I			I
Summer tanager (*Piranga rubra)*	I	I		
Swainson's hawk (*Buteo swainsoni)*	I	I	I	I
Western snowy plover (*Charadrius alexandrinus nivosus)*	I	I		
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis)*	I, CH			
Yellow-breasted chat (*Icteria virens)*	I	I		I
Yellow-headed blackbird (*Xanthocephalus xanthocephalus)*	I	I		I
Reptiles				
Desert tortoise (*Gopherus agassizii)*	I	I		
Panamint alligator lizard (*Elgaria panamintina)*	I			I
Amphibians				
Inyo Mountains slender salamander (*Batrachoseps campi)*	D	D		
Sierra Nevada yellow-legged frog (*Rana sierrae)*	D, CH			
Fish				
Owens pupfish (*Cyprinodon radiosus)*		D		D
Owens tui chub (*Siphateles bicolor snyderi*)		D		
Owens speckled dace (*Rhinichthys osculus ssp.)*				D
Mollusks				
California floater (*Anodonta californiensis)*	D			
Owens Valley springsnail (*Pyrgulopsis owensensis)*	D		D	D
Wong's springsnail (*Pyrgulopsis wongi)*	D	D	D	D
Insects				
San Emigdio blue butterfly (*Plebulina emigdionis)*		I		

See Appendix B, Table B-1 for additional details included federal/state status, query sources, habitat, and references.
D=**Direct**: Species directly dependent on groundwater for some or all water needs
I=**Indirect:** Species dependent upon other species that rely on groundwater for some or water needs
CH=USFWS-designated critical habitat occurs in management area

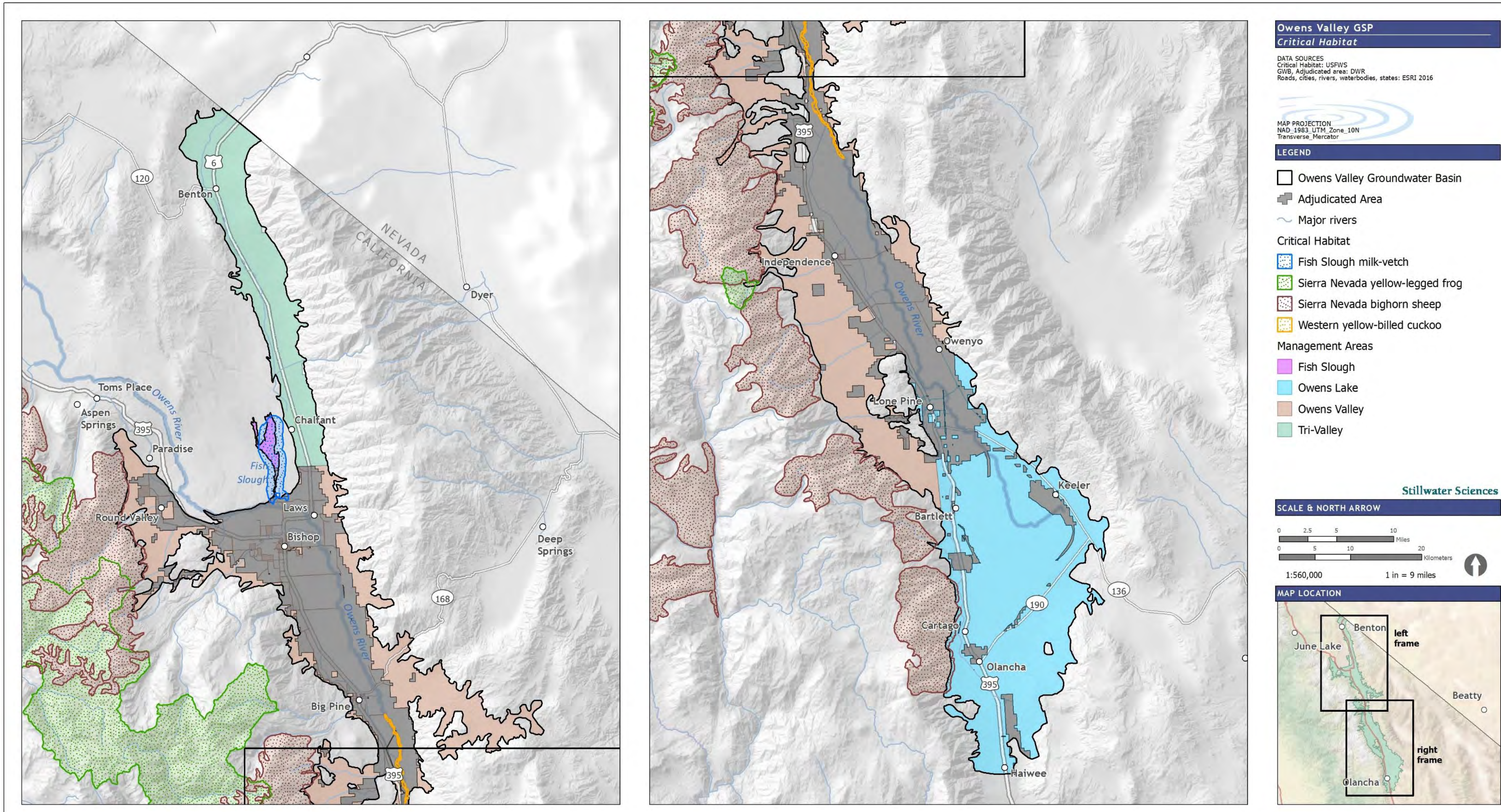

Figure 3.1-7. USFWS critical habitat and management areas within the OVGA Assessment Area.

Table 3.1-3. Special-status plant species and natural communities with known occurrence in management areas in the OVGA Assessment Area.

Common name *Scientific name*	Status[1]	Association with GDE	Occurrence location[2]	Source	Habitat and occurrence
Plants					
Silver-leaved milk-vetch *Astragalus argophyllus* var. *argophyllus*	2B.2, S2, G5T4, not state or federally listed	Certain	FS, TV	CNDDB	Alkaline or saline meadows, seeps, and playas; CNDDB observations in alkaline meadow southwest of Fish Slough source spring.
Horn's milk-vetch *Astragalus hornii* var. *hornii*	1B.1, S1, G4G5T1T2, not state or federally listed	Likely	Vicinity	CNDDB	Lake margins, wetland-riparian, alkaline meadows and seeps; last reported in area along Owens River in 1919.
Fish Slough milk-vetch *Astragalus lentiginosus* var. *piscinensis*	1B.1, S1, G5T1, FT	Certain	OV, FS, TV	CNDDB	Alkali sinks, playas, wetland-riparian; CNDDB sightings in shallow swales on alkali flats surrounding Fish Slough.
Shockley's milk-vetch *Astragalus serenoi* var. *shockleyi*	2B.2, S2, G4T3, not state or federally listed	Unlikely	OV	CNDDB	Sagebrush and shadscale scrub, pinyon-juniper woodland, found on alkaline soils; CNDDB occurrences along open washes and in sagebrush scrub in Owens Valley.
Hillman's silverscale *Atriplex argentea* var. *hillmanii*	2B.2, S2, G5T4, not state or federally listed	Likely	TV	CNDDB	Alkaline meadows and seeps, Great Basin scrub, saline or clay valley bottoms; two CNDDB observations in Owens Valley.
Falcate saltbush *Atriplex gardneri* var. *falcata*	2B.2, S2S3, G4T4Q, not state or federally listed	Unlikely	OV	CNDDB	Sagebrush and chenopod scrub, generally on alkaline soils; one CNDDB record in Owens Valley in 1974.
Inyo County star-tulip *Calochortus excavates*	1B.1, S2, G2, not state or federally listed	Certain	FS, OL, OV, TV	CNDDB	Alkaline meadows and seeps, mesic chenopod scrub; 58 regional CNDDB sightings in alkaline meadows.
Liddon's sedge *Carex petasata*	2B.3, S3, G5, not state or federally listed	Likely	OV	CNDDB	Broadleafed upland forest, lower montane coniferous forest, dry to wet meadows, seeps, pinyon and juniper woodland; single regional sighting in rocky stream margin.
Wheeler's dune-broom *Chaetadelpha wheeleri*	2B.2, S2, G4, not state or federally listed	Unlikely	TV	CNDDB	Sand dunes, alkali flats, creosote-bush and sagebrush scrub; last reported in area in 1938.
Fiddleleaf hawksbeard *Crepis runcinata*	2B.2, S3, G5, not state or federally listed	Likely	FS, OV, TV	CNDDB	Sagebrush scrub, pinyon and juniper woodland, wetland-riparian, alkaline seeps; all regional occurrences in alkaline meadows.

Common name *Scientific name*	**Status[1]**	**Association with GDE**	**Occurrence location[2]**	**Source**	**Habitat and occurrence**
Mojave tarplant *Deinandra mohavensis*	1B.3, S2, G2, SE	Unlikely	OL	CNDDB	Riparian and moist sites, openings in chaparral, desert scrub, woodland; single record from 2001 of approximately 200 individuals in swale in southwestern end of Owens Valley.
Parry's monkeyflower *Diplacus parryi*	2B.3, S3, G4G5, not state or federally listed	Unlikely	OV	CNDDB	Steep hillsides, along washes; previous sightings on slopes/washes near Highway 168.
Limestone monkeyflower *Erythranthe calcicola*	1B.3, S3, G3, not state or federally listed	Unlikely	OV	CNDDB	Disturbed areas along small streams, generally granitic soils; one previous record on limestone slope in Inyo Mountains.
Hot springs fimbristylis *Fimbristylis thermalis*	2B.2, S1S2, G4, not state or federally listed	Certain	FS, OV	CNDDB	Mineralized soils near hot springs and in seepage meadows; occurrences near Fish Slough and along eastern and western edges of Owens Valley.
Alkali ivesia *Ivesia kingii* var. *kingii*	2B.2, S2, G4T3Q, not state or federally listed	Likely	FS, OV	CNDDB	Meadows and seeps, playas, sagebrush scrub, alkali sink; previous sightings on alkaline soils near Fish Slough and along eastern edge of Owens Valley.
Small-flowered grass-of-Parnassus *Parnassia parviflora*	2B.2, S2, G5?, not state or federally listed	Certain	OV	CNDDB	Rocky seeps, mesic meadows; one previous CNDDB record on moist meadow slope at an elevation of approximately 7,600 feet.
Inyo phacelia *Phacelia inyoensis*	1B.2, S3, G3, not state or federally listed	Certain	FS, OV	CNDDB	Alkaline meadow margins, seeps in desert scrub; previous CNDDB records on alkaline meadows/scrub
Parish's popcornflower *Plagiobothyrys parishii*	1B.1, S1, G1, not state or federally listed	Certain	OL, OV, TV	CNDDB	Alkaline, mesic habitat in Great Basin scrub, desert springs, mud flats; most previous CNDDB observations in mesic areas and/or on alkaline soils in Owens Valley.
Narrow-leaved cottonwood *Populus angustifolia*	2B.2, S2, G5, not state or federally listed	Certain	OV	CNDDB	Riparian and wetland; one CNDDB record from riparian corridor along Division Creek.
Frog's-bit buttercup *Ranunculus hydrocharoides*	2B.1, S1, G4, not state or federally listed	Certain	OV	CNDDB	Freshwater marshes and swamps; two previous records within stream channels in Owens Valley.
Bailey's greasewood *Sarcobatus baileyi*	2B.3, S1, G4, not state or federally listed	Unlikely	OL	CNDDB	Alkaline soils, dry lakes, washes, scrub, roadside; single CNDDB record in upland desert scrub south of Owens Lake.

Common name *Scientific name*	Status[1]	Association with GDE	Occurrence location[2]	Source	Habitat and occurrence
Owens Valley checkerbloom *Sidalcea covillei*	1B.1, S2, G2, SE	Certain	OL, OV	CNDDB	Chenopod scrub, alkaline flats, meadows and seeps; many observations in alkaline meadows in Owens Valley.
Prairie wedge grass *Sphenopholis obtusata*	2B.2, S2, G5, not state or federally listed	Certain	OV	CNDDB	Mesic cismontane woodlands, meadows and seeps, streambanks, ponds; two reported sightings in wetlands in Owens Valley.
Western seablite *Suaeda occidentalis*	2B.3, S2, G5, not state or federally listed	Likely	OV	CNDDB	Saline or alkaline wetlands, mesic alkaline Great Basin scrub; single record on saline playa in Owens Valley.
Foxtail thelypodium *Thelypodium integrifolium* ssp. *complanatum*	2B.2, S2, G5T4T5, not state or federally listed	Likely	FS, OV	CNDDB	Alkaline or subalkaline, mesic Great Basin scrub, meadows and seeps; observations on moist and alkaline soils near Fish Slough and in Owens Valley.
Sensitive Natural Communities[2]					
Alkali cordgrass *Spartina gracilis*	S1, not globally ranked	Likely	OV	VegCAMP	Moist, poorly drained, alkaline areas along streams, alluvial flats, swales, meadows, and ponds; occur primarily in Mono and Inyo counties in eastern California.
Alkali meadow	S2.1, G3	Certain	OV	CNDDB	Moist, alkaline soils in valley bottoms and on lower portions of alluvial slopes; occur east of the Cascades and Sierra Nevada.
Alkali sacaton *Sporobolus airoides*	S2, not globally ranked	Certain	FS, OL, OV	VegCAMP	Moist, poorly drained, alkaline areas along streams, alluvial flats, swales, meadows, and ponds; occur throughout much of southern and Central California, including the Central Valley, Mojave Desert, and Great Basin.
Alkali seep	S2.1, G3	Certain	OV	CNDDB	Permanently moist or wet alkaline seeps; scattered throughout desert regions of California.
American bulrush marsh *Schoenoplectus americanus* herbaceous alliance	S3.2, G5	Certain	OL, OV	VegCAMP	Stream banks, pond and lake shores, sloughs, swamps, fresh and brackish marshes, and roadside ditches on poorly aerated soils with high organic content; occur in the Mojave and Sonoran deserts, the Sacramento-San Joaquin Delta, the Owens and Central valleys, and the Modoc Plateau.
Aspen groves *Populus tremuloides*	S3, G5	Certain	OL, OV	CALVEG	Depressions, swales, slopes, meadow margins, and elevated stream terraces; occur in the Sierra Nevada, Cascades, Klamath

Common name ***Scientific name***	**Status[1]**	**Association with GDE**	**Occurrence location[2]**	**Source**	**Habitat and occurrence**
forest and woodland alliance					Mountains, and Modoc Plateau.
Black cottonwood forest and woodland *Populus trichocarpa* forest and woodland alliance	S3, G5	Certain	OL, OV	CALVEG, VegCAMP	Seasonally flooded and permanently saturated soils on stream banks and alluvial terraces; occur throughout much of California except the Central Valley, Sacramento-San Joaquin Delta, and Mojave and Sonoran deserts.
Bush seepweed scrub *Suaeda moquinii* shrubland alliance	S3, G4	Likely	OL, OV	VegCAMP	Saline or alkaline soils in flat to gently sloping valley bottoms, playas, toe slopes adjacent to alluvial fans, and bajadas; occur in the Owens and Central valleys and Modoc Plateau, Great Basin, Mojave, and Sonoran deserts.
Desert olive *Forestiera pubescens*	Provisional S1S2, G1G2	Unlikely	OL, OV	VegCAMP	Floodplains, stream banks, springs, river terraces, washes, and swales; occur at elevations between 1,250 and 7,200 ft in the Sierra Nevada, Coast, Great Basin, and southern California mountains and the Mojave Desert.
Fremont cottonwood forest and woodland *Populus fremontii – Fraxinus velutina – Salix gooddingii* forest and woodland alliance	S3, G4	Certain	OL, OV	CALVEG, VegCAMP	On floodplains, along low-gradient rivers and streams, and in alluvial fans and valleys with a dependable subsurface water supply; occur throughout much of California except the Sierra Nevada and Modoc Plateau.
Fremont's smokebush – Nevada smokebush scrub *Psorothamnus fremontii – Psorothamnus polydenius* shrubland alliance	S3, G4?	Unlikely	OL, OV	VegCAMP	Sandy soils in intermittent washes, drainage bottoms, sand dunes, and upper bajadas; occur primarily in the Great Basin and Mojave deserts in eastern California.

Common name *Scientific name*	**Status**[1]	**Association with GDE**	**Occurrence location**[2]	**Source**	**Habitat and occurrence**
Goodding's willow – red willow riparian woodland and forest *Salix gooddingii – Salix laevigata* riparian forest alliance	S3, G4	Certain	OL, OV	VegCAMP	Terraces along large rivers, canyons, floodplains, stream and lake edges, ditches, and springs; occur throughout most of California at elevations below 9,000 ft.
Hardstem and California bulrush marshes *Schoenoplectus* (*acutus*, *californicus*) herbaceous alliance	S3S4, not globally ranked	Certain	OL, OV	VegCAMP	Brackish to freshwater marshes, stream banks and bars of river mouth estuaries, ponds and lake shores, sloughs, and roadside ditches; occur throughout most of California at elevations below 8,200 ft.
Joshua tree woodland *Yucca brevifolia* woodland alliance	S3, G4	Likely	OL	VegCAMP	Gentle to moderate slopes of alluvial fans and ridges; occur primarily in the Great Basin and Mojave deserts in eastern California.
Nevada joint fir – Anderson's boxthorn – spiny hop sage scrub *Ephedra nevadensis – Lycium andersonii – Grayia spinosa* shrubland alliance	S3S4, G5	Unlikely	OL, OV	VegCAMP	Dry, open ridges, canyons, bajadas, floodplains, valleys and washes, often with alkaline or saline soils; occur primarily in the Modoc Plateau, Great Basin, and Mojave deserts in eastern California.
Parry's saltbush *Atriplex parryi*	Provisional S2, G3	Likely	FS	VegCAMP	Dry lake beds, plains, alkali stream terraces, stable sand dunes, and barrier beaches; occur in eastern California in the Mojave Desert, Great Basin, and Modoc Plateau.
Spiny menodora scrub *Menodora spinescens* shrubland alliance	S2, G4	Unlikely	FS	VegCAMP	Well-drained ridges and slopes with soils derived from bedrock or alluvium; occur in the Great Basin and Mojave deserts in eastern California.
Transmontane alkali marsh	S2.1, G3	Certain	FS	CNDDB	Alkaline lake beds, spring margins, and river bottomlands at elevations between 3,000–7,000 ft; occur in the Modoc Plateau and east of the Sierra Nevada in Mono and Inyo counties.

Common name ***Scientific name***	**Status[1]**	**Association with GDE**	**Occurrence location[2]**	**Source**	**Habitat and occurrence**
Utah juniper woodland and forest *Juniperus osteosperma* forest and woodland alliance	S3, G5	Unlikely	OV	CALVEG	Slopes, ridges, and ravines with well-drained rocky or alluvial soils; occur in the Great Basin and Mojave Desert in eastern California.
Water birch thicket *Betula occidentalis* shrubland alliance	S2.2, G4	Certain	OV	CALVEG, CNDDB, VegCAMP	Intermittently saturated stream banks, alluvial terraces, and seeps; occur primarily in the Modoc Plateau and Great Basin deserts in eastern California.

[1] Status codes:

G = Global
T = Subspecies or variety
Federal
FT = Listed as threatened under the federal Endangered Species Act
FD = Federally delisted

State
S = Sensitive
SE = Listed as Endangered under the California Endangered Species Act
ST = Listed as Threatened under the California Endangered Species Act
SSC = CDFW species of special concern
SFP = CDFW fully protected species

Global Rank
1 Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
2 Imperiled—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
3 Vulnerable — At moderate risk of extinction or elimination due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
4 Apparently Secure — Uncommon but not rare; some cause for long-term concern due to declines or other factors.
5 Demonstrably Secure — Common; widespread and abundant.

California Rare Plant Rank
1B Plants rare, threatened, or endangered in California and elsewhere
2B Plants rare, threatened, or endangered in California, but more common elsewhere
4 More information needed about this plant, a review list
4 Plants of limited distribution, a watch list

CRPR Threat Ranks:
0.1 Seriously threatened in California (high degree/immediacy of threat)
0.2 Fairly threatened in California (moderate degree/immediacy of threat)
0.3 Not very threatened in California (low degree/immediacy of threats or no current threats known)

[2] Location codes: FS (Fish Slough) ; OL (Owens Lake); OV (Owens Valley); TV (Tri-Valley)

Table 3.1-4. Acres of USFWS-designated critical habitat critical habitat within Owens Valley management areas.

Common name *Scientific name*	USFWS critical habitat (acres)				
	Owens Valley	Owens Lake	Tri-Valley	Fish Slough	Total
Fish Slough milk-vetch *Astragalus lentiginosus* var. *piscinensis*	221	-	-	2,512	2,732
Sierra Nevada bighorn sheep *Ovis canadensis sierrae*	2,667	1,835	-	-	4,502
Sierra Nevada yellow-legged frog *Rana sierrae*	253	-	-	-	253
Yellow-billed cuckoo *Coccyzus americanus occidentalis*	31	-	-	-	31
All species	**3,171**	**1,835**	**0**	**2,512**	**7,518**

3.1.3.1 Owens Valley

Thirty-one groundwater dependent special-status animal species were identified as likely present with the Owens Valley management area. These include seven mammal species, sixteen bird species, two reptile species, two amphibian species, and three mollusk species (Table 3.1-2, Appendix B). Habitat use within the mapped GDEs likely includes: dependence on aquatic habitat (e.g., springs and seeps) for living (e.g., Owens Valley springsnail, Wong's springsnail [*Pyrgulopsis wongi*]), indirect dependence on groundwater dependent terrestrial or aquatic habitats for foraging (e.g., Yuma myotis [*Myotis yumanensis*], bald eagle [*Haliaeetus leucocephalus*]), and indirect dependence on wetland, riparian plants, or other ground-water-dependent vegetation for nesting or dwelling (e.g., Sierra Nevada red fox [*Vulpes vulpes necátor*], bank swallow [*Riparia riparia*], southwestern willow flycatcher [*Empidonax traillii extimus]*) (Appendix B).

Fourteen potentially groundwater dependent special-status plant species were documented within the Owens Valley management area. These include nine species identified as certain to depend on groundwater and five species that are likely to depend on groundwater. Many of the species certain to depend on groundwater (e.g., Inyo County star-tulip [*Calochortus excavates*], small-flowered grass-of-Parnassus [*Parnassia parviflora*] and Parish's popcornflower [*Plagiobothrys parishii*]) are dependent on alkaline meadows and seeps and occur in the alkaline soils in Owens Valley. The species likely to depend on groundwater are generally associated with wetlands and meadows (e.g., Fiddleleaf hawksbeard [*Crepis runcinata*] and Western seablite [*Suaeda occidentalis*]).

3.1.3.2 Owens Lake

Twenty-seven groundwater dependent special-status animal species were identified as likely present with the Owens Lake management area. These include seven mammal species, fourteen bird species, one reptile species, one amphibian species, two native fish species, one mollusk species, and one insect species (Table 3.1-2, Appendix B). Habitat use within the mapped GDEs likely includes: dependence on aquatic habitat (e.g., springs and seeps) for living (e.g., Owens pupfish, Owens tui chub), indirect dependence groundwater dependent terrestrial or aquatic habitats for foraging or drinking water (e.g., spottedbat [*Euderma maculatum*], northern harrier [*Circus hudsonius*]), and indirect dependence on wetland, riparian plants, or other vegetation for nesting or dwelling (e.g., western snowy plover [*Charadrius alexandrinus nivosus]*, yellow-breasted chat [*Icteria virens*]) (Appendix B). Furthermore, Owens Lake provides valuable migratory and breeding habitat for salt-tolerant shorebirds (e.g., special- western snowy plover) (NAS 2020).

Three potentially groundwater dependent special-status plant species were documented within the Owens Lake management area, all of which were identified as certain to depend on groundwater (i.e., Inyo County star-tulip [*Calochortus excavates*], Parish's popcorn flower [*Plagiobothrys parishii*] and Owens Valley checkerbloom [*Sidalcea covillei*]). These species are each generally found in alkaline habitats including alkaline flats, seeps, meadows and springs.

3.1.3.3 Tri Valley

Eight groundwater dependent special-status animal species were identified as likely present with the Tri-Valley management area. These include one mammal species, five bird species, and two mollusk species (Table 3.1-2, Appendix A). Likely utilization of habitat within the mapped GDEs include: dependence on aquatic habitat (e.g., springs and seeps) for living (e.g., Owens Valley springsnail, Wong's springsnail), indirect dependence on groundwater dependent terrestrial or aquatic habitats for foraging (e.g., Owens Valley vole [*Microtus californicus vallicola*], and indirect dependence on wetland, riparian plants, or other vegetation for nesting or dwelling (e.g., Swainson's Hawk [*Buteo swainsoni*]) (Appendix B).

Six potentially groundwater dependent special-status plant species were documented within the Tri-Valley management area. These included four species identified as certain to depend on groundwater and two species that are likely to depend on groundwater. All species identified as potentially dependent on groundwater occur in alkaline meadows, seeps, or other mesic habitats such as mud flats or springs. Species identified as certain to depend on groundwater included Silver-leaved milk-vetch [*Astragalus argophyllus* var. *argophyllus*], Fish Slough milk-vetch [*Astragalus lentiginosus* var. *piscinensis*], Inyo County star-tulip [*Calochortus excavates*], and Parish's popcornflower [*Plagiobothrys parishii*]); likely groundwater dependent species included Atriplex argentea var. hillmanii and Fiddleleaf hawksbeard [*Crepis runcinata*].

3.1.3.4 Fish Slough

Eighteen groundwater dependent special-status animal species were identified as likely present with the Fish Slough management area. These include two mammal species, eleven bird species, one reptile species, two native fish species, and two mollusk species (Table 3.1-2, Appendix B). Utilization of habitat within the mapped GDEs likely include: dependence on aquatic habitat (e.g., springs and seeps) for living (e.g., Owens pupfish, Owens specked dace), indirect dependence on terrestrial or aquatic habitats for foraging (e.g., American white pelican [*Pelecanus erythrorhynchos*]), and indirect dependence on wetland, riparian plants, or other vegetation for nesting or dwelling (e.g., Black tern [*Chlidonias niger*]) (Appendix B).

Eight potentially groundwater dependent special-status animal species were documented within the Fish Slough management area. These included five species identified as certain to depend on groundwater and 3 species that are likely to depend on groundwater. Many of the species certain to depend on groundwater (e.g., *Astragalus argophyllus* var. *argophyllus* [Silver-leaved milk-vetch], Hot springs fimbristylis [*Fimbristylis thermalis*], and Inyo phacelia [*Phacelia inyoensis*]) are associated with seeps and springs characteristic of Fish Slough. The species likely to depend on groundwater are generally associated with alkaline meadows (e.g., Fiddleleaf hawksbeard [*Crepis runcinate*], Alkali ivesia [*Ivesia kingii* var. *kingii*] and Foxtail thelypodium [*Thelypodium integrifolium* ssp. *complanatum*]).

3.1.4 Ecological value

The ecological value of each management area was characterized by evaluating the presence and groundwater-dependence of special-status species and ecological communities, and the vulnerability of these species and their habitat to changes in groundwater levels (Rohde et al. 2018).

3.1.4.1 Owens Valley

The Owens Valley management area was determined to have **high ecological value** because: (1) it supports a relatively large number of special-status species and ecological communities (Table 3.1-2), (2) contains a relatively large amount of designated critical habitat for four federally listed species (Table 3.1-4), (3) supports species that are directly dependent on groundwater (two amphibians and three mollusks; Table 3.1-2), and (4) includes species and ecological communities that are highly or moderately vulnerable to changes in groundwater discharge or groundwater levels that could substantially alter their distribution, species composition, and/or health (Rohde et al. 2018). The unit's high ecological value is also related to the relatively large amount of groundwater-fed aquatic habitat (i.e., 7.2 acres of seeps and springs) and the contributions of groundwater dependent vegetation to the ecological function and habitat value of many of the streams within the unit draining the eastern slope of the Sierra Nevada that support native aquatic species and beneficial uses in and adjacent to the management unit.

3.1.4.2 Owens Lake

The Owens Lake management area was determined to have **high ecological value** because: (1) it supports a relatively large number of special-status species and ecological communities (Table 3.1-2), (2) supports species that are directly dependent on groundwater (one amphibian, two fish, and one mollusk; Table 3.1-2), and (3) includes species and ecological communities that are highly or moderately vulnerable to changes in groundwater discharge or groundwater levels that could substantially alter their distribution, species composition, and/or health (Rohde et al. 2018). The unit's high ecological value is also related to its relatively large amount of GDE area (46,129 acres), accounting for 83% of the total GDE acreage across the entire OVGA Assessment Area.

3.1.4.3 Tri-Valley

The Tri-Valley management area was determined to have **low ecological value** because: (1) it supports a relatively small number of special-status species and ecological communities (Table 3.1-2), (2) contains no designated critical habitat for federally listed species (Table3.1-3), (3) supports few species that are directly dependent on groundwater (two mollusks; Table 3.1-2), and (4) includes few species or ecological communities that are vulnerable to changes in groundwater discharge or groundwater levels that could substantially alter their distribution, species composition, and/or health (Rohde et al. 2018).

3.1.4.4 Fish Slough

The Fish Slough management area was determined to have **high ecological value** because: (1) it supports a moderate number of special-status species and ecological communities (Table 3.1-2), (2) contains designated critical habitat for the federally listed and highly endemic Fish Slough milk-vetch (Table3.1-3), (3) supports species that are directly dependent on groundwater (two fish and two mollusks; Table 3.1-2), and (4) includes species and ecological communities that are highly or moderately vulnerable to changes in groundwater discharge or groundwater levels that could substantially alter their distribution, species composition, and/or health (Rohde et al. 2018). The unit's high ecological value is also related to the high proportion of its total area composed of GDEs (74%) and its critical role in supporting the last remaining populations of the endangered and highly endemic Owens pupfish and populations of the imperiled Owens speckled dace.

4 POTENTIAL EFFECTS ON GDEs

This section presents the methods and results of our analysis to identify how groundwater management could affect GDEs in the areas managed by the OVGA in the Owens Valley Groundwater Basin. Adverse effects (impacts) on GDEs are considered undesirable results under SGMA (State of California 2014). The analysis is based on the hydrologic conditions affecting GDEs and their susceptibility to changing groundwater conditions, trends in biological condition of the GDEs, and climate change projections and other anticipated conditions or management actions likely to affect GDEs in the future.

4.1 Approach

SGMA describes six groundwater conditions that could cause undesirable results, including adverse impacts on GDEs. These are (1) chronic lowering of groundwater levels, (2) reduction of groundwater storage, (3) seawater intrusion, (4) degraded groundwater quality, (5) land subsidence, and (6) depletion of interconnected surface waters. Rohde et al. (2018) identify chronic lowering of groundwater levels, degraded water quality, and depletions of interconnected surface water as the most likely conditions to have direct effects on GDEs, potentially leading to an undesirable result. Following this guidance and based on available information for the Owens Valley Groundwater Basin, we have eliminated reduction of groundwater storage, seawater intrusion (the subbasin is not located near or hydrologically connected to the ocean), and land subsidence from consideration. Water quality in the basin is generally high with the exception of high total dissolved solids and saline water in Owens Lake. Changes to the salinity of groundwater used by plant roots could affect the distribution of plant species and vegetation types, but water quality is not likely affected by groundwater management. Accordingly, degraded groundwater quality was not considered in the analysis of potential effects.

We evaluated the potential for chronic lowering of groundwater levels and depletion of interconnected surface waters to cause direct effects on GDEs compared to baseline conditions, with a focus on effects related to groundwater levels. First, we identified baseline hydrologic conditions for the GDE unit using available information (Section 1.3). Next, we determined each GDE unit's susceptibility to changing groundwater conditions using available hydrologic data, climate change projections, and the GDE susceptibility classifications (Rohde et al. 2018) summarized in Table 4.1-1.

Table 4.1-1. Susceptibility classifications developed for evaluation of a GDE's susceptibility to changing groundwater conditions (Rohde et al. 2018).

Susceptibility classifications	
High Susceptibility	Current groundwater conditions for the selected hydrologic data fall outside the baseline range.
Moderate Susceptibility	Current groundwater conditions for the selected hydrologic data fall within the baseline range but future changes in groundwater conditions are likely to cause it to fall outside the baseline range. The future conditions could be due to planned or anticipated activities that increase or shift groundwater production, causing a potential effect on a GDE.
Low Susceptibility	Current groundwater conditions for the selected hydrologic data fall within the baseline range and no future changes in groundwater conditions are likely to cause the hydrologic data to fall outside the baseline range.

We used these susceptibility classifications to trigger further evaluation of potential effects on GDEs. If we determined a GDE unit to have moderate or high susceptibility to changing groundwater conditions, we used biological information to assess whether evidence exists of a biological response to changing groundwater levels. This project did not include field monitoring of vegetation but instead relied on remote sensing to assess biological changes through time. The biological response analysis was based on changes in Normalized Difference Vegetation Index (NDVI) and Normalized Difference Moisture Index (NDMI) data for individual vegetation polygons within the GDE unit (Klausmeyer et al. 2019). The polygons correspond to different GDE mapping units (i.e., different species compositions) and the size of the GDE polygons varied.

NDVI, which estimates vegetation greenness, and NDMI, which estimates vegetation moisture, were generated from surface reflectance corrected multispectral Landsat imagery corresponding to the period of July 9 to September 7 of each year, which represents the period when GDE species are most likely to use groundwater rather than precipitation (see Klausmeyer et al. 2019 for further description of methods). Vegetation polygons with higher NDVI values indicate increased density of chlorophyll and photosynthetic capacity in the canopy, an indicator of vegetation vigor. Similarly, high NDMI values indicate that the vegetation canopy has high water content and is therefore not drought stressed. These indices are both commonly used proxies for vegetation health in analyses of temporal trends in health of groundwater dependent vegetation (Rouse et al. 1974, Jiang et al. 2006; as cited in Klausmeyer et al. 2019) including to assess vegetation changes in the Owens Valley Adjudicated Area (Huntington et al. 2016). Both NDVI and NDMI range from -1 to 1, but have different sensitivity to exposed standing water which is likely to occur during wet years in Owens Lake and portions of Fish Slough. The NDVI of standing water approaches -1. Averaging July to September NDVI minimizes the potential for standing water to decrease NDVI (Huntington et al. 2016). The NDMI signature of standing water is less distinct, and therefore may impact NDMI in years where standing water is likely. Changes in surface water extent within a GDE polygon may impact NDVI and NDMI trends in that polygon, particularly in the Owens Lake and Fish Slough management areas. An additional source of uncertainty is the 30-m (98-ft) resolution of NDVI and NDMI. This resolution is problematic for GDEs along small tributaries to the Owens Valley which are elongate features with narrow widths that can range from 1-10 pixels (98-984 ft) in the Landsat imagery, but are typically 2-3 pixels wide.

4.2 Biological Data

To assess the health of GDEs, we explored changes in GDE vegetation via NDVI and NDMI for each management area through time using TNCs GDE Pulse Tool (Klausmeyer et al. 2019). The pulse tool calculates the average summer NDVI and NDMI for polygons in the iGDE database (DWR 2020b). The GDE map (Figure 3.2-1) includes several revisions to the iGDE map as discussed in Section 2.2.1 due to the inclusion of the Jawbone Canyon Region and Owens Valley vegetation map and the additional wetland mapping from the Great Basin Air Pollution Control District are not included in this assessment. For this analysis, we used the DWR (2020b) dataset and removed vegetation polygons that the ICWD assessed as not groundwater dependent. These revised GDE maps can be included in future monitoring efforts, however, to track biological change through time. Using the iGDE dataset (DWR 2020b) does not affect the mapping in the Fish Slough and Tri-Valley management areas. It does, however, change the southern half of the Owens Valley management area and the entirety of the Owens Lake management area (compare Figures 3.2-1 and 2.1-2). Despite the updated GDE mapping, we are including an analysis of the Owens Valley and Owens Lake management areas to provide an initial estimate of GDE health through time, but the results may differ once the new mapping is incorporated in the five-year update.

Below we examine the changes in NDVI and NDMI for ICWD corrected iGDEs in each management area over the period of record for the GDE Pulse Tool (Klausmeyer 2019). The area-weighted average NDVI and NDMI for each management area is shown in Figure 4.2-1. The mean NDVI and NDMI for each management area in the NDVI and NDMI analysis are weighted by the area of each polygon relative to the total area of GDEs in the management area.

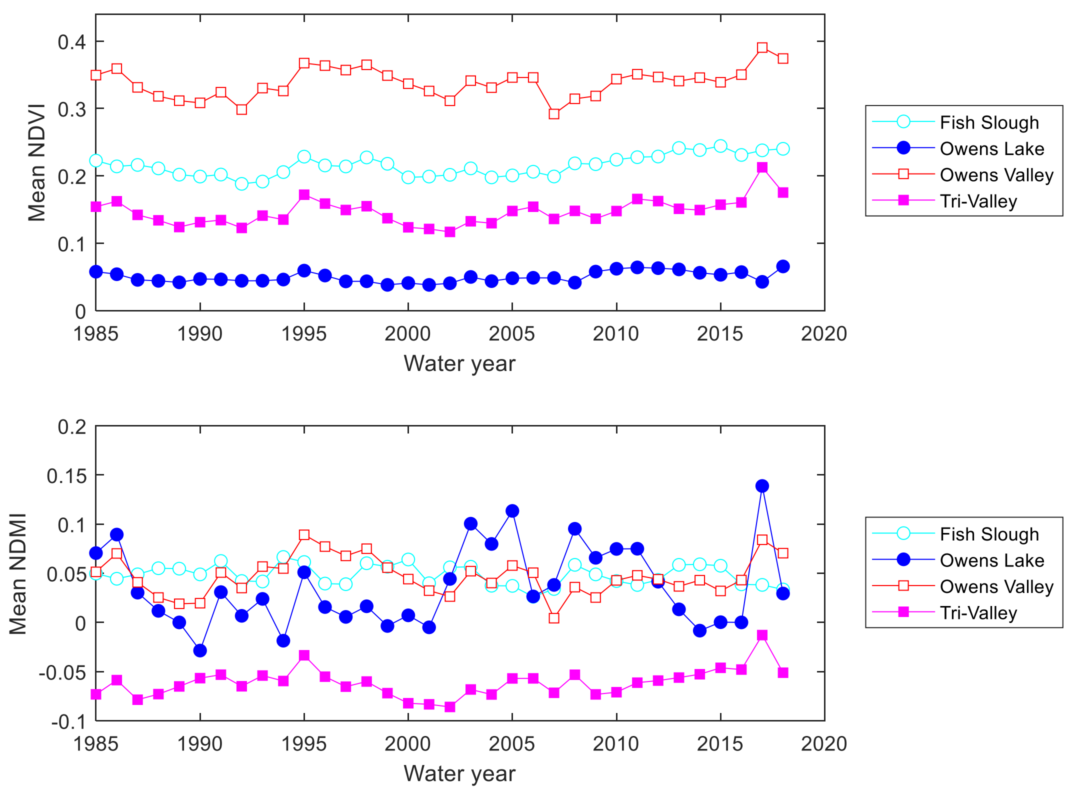

Figure 4.2-1. Area-weighted mean NDVI (top) and NDMI (bottom) for the ICWD corrected iGDEs in the four management areas through time.

4.2.1 Owens Valley

GDEs in the Owens Valley management area have the highest average NDVI of the four management units. The mean NDVI for the GDE units from 1985–2018 was 0.34 (Figure 4.2-1). The grey lines Figure 4.2-2 and 4.2-3 show the NDVI and NDMI, respectively, through time for each vegetation polygon in the iGDE map. The colored bold lines in figures 4.2-2 and 4.2-3 represent the 10th, 25th, 50th, 75th, and 90th percentile for each year of the NDVI and NDMI, respectively. Both NDVI and NDMI have similar trends through time for each percentile, suggesting that most plants are responding similarly. The NDVI of GDE plant communities were relatively steady during the period of record, with the exception of a sharp drop (particularly for NDVI) between 0.3–0.5 in 2007, followed by a gradual recovery by 2010. Thereafter the NDVI and NDMI values for GDEs were mostly stable throughout the drought, but show a rapid increase in 2017. We explored the NDVI changes for specific plant types (e.g., water birch, wet meadows, willow (scrub)), which showed a similar response to the data in Figure 4.2-2.

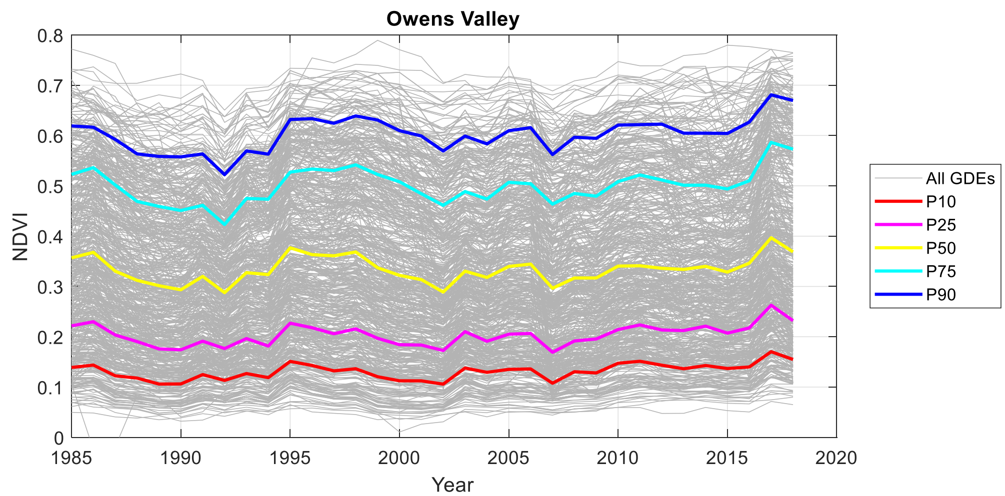

Figure 4.2-2. NDVI through time for all the GDE polygons in the Owens Valley management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDVI values for each year.

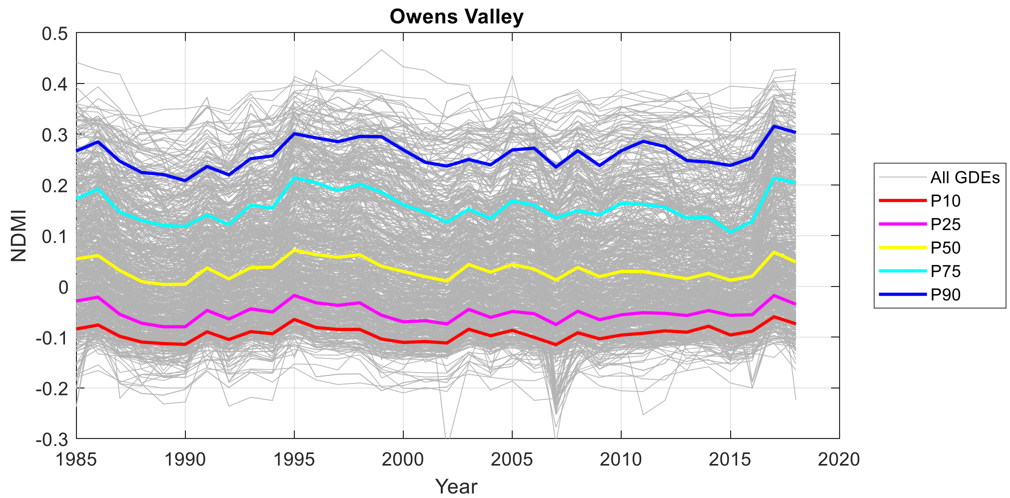

Figure 4.2-3. NDMI through time for the ICWD-corrected GDE polygons in the Owens Valley management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDMI values for each year.

The average NDVI and NDMI for GDEs in the Owens Valley management area rose with increases in precipitation and declined with decreases in precipitation until 2005 or 2006 (Figure 4.2-4). The drop in NDVI and NDMI observed in Figures 4.2-5 and 4.2-6 in 2007 were correlated with a drop in precipitation. Subsequently, the NDVI increased from 2007–2010, then remained quasi-steady despite very low precipitation until 2017, when it increased somewhat during the wet year. Because many of the GDEs in the Owens Valley management area are along tributaries originating in the Sierra Nevada, local precipitation is an incomplete indicator of water availability, but it roughly correlates with Sierra Nevada snowpack and other water sources. Nonetheless the stable NDVI and NDMI through the recent drought suggests that the GDEs are relatively stable. The stability of NDVI and NDMI in the Owens Valley Management Area during the 2012-2016 drought is surprising and differs from NDVI in the Adjudicated Area, which generally decreased from 2012-2016 based in ICWD data (Zach Nelson, personal communication). This difference between the Adjudicated and Non-Adjudicated areas could be a function of the poor vegetation mapping outside the Adjudicated Area or differences in the source of water (e.g., surface water along the tributaries in the Adjudicated Area). The stability of NDVI and NDMI in the Owens Valley management area should be explored using the revised vegetation map during the five-year after GSP submission.

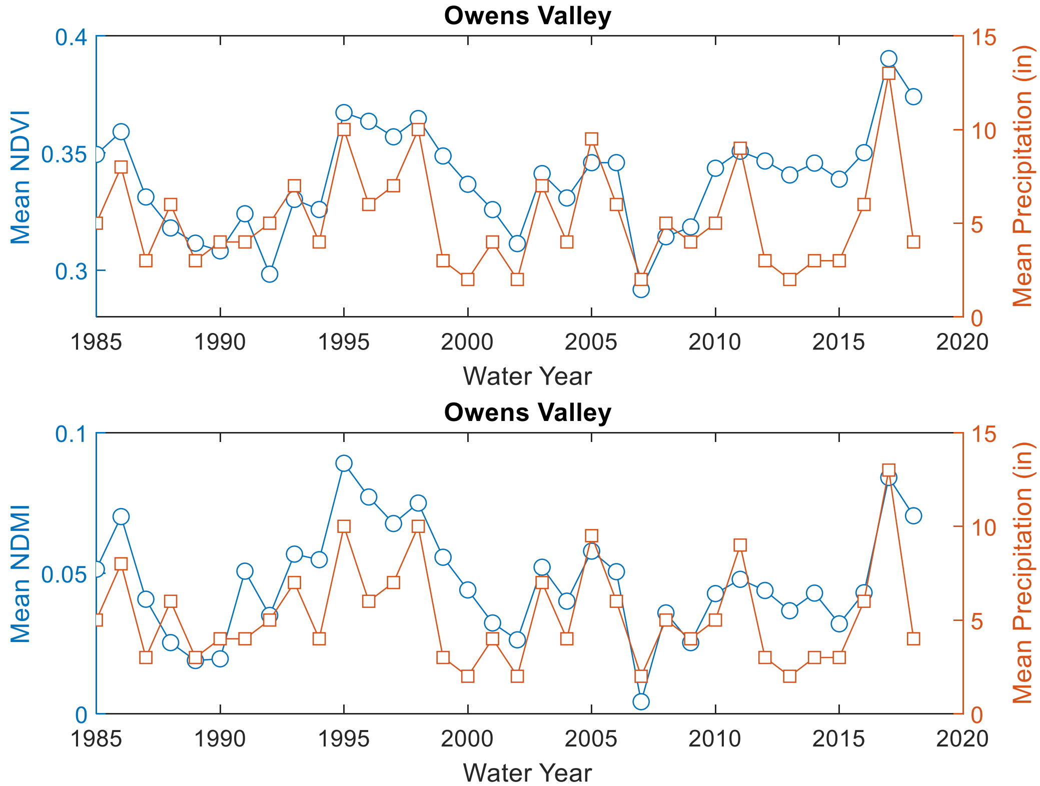

Figure 4.2-4. Weighted area mean NDVI (in blue) and mean precipitation (red) for the Owens Valley management area derived from the TNC pulse tool. The precipitation data were assembled by TNC from PRISM data.

4.2.2 *Owens Lake*

The Owens Lake management area has the most extensive GDEs among the 4 management areas, with over 15,000 acres in the original mapping (Table 3.1-1) and 46,129 acres in the revised map. NDVI ranges from less than 0 to 0.83 (Figure 4.2-8) and NDMI ranges from -0.17 to 1.0 (Figure 4.2-5). Despite containing the polygons with the highest NDVI and NDMI of the four areas, NDVI values for Owens Lake management area are, on average the lowest of 4 management areas, with an average NDVI of about 0.05. Part of the reason for the generally low NDVI values for Owens Lake could be the relatively poor quality of the FRAP and NWI mapping used in the pulse analysis. Spot checks of the mapping showed that FRAP polygons were often offset from available imagery. In addition, many of the polygons are very large and incorporate sparsely vegetated patches that contain a lot of bare soil on the lakebed. These maps have been updated with the new Jawbone Canyon and Owens Valley map, but this map has not yet been incorporated into the Pulse Analysis, although future monitoring of vegetation condition using NDVI can use the new map.

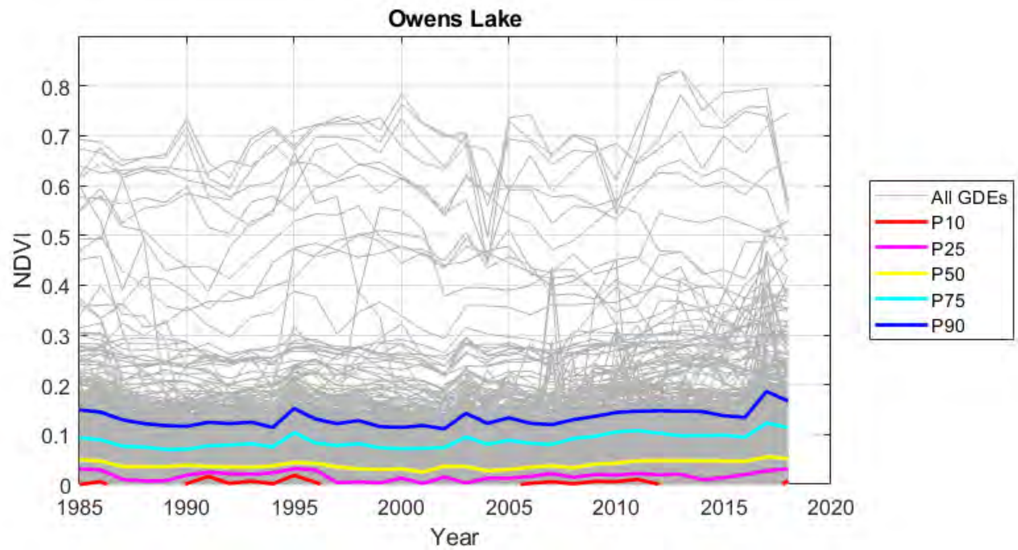

Figure 4.2-5. NDVI through time for the ICWD-corrected GDE polygons in the Owens Lake management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDVI values for each year.

NDVI has been relatively consistent for most of the period of record with short-term increases in NDVI in 1995, 2003 and 2018 (Figure 4.2-5). The 90th percentile NDMI has been declining since at least 2005, with increases in 1996, 2003, and 2017 (Figure 4.2-6). The largest decline in the 90th percentile NDMI occurred from 2011-2016 during the recent drought. The 75th percentile NDMI had peaks and valleys that were coincident with the 90th percentile NDMI, but without a long-term decline. The 10th, 25th, and 50th percentiles of NDVI and NDMI do not show a long-term trend, but have small increases during the same years as the 90th percentile data.

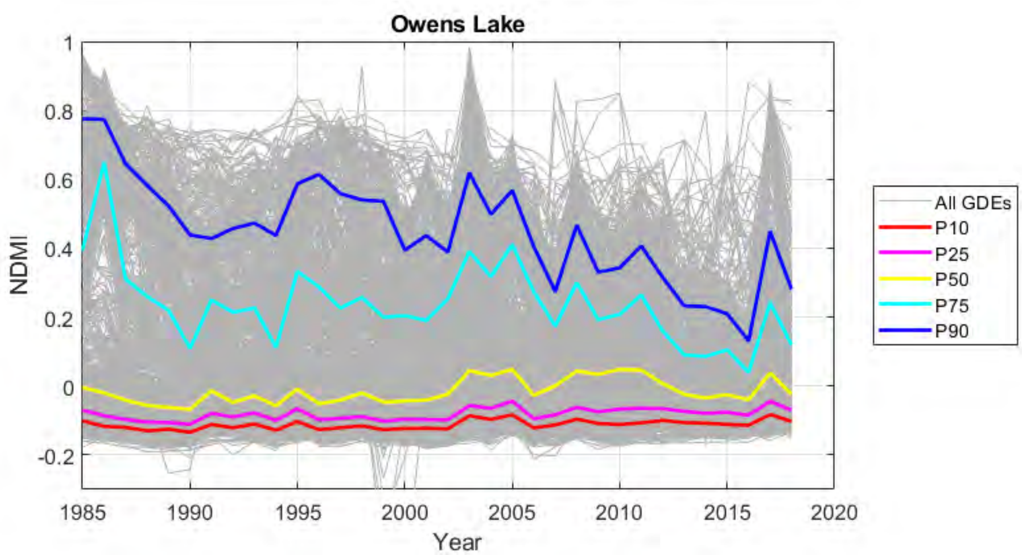

Figure 4.2-6. NDMI through time for the ICWD-corrected GDE polygons in the Owens Lake management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDMI values for each year.

Mean NDVI and mean NDMI are relatively independent of rainfall near Owens Lake and are likely more tied to surface water inflows to the lake. The mean NDVI was very high from 2009–2011 and gradually dropped during the 2012–2016 drought, mean NDVI then plummeted in 2017 and increased in 2018 (Figure 4.2-7). The decline in NDVI in 2017 was due to widespread ponded surface water at Owens Lake which reduced the NDVI where vegetation was sparse (as represented by the lowest NDVI polygons in Figure 4.2-5). The decline in mean NDMI values during 2012–2016 was more rapid than NDVI (Figure 4.2-7). The difference between NDVI and NDMI in 2017 is likely due to extensive surface water. It should be noted that the very low NDVI values make assessing differences through time in this arid environment using the GDE Pulse approach challenging. Instead, a revised approach looking at the spatial pattern of change for individual pixels in Owens Lake GDE rather than that averaged over the mapped polygons would be more appropriate in this setting and can be explored during the 5-year update. The cause of the decline in the 90th percentile NDMI at Owens Lake over time is unclear and may reflect changes in the distribution of vegetation not reflected in the iGDE map.

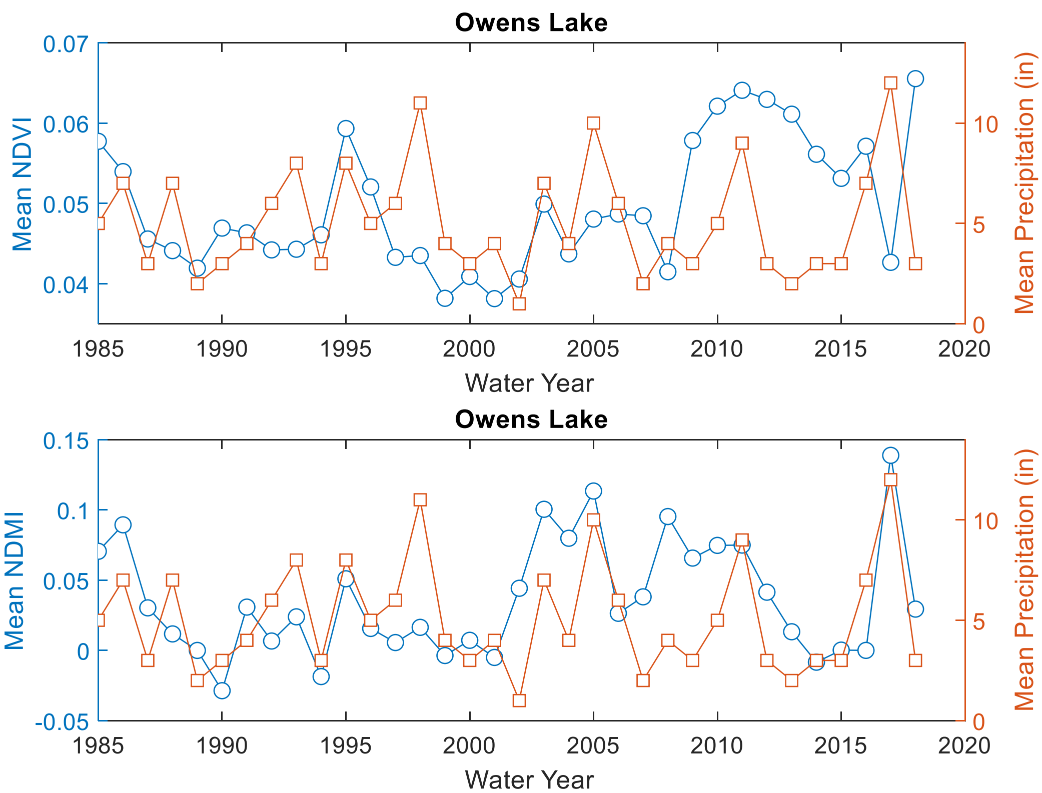

Figure 4.2-7. Weighted area mean NDVI (in blue) and mean precipitation (red) for the Owens Lake management area derived from the TNC pulse tool. The precipitation data was assembled by TNC from PRISM data.

One challenge for analyzing the changes in GDEs is that their area likely expands and contracts through time. The analysis presented here uses fixed maps of GDEs and tracks the changes through time within those fixed GDE areas or polygons. An alternative method would be to track changes in NDVI/NDMI through time in broader areas that could potentially contain GDEs. This method has the advantage of allowing the areal extent of GDEs patches to expand and contract, but it would struggle to define whether observed changes represent a change in the extent of GDEs versus plants that are not dependent on groundwater. Figure 4.2-8 shows the change in NDVI (represented as a regression slope for each pixel) with blue pixels showing areas where the NDVI increased and red pixels showing areas where NDVI decreased. This figure shows that NDVI has increased in some places while decreasing in others. A method that coupled change in NDVI/NDMI with assessment of the change in species composition and groundwater dependence through time would be more robust, but is beyond the scope of this assessment.

Planned restoration and land management actions at Owens Lake (Nuvis 2013) are likely to alter the extent and health of GDEs in the Owens Lake management area.

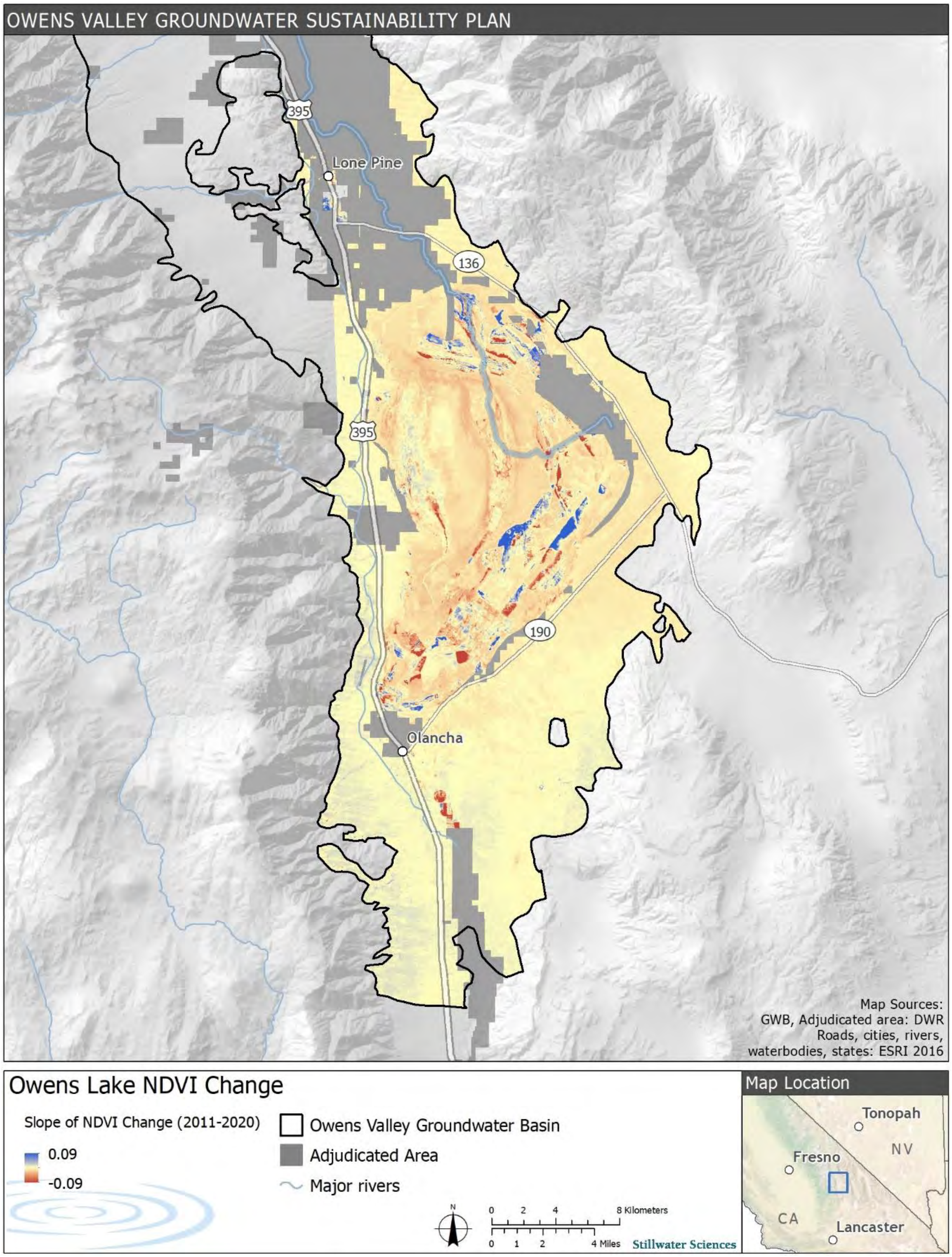

Figure 4.2-8. Slope of NDVI change for Owens Lake from 2011–2020. Data processed using code from Zach Nelson, ICWD.

4.2.3 **Tri-Valley** *management area*

The Tri-Valley management area had a mean NDVI of about 0.15, which is intermediate between Owens Lake and Fish Slough. NDVI ranges from 0.04 to 0.72 (Figure 4.2-9), while NDMI ranges from -0.16 to 0.39 (Figure 4.2-10). The NDMI and NDVI have been increasing since the early 2000s and did not decline during the drought. The high NDVI GDEs are classified as wet meadows, some of which could be influenced by agricultural runoff, although this hasn't been confirmed by field assessments. These wet meadow communities may be sensitive to changes in groundwater and should be monitored in the future to assess their health and connection to groundwater.

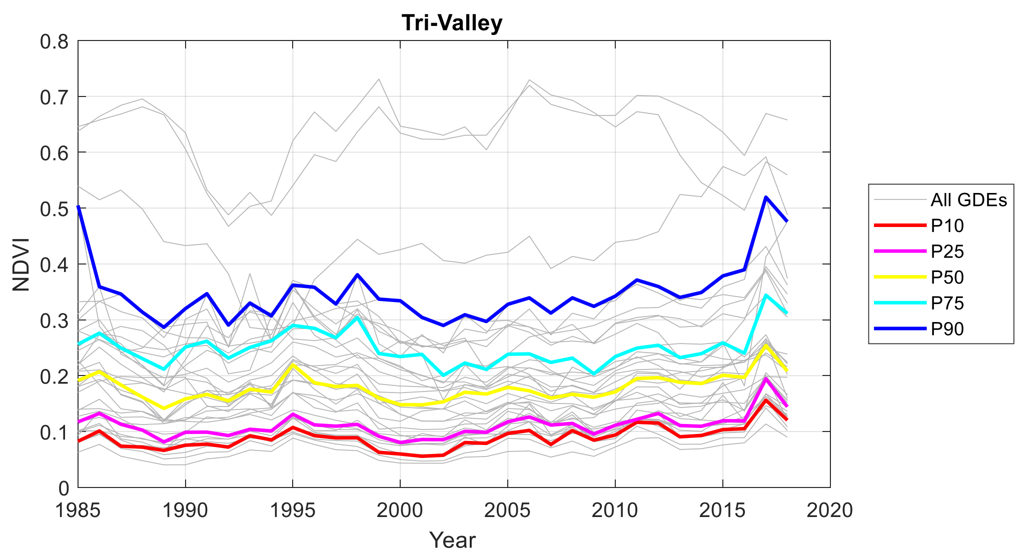

Figure 4.2-9. NDVI through time for the ICWD-corrected GDE polygons in the Tri-Valley management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDVI values for each year.

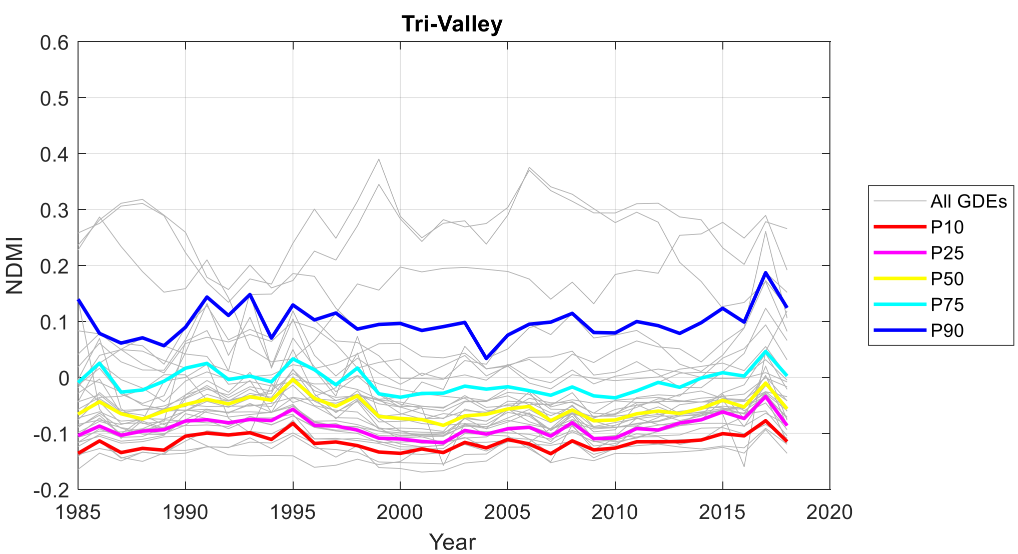

Figure 4.2-10. NDMI through time for the ICWD-corrected GDE polygons in the Tri-Valley management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDVI values for each year.

The average NDVI and NDMI decreased from 1986 through 1990 and then was quasi stable until increasing from 1993-1995. The NDVI then gradually decreased until 2002 (Figure 4.2-11). Since 2002 the average NDVI and NDMI have gradually increased, with a large one-year peak in the wet 2017 water year. The average NDVI and NDMI vary slightly with differences in precipitation, but the long-term gradual increases are independent of precipitation.

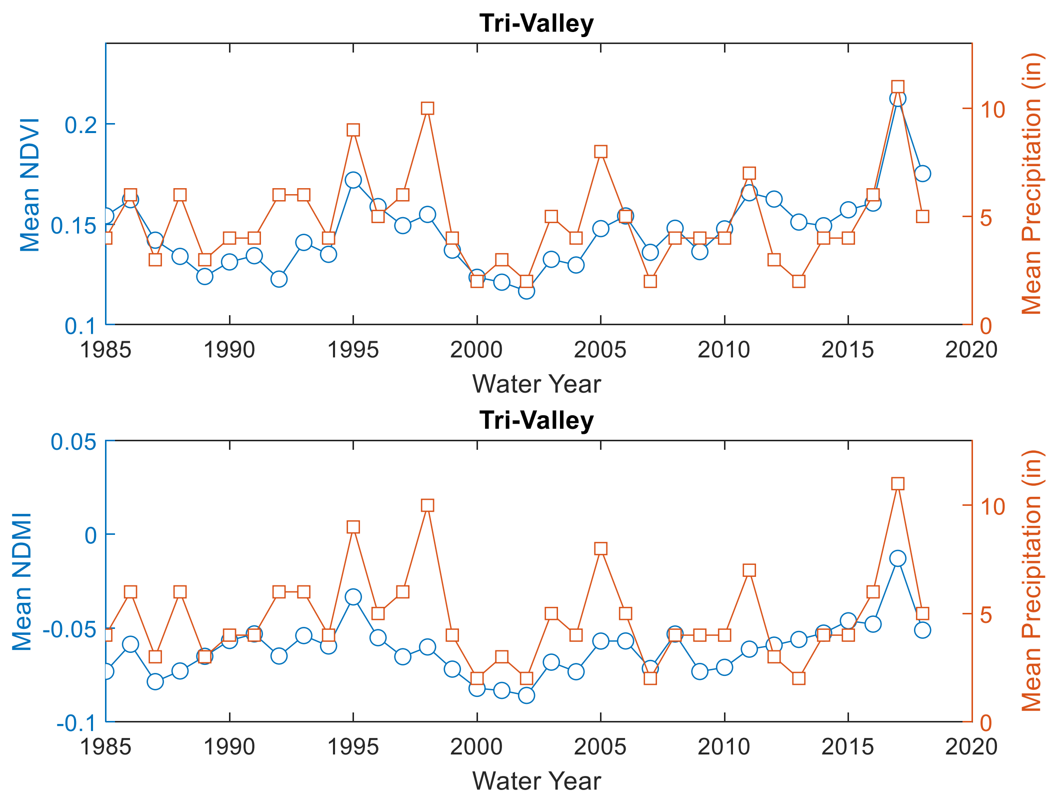

Figure 4.2-11. Area-weighted Mean NDVI (in blue) and mean precipitation (red) for the Owens Lake management area derived from the TNC pulse tool. The precipitation data was assembled by TNC from PRISM data.

4.2.4 Fish Slough

Groundwater dependent vegetation in the Fish Slough management area has an area-weighted average NDVI of 0.22 over the period of record and area-weighted average NDMI of 0.026 (Figure 4.2-1). Both of these values are less than the mean NDVI and NDMI values for Owens Valley GDEs and are greater than Tri-Valley and Owens Lake GDEs (Figure 4.2-1). Overall, the NDVI values in the Fish Slough management area range from <0.1 to 0.72 (the grey lines in Figure 4.2-12). The NDMI values range from -0.13 to 0.45 (the grey lines in Figure 4.2-13).

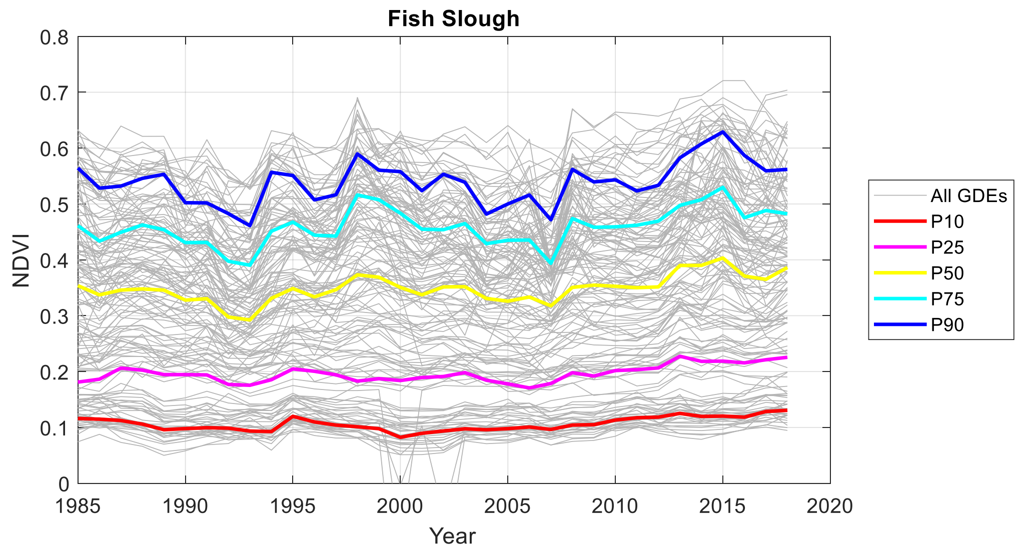

Figure 4.2-12. NDVI through time for the ICWD-corrected GDE polygons in the Fish Slough management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDVI values for each year.

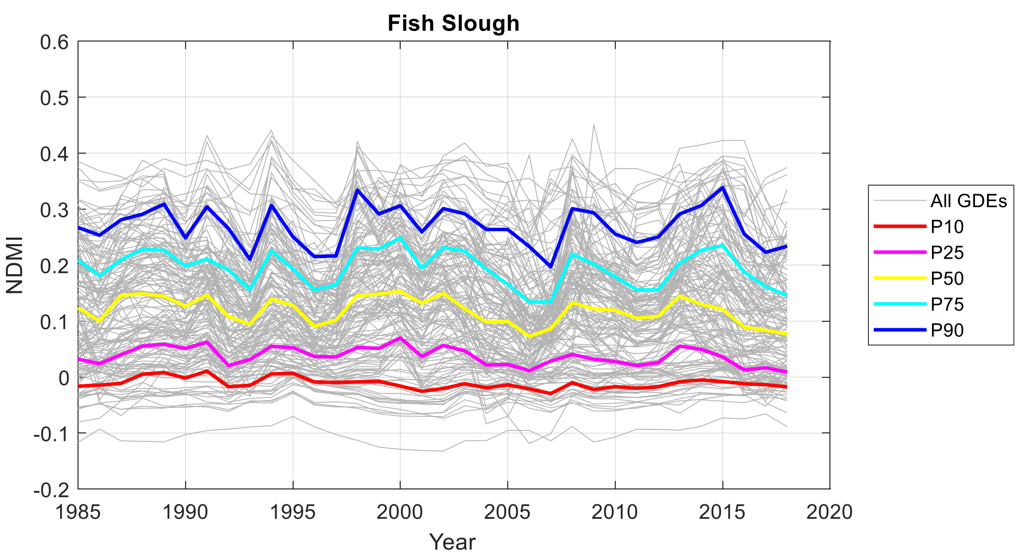

Figure 4.2-13. NDMI through time for the ICWD-corrected GDE polygons in the Fish Slough management area (the grey lines). The color lines represent the 10th, 25th, 50th, 75th, and 90th percentile NDMI values for each year.

From 1994 to 2005, NDVI and NDMI of GDEs in Fish Slough varied with precipitation, with NDVI increases during wetter years, and decreases during drier years (Figure 4.2-14). Starting around 2005, mean NDVI started to increase in the Fish Slough management area through 2011 or 2012. During the 2012–2016 drought the NDVI was relatively constant from 2012–2015 but decreased during 2016 (Figure 4.2-14). The mean NDVI in 2017 (a wet year) increased from 2016, but was still a bit lower than in 2013–2015 during the drought.

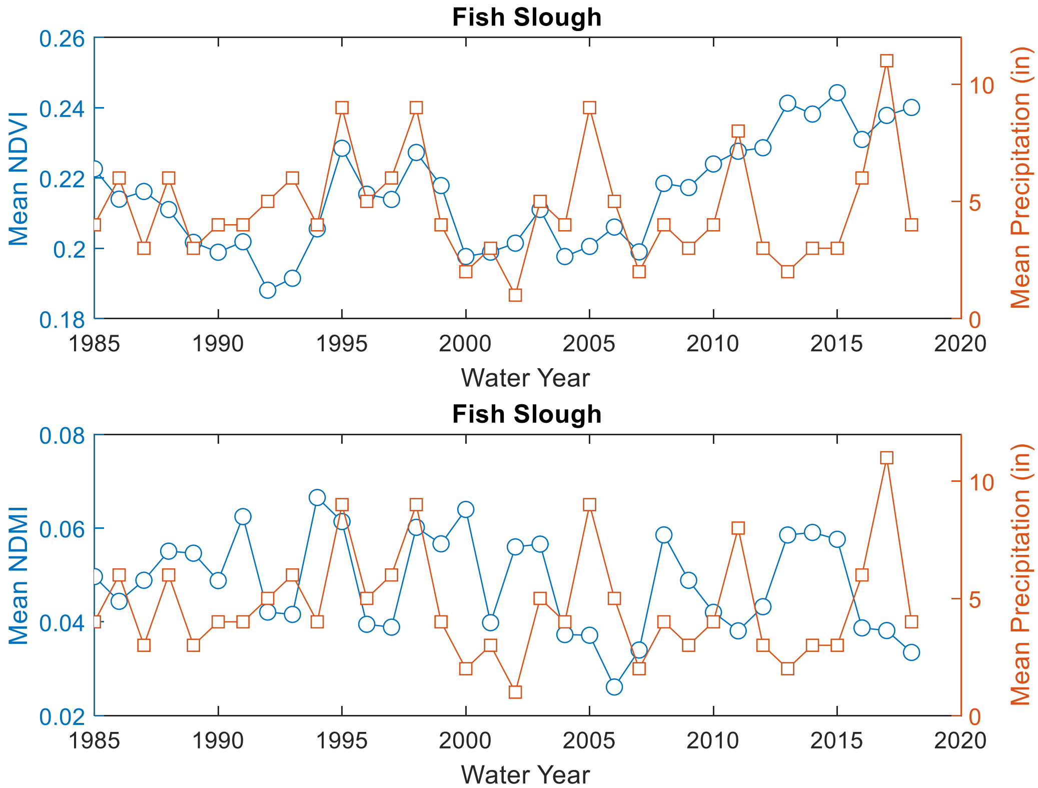

Figure 4.2-14. Area-weighted Mean NDVI (in blue) and mean precipitation (red) for the Fish Slough management area derived from the TNC pulse tool. The precipitation data was assembled by TNC from PRISM data.

GDEs with mean NDVI between 0.1–0.2 were relatively stable over the period of record. These GDEs include *Sarcobatus vermiculatus* (greasewood), *Atriplex parryi* (Parry's saltbush), *Ivesia kingi* (alkali ivesia), *Ericameria albida* (white-flowered rabbitbrush), *Distichlis spicata* (salt grass), *Juncus arcticus* var. *balticus* (Baltic rush), and *J. arcticus* var. *mexicanus* (Mexican rush).

Figure 4.2-15 shows the slope of NDVI change from 2011-2020 and the vegetation map for the Fish Slough Management Area. The NDVI data was obtained using Google Earth Engine using a modified code written by Zach Nelson of ICWD. The patterns of change from 2011-2018 (not shown) is similar to the change from 2011-2020. The most significant changes in NDVI occurred in the eastern half of the management unit. Declines in NDVI typically occurred in tule-cattails adjacent to the channel. Increases in NDVI typically occurred in alkaline mixed grasses and forbs and, to a lesser extent, sections on the edge of the Tule-Cattail in the northwestern limb of the management unit. The cattails and tules (*Schoenoplectus acutus*, *S. americanus*, and *Typha* species) are located near the channel and have high water demands and relatively shallow rooting depths ranging from approximately 0.9-2.1 ft (Appendix C).

In general, the plants with higher NDVI (i.e., tules and cattails) can vary more than plant species and communities with lower NDVI, but that does not automatically suggest that smaller changes represents less important ecological changes. The tules and cattails could be affected by declining flows shown in Section 1.3. The general increases in NDVI since 2005 have occurred throughout

Fish Slough and may reflect changes in the composition and extent of vegetation through time, possibly due to revised water management by the custodial agencies. The GDE pulse tool shows that declines in NDVI and NDMI occur along the mapped wetted channel in the Fish Slough management area, and this decline could reflect decreasing flows. Arresting the decrease in flows is likely crucial to managing GDEs in Fish Slough, but requires additional study to assess the cause of change.

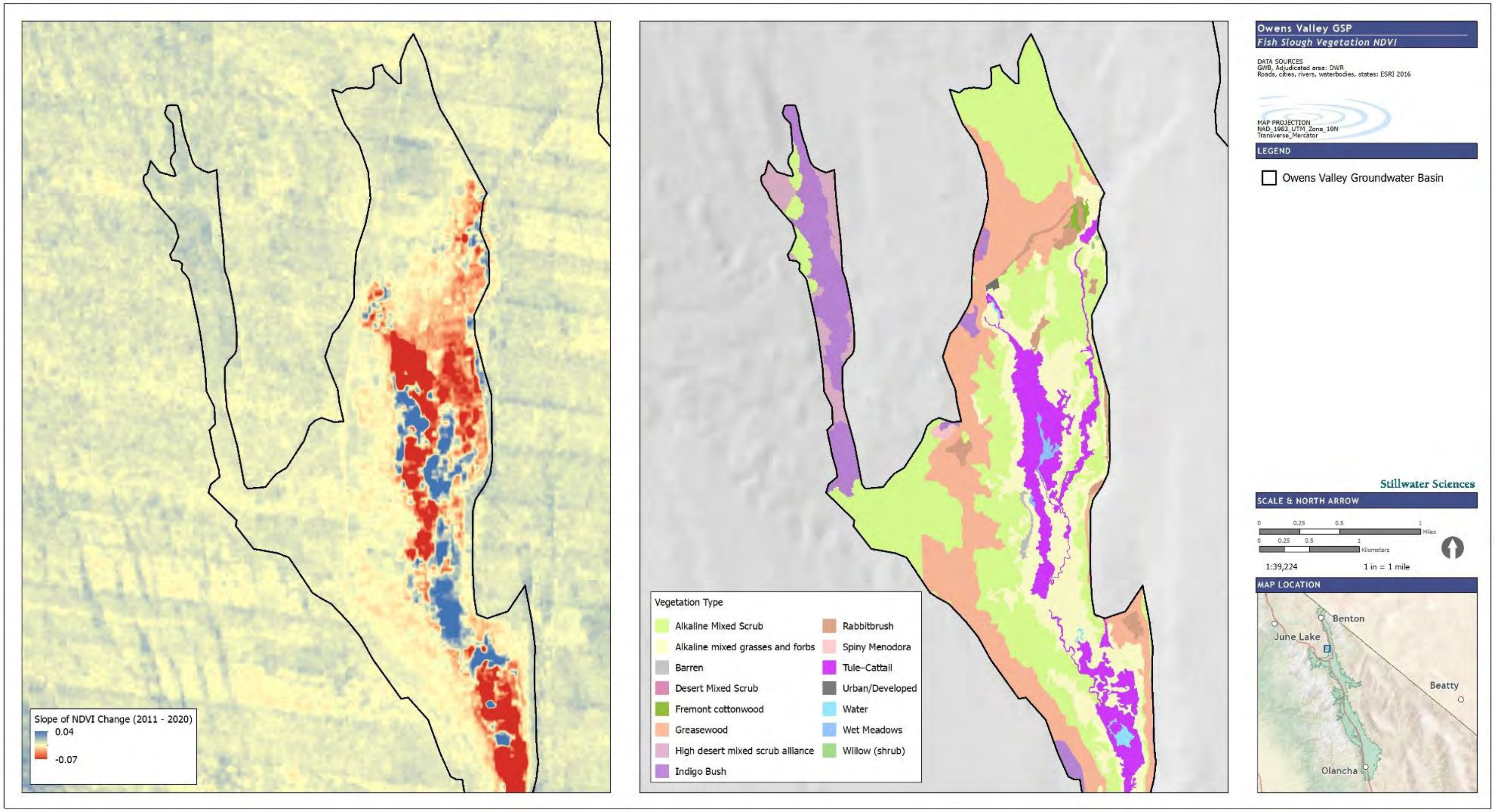

Figure 4.2-15. Comparison of NDVI change from 2011–2020 (left) and the vegetation map of Fish Slough (right) mapped in 2010.

4.3 Climate Change Effects

In Technical Appendix 10 Water Budget, DBS&A used a simple land system water budget to assess potential changes to the annual groundwater budget due to climate change from 2015–2045 and compared that with model results from the historical period (1986–2018). The water groundwater budget is also being assessed for 2056–2085. Climate simulation models contained in the USGS Basin Conceptual Model (BCM) were used to assess predicted changes in precipitation, potential evapotranspiration (PET), surface water runoff, and groundwater recharge. This water budget did not include a groundwater flow model and thus does not account for any future changes in groundwater pumping or interconnected surface water. The BCM predicts the annual water budget for the groundwater basin and its contributing area. The climate model predicts that precipitation will increase by 6% relative to the historical period, while ET will increase by 19%. Further, the climate model predicts that surface runoff will decrease by 5.7% and groundwater recharge will increase by 2.5%. These results are summed for the contributing area and groundwater basin and do not account for changes in vegetation that may co-occur with a warming climate. This assessment does not account for any changes to water diversions or changes in the timing of flows.

Because the climate is projected to be warmer, the proportion of total precipitation in the watershed falling as rain is likely to increase while snow is likely to decrease, and snowmelt is likely to occur earlier in the year compared to current conditions. This is likely to result in decreased baseflows during the summer months in the tributaries from the Sierra Nevada and the White/Inyo mountains. The impacts of flow timing on groundwater elevations have not been explored in the study area. Future changes to interconnected surface waters in Fish Slough may be less affected by changes in flow timing than other waterbodies in the basin because it is spring-fed but the total discharge and outflow from Fish Slough may decline in response to climate change. In addition, climate models suggest that over the next century California is likely to have more frequent, intense precipitation events, while also being subject to more frequent droughts (Swain et al. 2018).

4.4 Summary of Potential Effects

Potential effects on each of the four management areas are summarized here based on three primary criteria:

1. Ecological value (high, moderate, low), as described in Section 3.1.4.
2. Ecological condition of the GDEs within each unit (good, fair, poor), based on the information summarized in Sections 3.1.1 through 3.1.3 and the NDVI/NDMI data presented in Section 4.2.
3. Susceptibility to changing groundwater conditions (high, moderate, low) based on available hydrologic data, climate change projections, and the GDE susceptibility classifications summarized in Table 4.1-1.

4.4.1 Owens Valley

Ecological Value: **High**

- The Owens Valley management area supports a relatively large number of special-status species and ecological communities, some of which are directly dependent on groundwater.

- The management area includes designated critical habitat for four federally listed species.
- The management area supports species and ecological communities that are vulnerable to changes in groundwater levels.

Ecological Condition: **Good**

- NDVI/ NDMI trends from 1985–2018 show minimal change in the management area and indicate vegetation responds mainly to precipitation and runoff. The vegetation structure and functions are relatively intact and within the range of natural variability, and adverse impacts are not likely occurring in the management area as a result of current groundwater management.
- Although the majority of native, special-status fishes have declined or been extirpated from aquatic habitats in the Owens Valley management area due largely to introduced species, suitable habitat is present for most special-status species with likelihood to occur in the management area.
- Ongoing and planned restoration is intended to expand vegetation and wildlife habitat including GDEs.
- Groundwater dependent vegetation contributes to the ecological function, habitat value, and beneficial uses of many of the creeks within the management area.

Susceptibility to Changing Groundwater Conditions: **Moderate**

- Shallow groundwater conditions outside the Adjudicated Area are not well known and thus groundwater conditions in the management area are assessed based on conditions in the adjacent Adjudicated Area. Current shallow groundwater conditions (since 2015) in the Adjudicated Area are within the range of variability since 1980; fluctuations coincide with wet/dry precipitation periods and no trends in groundwater levels over time are observed.
- Future changes in groundwater conditions in the management area related to increased groundwater production or climate change could cause groundwater levels to fall below the baseline range and result in potential effects on GDEs.
- Streams in the management area may be connected to groundwater at their downstream ends, but interconnected surface waters are likely rare for the majority of streams outside the Adjudicated Area.

Potential for Effects

Available data indicate little or no effect on GDEs related to groundwater management in the Owens Valley Management Area since 1985, when Landsat data became available. However, GDEs are moderately susceptible to potential future changes in groundwater conditions (i.e., increased groundwater extractions) in the management area and the synergistic effects of climate change, which in combination could cause groundwater levels to fall below the baseline range and result in potential effects on GDEs.

Monitoring of ecological conditions and trends in vegetation-dominated GDEs and interconnected surface waters, if present, is recommended to document potential adverse impacts related to future groundwater management and identify projects and management actions that can be implemented to avoid or minimize significant and unreasonable impacts to GDEs.

4.4.2 Owens Lake

Ecological Value: **High**

- The Owens Lake management area supports a relatively large number of special-status species and ecological communities, some of which are directly dependent on groundwater.
- The management area includes designated critical habitat for one federally listed species.
- The management area supports species and ecological communities that are vulnerable to changes in groundwater levels.
- The management area contains 83% of the total GDE acreage in the OVGA Assessment Area.

Ecological Condition: **Undetermined**

- NDVI/NDMI trends in the Owens Lake management area from 1985–2018 show minimal change and indicate that vegetation likely responds mainly to surface water inflows to the lake. The long-term decline in the 90th percentile NDMI and considerable long-term fluctuation in the 75th percentile NDMI value cannot be clearly attributed to groundwater management, precipitation, surface water management related to dust control, or other known factors. There is currently little groundwater extraction in this management unit. The variable NDMI values and very low NDVI values make assessing trends difficult using these polygons and indices alone. Assessment of NDVI changes of the Lake as a whole from 2011-2020 show areas of increase and decrease, suggesting that the overall trends depicted by NDVI in the iGDE polygons may not capture changes in GDE health including the expansion and/or contraction of GDEs. Interpreting NDVI/NDMI values is difficult due to poor map quality in the iGDE database, and could be resolved by analyzing the NDVI/NDMI of the updated GDE map and tracking change for the unit as a whole to allow for adjustments in the extent of GDEs. Consequently, it is uncertain whether vegetation structure and functions will remain intact and within the range of natural variability if pumping projects at Owens Lake proceed.
- Availability and suitability of habitat for those special-status species with likelihood to occur in the management area has varied considerably in response to changes in water management and dust control practices affecting Owens Lake. Ongoing and planned habitat restoration projects should help to maintain or enhance habitat conditions.

Susceptibility to Changing Groundwater Conditions: **Moderate**

- Current shallow groundwater conditions in the Owens Lake Management Area have remained relatively stable, with variations of < 2 ft. Prior fluctuations since 1980 appear related to the extent and duration of surface water on the lakebed.
- Future changes in groundwater conditions in the management area related to increased groundwater production, changes in dust management practices, or climate change could cause groundwater levels to fall below the baseline range. Continued management of the lake to maintain botanical and wildlife habitat should reduce the likelihood of adverse effects.
- There are few surface waterbodies in the management area and only the surrounding springs and seeps are considered to be interconnected surface waters.

Potential for Effects

Available data show that groundwater elevation has been relatively stable and while GDE conditions have been dynamic, there is no clear long-term trend in GDE health in the Owens Lake management area. The susceptibility of GDEs in the management area to future changes in groundwater conditions and climate change is considered moderate, and data are insufficient to predict potential effects on GDEs.

Continued monitoring of shallow groundwater, ecological conditions, and trends in vegetation-dominated GDEs and interconnected surface waters, if present, is recommended to document linkages and potential adverse impacts related to future groundwater management and identify projects and management actions to avoid or minimize impacts to GDEs.

4.4.3 Tri-Valley

Ecological Value: **Low**

- The Tri-Valley management area supports a relatively small number of special-status species and ecological communities and few species that are directly dependent on groundwater.
- The management area includes no designated critical habitat for federally-listed species.
- The management area has few species or ecological communities that are vulnerable to changes in groundwater levels.

Ecological Condition: **Fair**

- NDVI/ NDMI trends from 1985–2018 show small fluctuations in the average NDVI and NDMI related to differences in precipitation and a gradual increase since 2002 that appears unrelated to precipitation. GDEs in the management area with high NDVI values are mostly classified as wet meadows, some of which may be influenced by agricultural runoff. These patterns suggest that vegetation structure and functions are relatively intact and within the range of natural variability, and adverse impacts are not likely occurring in the management area as a result of current groundwater management.
- Suitable habitat is present for those special-status species with likelihood to occur in the management area.

Susceptibility to Changing Groundwater Conditions: **Low**

- Depth to water in monitoring wells in the Tri-Valley management area are typically greater than 85 feet below the ground surface, and the presence of shallow groundwater is not known or monitored, although springs and seeps have been mapped in the management area.
- Due to the depth of groundwater in the management area, future changes in groundwater conditions related to increased groundwater production or climate change are unlikely to affect GDEs.
- There are few surface waterbodies and no interconnected surface waters in the management area.~~, and therefore there are no GDEs associated with surface waters are minimal~~.

Potential for Effects

Available data indicate little or no effect on GDEs related to groundwater management in the Tri-Valley management area. The susceptibility of GDEs in the management area to future changes in groundwater conditions and climate change is low, largely because the depth of groundwater far exceeds the rooting depth of phreatophytic vegetation.

Monitoring of ecological conditions and trends in vegetation-dominated GDEs ~~and the few interconnected surface waters~~ is recommended to document potential adverse impacts related to future groundwater management and identify projects and management actions that can be implemented to avoid or minimize impacts to GDEs. The wet meadow communities in this management area are likely sensitive to changes in groundwater and should be included in future monitoring.

4.4.4 Fish Slough

Ecological Value: **High**

- The Fish Slough management area supports a moderate number of special-status species and ecological communities, some of which are directly dependent on groundwater.
- The management area includes critical habitat for one federally listed species.
- The management area supports species and ecological communities that are vulnerable to changes in groundwater levels.
- A high proportion (74%) of the management area's total area is composed of GDEs.
- Fish Slough provides critically important habitat for at-risk populations of endemic fish and plants.

Ecological Condition: **Fair**

- Groundwater dependent vegetation and spring-fed aquatic habitats in the management area provide crucial ecological function and habitat for native aquatic species, terrestrial species, and plants, as well as ecological communities and designated beneficial uses in and adjacent to the management area.
- The extent and suitability of habitat for those special-status species with likelihood to occur in the management area has likely been reduced as groundwater levels and discharge of springs feeding Fish Slough have declined.
- NDVI/ NDMI trends from 1985–2018 show considerable long-term fluctuation in the management area, some of which appears to be related to wet/dry precipitation periods. A general increase in NDVI since 2005 may reflect changes in the composition and extent of vegetation over time, but NDVI decreases in the patches of tules and cattails during the drought have persisted through 2020. The decline of tules and cattails may be related to declining groundwater or interconnected surface water. BLM has conducted some minor vegetation management in Fish Slough (Nick Buckmaster, personal communication), but to our knowledge it is less extensive than the tule and cattail areas where NDVI declined.
- The vegetation structure and functions in the management area appear relatively intact and within the range of natural variability, but adverse impacts may be occurring as a result of current groundwater management.

Susceptibility to Changing Groundwater Conditions: **High**

- Fish Slough is a spring-complex with interconnected surface water that is primarily sourced from groundwater.
- Depth to water in monitoring wells in the Fish Slough management area and discharge in the springs that feed Fish Slough have experienced long-term declines.
- Declines in NDVI and NDMI along the wetted channel in the Fish Slough management area could reflect decreasing flows.
- Persistence and recovery of special-status fishes and other aquatic and terrestrial groundwater dependent species in the management area are highly dependent on maintaining or increasing shallow groundwater levels and spring discharge.
- Future changes in groundwater conditions in the management area related to increased groundwater production or climate change could cause groundwater levels to fall below the baseline range and exacerbate effects on GDEs.

Potential for Effects

Available data indicate potential effects on GDEs related to groundwater management in the Fish Slough management area. GDEs in the management area are highly susceptible to future changes in groundwater conditions and the synergistic effects of climate change, which in combination could drive further reduction of spring discharge and groundwater levels and exacerbate adverse effects on GDEs. Arresting the reduction in spring flows is likely crucial to maintaining the health of GDEs in Fish Slough.

Monitoring of ecological conditions and trends in aquatic habitats (interconnected surface waters) and vegetation-dominated GDEs is recommended to document potential adverse impacts related to future groundwater management and identify projects and management actions that can be implemented to avoid or minimize impacts to GDEs.

5 GDE MONITORING

The health of GDEs has been monitored extensively in the Adjudicated Area of the Basin by ICWD using remote sensing of vegetation coupled with targeted field verification. Applying a similar approach to GDEs outside the Adjudicated Area would allow the OVGA to efficiently monitor GDEs.

The Fish Slough management area includes both declining interconnected surface water flows since the 1960s (Figure 1.3-1) and declining groundwater levels since the 1980s (Figure 1.3-2). The declining interconnected surface flows pose a threat to aquatic and riparian species. The health of GDEs can be monitored by analyzing remotely gathered NDVI and NDMI. In Fish Slough, pairing monitoring of groundwater levels and interconnected surface water discharge with remote sensing of GDEs would allow the OVGA to monitor the likely driver of GDE decline and correlate it with vegetation response.

The Owens Valley GDE has relatively stable shallow groundwater that falls during droughts and rises during wetter periods, although well data are sparse outside of the Adjudicated Area. The GDEs are distributed along the relatively long management area and would require numerous monitoring wells to track spatial changes in shallow groundwater. Remote sensing could be used to target GDEs that are declining relative to historical conditions. Updating the remote sensing analysis to incorporate the new vegetation maps in the southern portion of the Owens Valley management area would allow the vegetation health indicators to be tracked more accurately.

The Owens Lake GDE has relatively stable shallow groundwater that falls during droughts and rises during wetter periods, but shallow groundwater levels are generally within 15 feet of the ground surface. Assessment of the GDE condition through time in this management unit is complicated by the poor map quality in the iGDE database, but updating maps to include the Great Basin wetland map and the Jawbone Canyon and Owens Valley vegetation map should remove the large patches of relatively low NDVI data that skews the results. Continued monitoring of existing wells and remote sensing of vegetation should identify any declines in GDE health.

The Tri-Valley management area has declining groundwater levels, but the presence or changes to shallow groundwater are unknown. Continued monitoring of vegetation using remote sensing with NDVI and NDMI can be used to assess changes with time.

Assessing the groundwater dependence for much of the Owens Valley and Tri-Valley management units requires better quantifying the groundwater dependence of potential GDE polygons mapped in the units. Long-term monitoring, including surveying the presence and distribution groundwater dependent special-status species within the mapped GDEs, should be incorporated into future GDE management plans. Many of the animal species that likely occur within mapped GDEs are categorized as indirectly dependent on groundwater. The extent that the species require groundwater for survival within these GDE units is unknown, particularly in the Owens Valley and Tri-Valley management units. Monitoring of special-status species alongside monitoring GDE health would provide information regarding species dependence on groundwater within the Owens Valley Basin as well as inform the effect on population trends from management activities of these species over time. A focal species approach would be used to understand broader ecosystem linkages so that management actions directed to benefit these species will also benefit the larger ecosystem. This long-term species' monitoring would be used to evaluate the potential effects of changing groundwater, interconnected water supply, and associated GDE vegetation communities on special-status species populations.

6 LITERATURE CITED

CA Dept. of Forestry and Fire Protection (CalFire). 2015. Fire and Resource Assessment Program (FRAP) FVEG [ESRI File Geodatabase]. Sacramento, CA. Accessed October 2016.

CA Department of Water Resources 2016

CDFW (California Department of Fish and Wildlife). VegCAMP. 2014. Fish Slough. Digital vegetation map managed through the California Vegetation Classification and Mapping Program (VegCAMP). Accessed January 2016.

CDFW. 2019. California Natural Diversity Database. RareFind 5 [Internet], Version 5.1.1. [accessed: March 2019].

CDFW. 2020a. Special Vascular Plants, Bryophytes, and Lichens List. Accessed November 2020.

CDFW. 2020b. Sensitive Natural Communities List. Accessed November 2020.

CNPS. 2019. A Manual of California Vegetation, online edition. http://www.cnps.org/cnps/vegetation/ [accessed July 2019]. California Native Plant Society, Sacramento, California.

Danskin, W.R. 1998. Evaluation of the hydrologic system and selected water-management alternatives in the Owens Valley, California (Vol. 2370). US Geological Survey, Information Services.

DWR 2020a. Sustainable Groundwater Management Act 2019 Basin Prioritization Process and Results. May 2020. https://water.ca.gov/Programs/Groundwater-Management/Basin-Prioritization

DWR. 2020b. Natural Communities Commonly Associated with Groundwater Dataset Viewer. https://gis.water.ca.gov/app/NCDatasetViewer/#. Accessed November 2020.

eBird. 2020. eBird: An online database of bird distribution and abundance. Website [accessed November 2020]. eBird, Cornell Lab of Ornithology, Ithaca, New York.

Fan, Y., Miguez-Macho, G., Jobbágy, E.G., Jackson, R.B. and Otero-Casal, C., 2017. Hydrologic regulation of plant rooting depth. Proceedings of the National Academy of Sciences, 114(40), pp.10572-10577.

Groeneveld, D. 1992. Owens Valley, California, plant ecology: effects from export groundwater pumping and measures to conserve the local environment. In The History of Water: Eastern Sierra Nevada, Owens Valley, White-Inyo Mountains (Vol. 4, pp. 128–155). University of California Los Angeles, CA.

Hall, Clarence A., Jr. 1991. Natural History of the White-Inyo Range, Eastern California. Berkeley, California. Available at http://ark.cdlib.org/ark:/13030/ft3t1nb2pn/

Herbst, D.B. and M. Prather, 2014, Owens Lake – from Dustbowl to Mosaic of Salt Water Habitats: Lakeline Magazine, Fall 2014.

Hershler, R. 1989. Springsnails (*Gastropoda: Hydrobiidae*) of Owens and Amargosa River (exclusive of Ash Meadows) drainages, Death Valley System, California-Nevada. Proceedings of the Biological Society of Washington 102:176–248.

Hollett, K.J., Danskin, W.R., McCaffrey, W.F., and Walti, C.L., 1991, Geology and water resources of Owens Valley, California: U.S. Geological Survey Water-Supply Paper 2370-B.

Huntington, J., McGwire, K., Morton, C., Snyder, K., Peterson, S., Erickson, T., Niswonger, R., Carroll, R., Smith, G. and Allen, R., 2016. Assessing the role of climate and resource management on groundwater dependent ecosystem changes in arid environments with the Landsat archive. Remote sensing of Environment, 185, pp.186-197.

Inyo County/City of Los Angeles Technical Group. 1990. Green Book for the long-term groundwater management plan for the Owens Valley and Inyo County. 176 pp.

ICWD (Inyo County Water Department). 2020. Shapefile of kept and removed vegetation polygons from the DWR Natural Communities Commonly Associated With Groundwater Database. Shapefile provided by Aaron Steinwand.

Jones and Stokes and Great Basin Unified Air Pollution Control District. 1996. Delineation of Waters of the United States for the Owens Lake Playa. Prepared for the U.S. Army Corps of Engineers. Data provided by Grace Holder, Great Basin Unified Air Pollution Control District.

Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, and A. Lyons. 2018. Mapping indicators of groundwater dependent ecosystems in California. https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf

Klausmeyer, K. R., T. Biswas, M. M. Rohde, F. Schuetzenmeister, N. Rindlaub, and J. K. Howard. 2019. GDE pulse: taking the pulse of groundwater dependent ecosystems with satellite data. San Francisco, California. Available at https://gde.codefornature.org

Lahontan RWQCB (Regional Water Quality Control Board Lahontan Region). 2016. Water Quality Control Plan for the Lahontan Region, North and South Basins. Lahontan RWQCB, South Lake Tahoe, California.

Lichvar, R. W., D. L. Banks, W. N. Kirchner, and N. C. Melvin. 2016. The National wetland plant list: 2016 wetland ratings. Phytoneuron 2016–30: 1–17.

Los Angeles Department of Water and Power (LADWP). 2010. Owens Lake Habitat Management Plan. March 2010.

LADWP. 2015. Habitat Conservation Plan for Los Angeles Department of Water and Power's operations, maintenance, and management activities on its land in Mono and Inyo Counties, California. August 2015.

LADWP. 2019a. 2019 Lower Owens River Project Annual Report.

LADWP. 2019b. 2019 Annual Owens Valley Report.

LADWP. 2021. Consolidated Hydrologic Monitoring at Owens Lake, Quarterly Report – December 2020.

LADWP and Ecosystems Sciences. 2010. Owens Valley Land Management Plan.

LADWP and MWH. 2011. Owens Lake Groundwater Evaluation Project. Updated Conceptial Model Report – FINAL.

Manning, S.J. 1997. Plant communities of LADWP land in the Owens Valley: an exploratory analysis of baseline conditions. Inyo County Water Department report, Inyo County Water Department, Bishop, California.

Mathie, A.M., Welborn, T.L., Susong, D.D., and Tumbusch, M.L., 2011, Phreatophytic land-cover map of the northern and central Great Basin Ecoregion: California, Idaho, Nevada, Utah, Oregon, and Wyoming: U.S. Geological Survey Scientific Investigations Map 3169. Available at http://pubs.usgs.gov/sim/3169/.

Menke, J.; Hepburn, A.; Johnson, D.; Reyes, E.; Glass, A.; Evens, J.; Winitsky, S. Sikes, K. 2020 (in progress). Vegetation Mapping and Classification of the Jawbone Canyon Region and Owens Valley. Report to Bureau of Land Management. Aerial Information Systems, Redlands, California.

Moyle, P. B., R. M. Quiñones, J. V. Katz, and J. Weaver. 2015. Fish species of special concern in California. Third edition. California Department of Fish and Wildlife, Sacramento.

National Academies of Sciences, Engineering, and Medicine. 2020. Effectiveness and Impacts of Dust Control Measures for Owens Lake. Washington, DC: The National Academies Press. https://doi.org/10.17226/25658.

Nuvis. 2013. Owens Lake Master Project. Prepared for the Los Angeles Department of Water and Power. April 2013.

Orme, A.R. and Orme, A.J., 2008, Late Pleistocene shorelines of Owens Lake, California, and their hydroclimatic and tectonic implication, in Reheis, M.C., Hershler, R., and Miller, D.M., eds., Late Cenozoic Drainage History of the Southwestern Great Basin and Lower Colorado River Region: Geologic and Biotic Perspectives: Geological Society of America Special Paper 439, p. 207–226.

Paskier, L.C., M.F. Kane, and W.H. Jackson, 1964, Volcanism of Owens Valley Region, California—A Geophysical Study, Geological Survey Professional Paper 438 prepared partly in cooperation with the California Division of Mines and Geology.

Rohde, M. M., S. Matsumoto, J. Howard, S. Liu, L. Riege, and E. J. Remson. 2018. Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans. The Nature Conservancy, San Francisco, California.

Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California.

Sorenson, S.K, P.D. Dileanis, and F.A. Branson, 1991, Soil water and vegetation responses to precipitation and changes in depth to groundwater in Owens Valley, California: U.S. Geological Survey Water-Supply Paper 2370-G.

State of California. 2014. Sustainable Groundwater Management Act.

Steinwand, A.L., Harrington, R.F. and Groeneveld, D.P., 2001. Transpiration coefficients for three Great Basin shrubs. Journal of Arid Environments, 49(3), pp.555–567.

Steinwand, A.L., Harrington, R.F. and Or, D. 2006. Water balance for Great Basin phreatophytes derived from eddy covariance, soil water, and water table measurements. Journal of Hydrology, 329(3–4), pp.595–605.

Swain, D.L., Langenbrunner, B., Neelin, J.D. and Hall, A., 2018. Increasing precipitation volatility in twenty-first-century California. Nature Climate Change, 8(5), pp.427–433.

Tallyn, E.F., 2002, Soil survey of Benton-Owens Valley area, California, parts of Inyo and Mono Counties. U.S. Department of Agriculture, Natural Resources Conservation Service.

TNC. 2019a. Freshwater species list for Owens Valley and Fish Slough Groundwater Basins. https://groundwaterresourcehub.org/sgma-tools/environmental-surface-water-beneficiaries

TNC. 2019b. GDE pulse. Interactive map. Website. https://gde.codefornature.org/#/home [accessed July 2019].

US Department of Agriculture - Forest Service. 2014. Existing Vegetation Great Basin, 1999–2009, v1 [ESRI File Geodatabase]. MeClellan, CA. Accessed June 2016.

US Department of Agriculture - Forest Service. 2014. Existing Vegetation South Sierra, 2000–2008, v1 [ESRI File Geodatabase]. MeClellan, CA. Accessed June 2016.

US Department of Agriculture - Forest Service. 2014. Existing Vegetation South Interior, 2000–2008, v1 [ESRI File Geodatabase]. MeClellan, CA. Accessed June 2016.

USFS (U.S. Forest Service). 2011. FSM 2600 – Wildlife, Fish, and Sensitive Plant Habitat Management, Chapter 2670 – Threatened, Endangered, and Sensitive Plants and Animals. Forest Service Manual Rocky Mountain Region (Region 2). Denver, CO.

USFWS (U.S. Fish and Wildlife Service). 1998. Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties. Portland, Oregon.

USFWS. 2005. Endangered and threatened wildlife and plants; designation of critical habitat for *Astragalus lentiginosus var. piscinensis* (Fish Slough Milk-Vetch). Federal Register 70 (10), No. 110. 33774–33795.

USFWS. 2008. Endangered and threatened wildlife and plants; designation of critical habitat for the Sierra Nevada Bighorn Sheep (*Ovis canadensis sierrae*) and Taxonomic Revision; Final Rule. Federal Register 73 45534–45604.

USFWS. 2016. Endangered and threatened wildlife and plants; designation of critical habitat for the Sierra Nevada yellow-legged frog, the Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad; final rule. Federal Register 81 9046–59119.

USFWS. 2018. National Wetlands Inventory website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. http://www.fws.gov/wetlands/

Appendices

Appendix 9-A

GDE Vegetation Communities in Owens Valley Management Areas

Table A-1. Certain and Likely GDE Vegetation types (by source) in Owens Valley management areas.

Vegetation type	Area (acres)				
	Fish Slough	Owens Lake	Owens Valley	Tri-Valley	Total
Classification and Assessment with Landsat of Visible Ecological Groupings (CALVEG)					
Alkaline mixed grasses and forbs alliance			24.6		**24.6**
Alkaline Mixed Scrub Alliance	136.2	27.4	131.4	782.9	**1,077.9**
Annual Grasses and Forbs Alliance			1.3		**1.3**
Barren			60.9		**60.9**
Bitterbrush Alliance			9.3		**9.3**
Black Cottonwood Alliance			36.2	3.0	**39.3**
Canyon Live Oak Alliance		0.0			**0.0**
Desert Mixed Shrub Alliance			5.6		**5.6**
Eastside Pine Alliance			34.6		**34.6**
Ephedra Alliance			1.9		**1.9**
Fremont Cottonwood Alliance		17.8	250.0	1.1	**268.9**
Grain and Crop Agriculture			1.2		**1.2**
Greasewood Alliance			0.1		**0.1**
Great Basin – Desert Mixed Scrub Alliance			22.2		**22.2**
Great Basin Mixed Scrub Alliance			5.5		**5.5**
High Desert Mixed Scrub Alliance			9.7		**9.7**
Horsebrush Alliance			1.1		**1.1**
Indigo Bush Alliance			0.1		**0.1**
Perennial Grass/Forb Alliance			6.0		**6.0**
Playas (desert basin features)			1.4		**1.4**
Quaking Aspen Alliance		0.2	140.4		**140.6**
Riparian Mixed Hardwood Alliance		6.8	323.5		**330.3**
Saltbrush Alliance			24.1		**24.1**
Shadescale Alliance			2.4		**2.4**
Shrub Willow Alliance		1588.0	1,149.8	110.3	**2,848.1**
Singleleaf Pinyon Pine Alliance		5.3	25.3		**30.6**
Tule - Cattail Alliance		233.6	11.4		**244.9**
Water			4.4		**4.4**
Water Birch Alliance		4.8	245.9		**250.7**
Wet Meadow Alliance		13.6	1,082.7	112.8	**1,209.1**
Willow Alliance		52.8	392.7		**445.5**
Fire and Resource Assessment Program's (FRAP)					
Alkali Desert Scrub		29.9	0.5		**30.4**
Barren		0.0			**0.0**
Desert Riparian		0.0			**0.0**
Desert Scrub		0.0			**0.0**
Montane Riparian		18.7	6.4		**25.2**
Sagebrush		1.6	45.4		**47.0**
Great Basin Unified Air Control District (GBUACD)					
Wetland		158.2	1.0		**159.3**

Vegetation type	Area (acres)				
	Fish Slough	**Owens Lake**	**Owens Valley**	**Tri-Valley**	**Total**
Indicators of Groundwater Dependent Ecosystems (iGDE) – National Hydrography Dataset (NHD)					
Seep or Spring		2.5	7.2	4.1	**13.8**
iGDE – National Wetland Inventory (NWI)					
Lacustrine, Littoral, Unconsolidated Shore, Seasonally Flooded		0.2			**0.2**
Palustrine, Emergent, Persistent, Seasonally Flooded		0.8	174.5	0.5	**175.8**
Palustrine, Emergent, Persistent, Seasonally Saturated		4.0	59.4	2.6	**66.1**
Palustrine, Forested, Broad-Leaved- Evergreen, Seasonally Saturated		0.8			**0.8**
Palustrine, Forested, Seasonally Flooded			15.5		**15.5**
Palustrine, Forested, Seasonally Saturated			22.0		**22.0**
Palustrine, Scrub-Shrub, Broad-Leaved-Evergreen, Seasonally Flooded			0.3		**0.3**
Palustrine, Scrub-Shrub, Broad-Leaved-Evergreen, Seasonally Saturated		4.8	56.3		**61.1**
Palustrine, Scrub-Shrub, Seasonally Flooded		8.8	113.6	13.8	**136.2**
Palustrine, Scrub-Shrub, Seasonally Saturated		0.1	59.4	0.9	**60.4**
Palustrine, Unconsolidated Bottom, Permanently Flooded			0.1		**0.1**
Palustrine, Unconsolidated Shore, Seasonally Flooded			2.9		**2.9**
Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded			0.7		**0.7**
Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded		1.2	50.1	1.4	**52.8**
Riverine, Upper Perennial, Rock Bottom, Permanently Flooded		7.2	16.0		**23.2**
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded			6.4		**6.4**
Vegetation Classification and Mapping Program (VegCAMP) – Fish Slough					
Alkaline Mixed Grasses and Forbs	547.1		17.1		**564.2**
Alkaline Mixed Scrub	574.2		44.4		**618.6**
Big Sagebrush			4.3		**4.3**
Fremont Cottonwood	7.5				**7.5**
Greasewood	573.0		62.6		**635.6**
Rabbitbrush	54.7		1.1		**55.8**
Tule-Cattail	276.1		17.6		**293.7**
Water	9.6				**9.6**
Wet Meadows	10.1				**10.1**
Willow (shrub)	2.0				**2.0**

Vegetation type	Area (acres)				
	Fish Slough	Owens Lake	Owens Valley	Tri-Valley	Total
VegCAMP – Jawbone Canyon Region and Owens Valley					
Ambrosia dumosa		8.0	35.6		**43.6**
Ambrosia salsola – Bebbia juncea Alliance			2.4		**2.4**
Anemopsis californica		39.3			**39.3**
Anthropogenic Areas of Little or No Vegetation		0.5	1.1		**1.6**
Arid West Freshwater Emergent Marsh Group		11.2			**11.2**
Artemisia tridentata		17.2	122.0		**139.2**
Atriplex canescens		<0.1	1.5		**1.5**
Atriplex confertifolia		5.8	11.5		**17.3**
Atriplex lentiformis		1.3	6.2		**7.5**
Atriplex polycarpa		55.5	27.3		**82.8**
Baccharis sergiloides		1.8			**1.8**
Betula occidentalis		5.5	221.9		**227.4**
Bolboschoenus maritimus, *Schoenoplectus americanus*		130.8			**130.8**
Built-up & Urban Disturbance		21.9	29.6		**51.5**
Chorizanthe rigida – Geraea canescens Desert Pavement Sparsely Vegetated		8.2			**8.2**
Coleogyne ramosissima		9.3	25.6		**34.9**
Dicoria canescens – Abronia villosa		1.1			**1.1**
Distichlis spicata		5,367.9	9.7		**5,377.6**
Ephedra nevadensis – Lycium andersonii – Grayia spinosa		11.2	219.1		**230.3**
Ericameria nauseosa		26.1	32.2		**58.3**
Ericameria nauseosa – Atriplex lentiformis Mapping Unit		15.5	18.8		**34.3**
Eriogonum fasciculatum – (*Viguiera parishii*) Alliance		2.8	15.1		**17.9**
Eucalyptus spp. – *Ailanthus altissima – Robinia pseudoacacia*		3.2	11.6		**14.8**
Exotic Trees			6.4		**6.4**
Forestiera pubescens			0.6		**0.6**
Irrigated Pastures		3.3	27.6		**30.9**
Juncus arcticus (var. *balticus*, *mexicanus*)		108.9	2.7		**111.6**
Larrea tridentata – Ambrosia Dumosa		20.4			**20.4**
Major Canals and Aqueducts		0.1			**0.1**
Non-woody Row and Field Agriculture		3.6			**3.6**
North American Warm Desert Dunes and Sand Flats Group		0.2			**0.2**
Perennial Stream Channel			0.7		**0.7**
Pinus jeffreyi Alliance			3.3		**3.3**
Pinus monophyla			1.2		**1.2**
Populus fremontii		82.6	5.0		**87.6**
Populus trichocarpa		1.3	5.0		**6.3**
Psorothamnus fremontii – Psorothamnus polydenius		11.3	0.4		**11.7**
Purshia tridentata			19.7		**19.7**

Vegetation type	Area (acres)				
	Fish Slough	Owens Lake	Owens Valley	Tri-Valley	Total
Quercus chrysolepis		14.3			**14.3**
Quercus wislizeni			5.5		**5.5**
Restoration		3,562.2			**3,562.2**
Rosa woodsii			6.4		**6.4**
Salix exigua		16.4	53.1		**69.5**
Salix gooddingii – Salix laevigata Alliance		11.8	26.1		**37.9**
Salix lasiolepis		10.5	63.9		**74.4**
Sarcobatus vermiculatus		10,578.3	200.5		**10,778.8**
Schoenoplectus (*acutus*, *californicus*)		502.8	1.5		**504.3**
Sparsely Vegetated Playa (Ephemeral Annuals)		5,477.8	11.0		**5,488.8**
Sparsely Vegetated Recent Burned Areas			15.3		**15.3**
Sporobolus airoides		103.2	55.3		**158.5**
Suaeda moquinii – Isocoma acradenia Alliance		2,396.1			**2,396.1**
SW North American Riparian/Wash Scrub Group			2.3		**2.3**
Tamarix spp.		151.1	0.2		**151.3**
Typha (*angustifolia*, *domingensis*, *latifolia*) Alliance		18.9	3.7		**22.6**
Unvegetated Wash and River Bottom		0.2	1.4		**1.6**
Vancouverian and Rocky Mountain Naturalized Annual Grassland Group		22.2	12.0		**34.2**
Warm Semi-Desert/Mediterranean Alkali-Saline Wetland Macrogroup		1,777.7			**1,777.7**
Water		1.9	0.9		**2.8**
Water Impoundment Feature		165.5			**165.5**
Yucca brevifolia		1,521.4			**1,521.4**
VegCAMP – Mojave					
Big Sagebrush		223.3			**223.3**
Iodine Bush-Bush Seepweed		4,753.4			**4,753.4**
Joshua Tree		935.1			**935.1**
Shadscale		2,625.4	1.3		**2,626.7**
White Burrobush		3,094.8			**3,094.8**
Total	**2,190.5**	**46,129.2**	**6,114.7**	**1,033.4**	**55,468.2**

References

USFWS (U.S. Fish and Wildlife Service). 2020. Endangered and threatened wildlife and plants; designation of critical habitat for the Revised Designation of critical habitat for the Western Distinct Population Segment of the Yellow- Billed Cuckoo; proposed rule. Federal Register 85: 11,458–11,594.

USGS (US Geological Survey). 2002. Central Mojave vegetation database. Digital vegetation map managed through the California Vegetation Classification and Mapping Program (VegCAMP). Prepared by USGS, Western Ecological Research Center. Accessed January 2016.

USGS. 2016. National hydrography dataset, high resolution, v220. Washington D.C. Retrieved from ftp://nhdftp.usgs.gov/DataSets/Staged/States/FileGDB/HighResolution/NHDH_CA_931v220.zip.

U.S. National Park Service. 2012. Geospatial Vegetation Information for the Manzanar National Historical Site Vegetation Inventory Project. Accessed January 2016.

Zdon, A., K. Rainville, N.Buckmaster, S. Parmenter, and A. H. Love. 2019. Identification of Source Water Mixing in the Fish Slough Spring Complex, Mono County, California. Hydrology 6: 26.

Appendix 9-B

Special-status Wildlife and Aquatic Species from Database Queries

Table B-1. Special-status terrestrial and aquatic animal species with known occurrence, or presence of suitable habitat in the Owens Valley Groundwater Authority (OVGA) Assessment Area.

Common name *Scientific name*	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Mammals					
California wolverine *Gulo gulo*	FPT, FSS/ST, SFP	Likely (limited distribution)	CNDDB	No known reliance on groundwater	Dense mixed-conifer forest in North Coast and Sierra Nevada mountains of California; uses caves, hollows, logs, rock outcrops, and burrows for cover. Nocturnal, solitary, species which are primarily scavengers. Wolverines will also prey on small to medium sized mammals. Individuals have very large home ranges, and they are known to travel great distances, occasionally in daylight. Females require dens that are excavated in snow deeper than 5 feet. Occurring in North Coast at 1,600–4,800 feet and in Sierra Nevada mountains at 4,300–10,800 feet. Documented in the vicinity of Owens Valley management area east of Seven Pines (CDFW 2019).
Long-legged myotis *Myotis volans*	BLMS/–	Likely	CNDDB	Indirect	Most common in woodland and forest habitats above 4000 feet, but also found in chaparral, coastal scrub, Great Basin shrub habitats, from sea level to 11,400 feet. Feeds on flying insects, primarily moths, over water and open habitats. Documented in Owens Valley management areas near Laws and in the vicinity of the Owens Lake management area (CDFW 2019). Drinks water, feeds over water, and may be found in riparian habitat. Facultatively groundwater dependent (TNC 2019a).

Common name ***Scientific name***	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Mohave ground squirrel *Xerospermophilus mohavensis*	BLMS/ST	Likely	CNDDB	Indirect	Prefers desert scrub (e.g., open and alkali) and Joshua tree communities with sandy to gravelly soils and flat to moderately hilly terrain. Typically documented at 1,800 and 5,000 feet elevation. Relies on groundwater-dependent vegetation for forage (Rhode et al. 2019). Documented in Owens Lake management area (CDFW 2019).
Owens Valley vole *Microtus californicus vallicola*	BLMS/SSC	Likely	CNDDB	Indirect	Nocturnal short-tailed vole with limited range in Owens Valley and Fish Slough, most common in native meadows. Much of their time is spent underground in burrows; foraging takes place on above-ground runways connecting burrows. Feeds on stems and leaves of forbs and grasses. Documented in Owens Valley, Owens Lake, Fish Slough, and Tri-Valley management areas (CDFW 2019).
Pallid bat *Antrozous pallidus*	FSS, BLMS/ SSC	Likely	CNDDB	No known reliance on groundwater	Roosts in rock crevices, tree hollows, mines, caves, and a variety of vacant and occupied buildings; feeds in a variety of open woodland habitats. Habitat and prey (e.g., insects and arachnids) not associated with aquatic ecosystems. Documented in Owens Valley, Owens Lake, and Fish Slough management areas (CDFW 2019).
Sierra Nevada bighorn sheep *Ovis canadensis sierrae*	FE/SE	Likely	CNDDB	Indirect	Prefer open arid habitat including alpine meadows, summit plateaus, and hanging meadows fed by springs. It relies on groundwater-dependent herbaceous plants, grasses, and shrubs (Rhode et al. 2019). Typically found at high elevations in the summer (10,000–14,000 ft) and lower elevations in the winter (5,000–9,000 feet). USFWS critical habitat overlaps with the Owens Lake and Owens Valley management areas.

Common name ***Scientific name***	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Sierra Nevada red fox *Vulpes vulpes necator*	FPE, FSS/ST	Likely	CNDDB	Indirect	Depends on ground-water dependent vegetation for its habitat and foraging habitat (Rhode et al. 2019). Prefers wet meadows to forested areas; high-elevation conifer forest, and sub-alpine woodlands; dense vegetation and rocky areas for den sites. Preys on small mammals and lagomorphs (e.g., rabbits and pikas). Elevational distribution is 5,000 to 7,000 ft. Documented in Owens Valley management area, including vicinity of Bishop and 1.8 miles west of Rovanna (CDFW 2019).
Spotted bat *Euderma maculatum*	BLMS/SSC	Likely	CNDDB	Indirect	Highly associated with cliffs and rock crevices, although may occasionally use caves and buildings; inhabit arid deserts, grasslands, and mixed coniferous forests. Feeds on moths over water and along washes. Drinks water. Documented in Owens Valley management area, in the vicinity of Bishop, and throughout the Owens Lake management area (CDFW 2019).
Townsend's big-eared bat *Corynorhinus townsendii*	FSS, BLMS/SSC	Likely	CNDDB	Indirect	Most abundant in mesic habitats, also found in oak woodlands, desert, vegetated drainages, caves or cave-like structures (including basal hollows in large trees, mines, tunnels, and buildings) and riparian communities. Feeds on moths, beetles, and sofeet-bodied insects and drinks water. Documented in Owens Valley, Owens Lake, and Fish Slough management areas (CDFW 2019).
Western small-footed myotis *Myotis ciliolabrum*	BLMS/–	Likely	CNDDB	Indirect	Found in arid, upland habitats and prefers open stands in forests and woodlands as well as brushy habitats near water. Utilize caves, buildings, mines, and crevices for cover. Prey includes small flying insects. Forages among trees and over water. Drinks water. Documented in Owens Valley management area (CDFW 2019).

Common name *Scientific name*	Status[1] Federal/State	Potential to occur in GDE management areas	Query source[2]	GDE association[3]	Habitat and documented occurrences in management areas
Western white-tailed jackrabbit *Lepus townsendii townsendii*	–/SSC	Likely	CNDDB	No known reliance on groundwater	Nocturnal solitary species with most activity occurring near dusk. Found in plains, prairies, sagebrush, and alpine meadows with scattered coniferous trees, up to 14,000 ft in elevation (Hall 1991). Feeds on grasses and shrubs. Documented in Owens Valley management area near Bishop (CDFW 2019).
Yuma myotis *Myotis yumanensis*	BLMS/–	Likely	CNDDB	Indirect	Use a variety of habitats including riparian, agriculture, shrub, urban, desert, , open forests and woodlands. Distribution is strongly associated with water; drinks water and forages near or over waterbodies. Documented in Owens Lake management area (CDFW 2019).
Birds					
American white pelican *Pelecanus erythrorhynchos*	–/SSC (nesting colonies)	Likely	CAFSD, eBird	Indirect	Salt ponds, large lakes, and estuaries; loafs on open water during the day; roosts along water's edge at night. Forages for small fish in shallow water on inland marshes. Owens Valley and Fish Slough are both used during pre-breeding migration; breeding likely occurs in areas of Fish Slough (eBird 2020). Occurrences in Owens Lake, Owens Valley and Fish Slough management areas (eBird 2020).
Bald eagle *Haliaeetus leucocephalus*	FD, BGEPA, BLMS/SE, SFP	Likely	CNDDB, CAFSD, eBird	Indirect	Large bodies of water or rivers with abundant fish, uses snags or other perches; nests in advanced-successional conifer forest near open water (e.g., lakes, reservoirs, rivers). Bald eagles are reliant on surface water that may be supported by groundwater and/or groundwater-dependent vegetation (Rhode et al. 2019). Occurrences in Owens Lake, Tri-Valley (eBird 2020), and Owens Valley management areas (eBird 2020, CDFW 2019).

Common name ***Scientific name***	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Bank swallow *Riparia riparia*	BLMS/ST	Likely	CNDDB, CAFSD, eBird	Indirect	Nests in vertical bluffs or banks, usually adjacent to water (i.e., rivers, streams, ocean coasts, and reservoirs), where the soil consists of sand or sandy loam. Feeds on caterpillars, insects, frog/lizards, and fruit/berries. Relies on surface water that may be supported by groundwater (Rohde et al 2019). Occurrences in Owens Valley (CDFW 2019, eBird 2020), Fish Slough, Tri-Valley, and Owens Lake management areas (eBird 2020).
Black tern *Chlidonias niger*	–/SSC	Likely	CAFSD, eBird	Indirect	Nests semi-colonially in protected areas of marshes with floating nests. Feeds on insects. Owens Valley and Fish Slough are used for pre-breeding and post-breeding migration (eBird 2020). Occurrences in Owens Lake, Owens Valley, and Fish Slough management areas (eBird 2020).
Burrowing owl *Athene cunicularia*	BLMS/SSC	Likely	CNDDB, eBird	No known reliance on groundwater	Level, open, dry, heavily grazed or low- stature grassland or desert vegetation with available burrows. Preys on invertebrates and vertebrates. Occurrences in Owens Valley, Fish Slough (CDFW 2019, eBird 2020), and Owens Lake management areas (eBird 2020).
Golden eagle *Aquila chrysaetos*	BGEPA, BLMS/SFP	Likely	CNDDB, eBird	No known reliance on groundwater	Open woodlands and oak savannahs, grasslands, chaparral, sagebrush flats; nests on steep cliffs or medium to tall trees. Primary prey are small to medium mammals and birds; also scavenge and catch fish. Occurrences in Fish Slough (CDFW 2019, eBird 2020), Owens Valley, Owens Lake, and Tri-Valley management areas (eBird 2020).
Le Conte's thrasher *Toxostoma lecontei*	BLMS/SSC	Likely	CNDDB, eBird	No known reliance on groundwater	Desert scrub, mesquite, tall riparian brush and, chaparral. Preys on insects and spiders; also feeds on seeds and berries. Occurrences in Owens Lake (CDFW 2019, eBird 2020), Owens Valley, and Fish Slough management areas (eBird 2020).

Common name ***Scientific name***	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Least Bell's vireo *Vireo bellii pusillus*	FE/SE	Unlikely	CNDDB, CAFSD	Indirect	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy. This species relies on groundwater-dependent vegetation in riparian areas, particularly during breeding periods (Rohde et al 2019). Eats insects, fruits, and berries. Occurrences in Owens Valley and Owens Lake management areas are presumed extirpated (CDFW 2019).
Least bittern *Ixobrychus exilis*	FSS/SSC	Likely	CNDDB, CAFSD, eBird	Indirect	Freshwater and brackish marshes with dense aquatic or semiaquatic vegetation interspersed with clumps of woody vegetation and open water. Prey includes fish, frogs, crayfish, crustaceans, insects, and small rodents. Occurrences in Owens Lake management area (CDFW 2019, eBird 2020), and in the vicinity of Owens Valley management area (CDFW 2019, eBird 2020).
Loggerhead shrike *Lanius ludovicianus*	–/SSC	Likely	CNDDB, eBird	No known reliance on groundwater	Open shrubland or woodlands with short vegetation and and/or bare ground for hunting; some tall shrubs, trees, fences, or power lines for perching; typically nest in isolated trees or large shrubs. Feeds on insects, amphibians, reptiles, small mammals, and birds. Occurrences in Owens Lake (CDFW 2019, eBird 2020), Owens Valley, Fish Slough, and Tri-Valley management areas (eBird 2020).
Long-eared owl *Asio otus*	BLMS/SSC	Likely	CNDDB, eBird	Indirect	Riparian habitat; nests in dense vegetation close to open grassland, meadows, riparian, or wetland areas for foraging. Prey on small mammals. Occurrences in Owens Valley (CDFW 2019, eBird 2020), Owens Lake Fish Slough, and Tri-Valley management areas (eBird 2020).
Lucy's warbler *Oreothlypis luciae*	–/SSC	Likely	CAFSD, eBird	Indirect	Breeds in riparian mesquite woodlands. Preys on aquatic organisms including insects, crustaceans, zooplankton, and invertebrates. Owens Valley, Owens Lake area, and southern areas of Fish Slough are used for breeding (eBird 2020). Occurrences in Owens Valley and Owens Lake management areas (eBird 2020).
Mountain plover *Charadrius montanus*	FPT, BLMS/SSC	Likely	CNDDB, eBird	No known reliance on groundwater	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grain fields. Preys on insects.

Common name *Scientific name*	Status[1] Federal/State	Potential to occur in GDE management areas	Query source[2]	GDE association[3]	Habitat and documented occurrences in management areas
					Occurrences in Owens Valley and Owens Lake management areas (CDFW 2019, eBird 2020).
Northern goshawk *Accipiter gentilis*	FSS/SSC	Likely	CNDDB, CAFSD, eBird	No known reliance on groundwater	Mature and old-growth stands of coniferous forest, middle and higher elevations; nests in dense part of stands near an opening. May hunt in riparian corridors. Preys on birds, mammals, and reptiles. Occurrences in the vicinity of Fish Slough (eBird 2020) and Owens Valley management areas (CDFW 2019, eBird 2020).
Northern harrier *Circus hudsonius*	–/SSC	Likely	CNDDB, eBird	Indirect	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields. Eats small mammals, amphibians, reptiles, and birds. Occurrences in Owens Valley (CDFW 2019, eBird 2020), Owens Lake, Fish Slough and Tri-Valley management areas (eBird 2020).
Redhead *Aythya americana*	–/SSC	Likely	CAFSD, eBird	Indirect	Freshwater emergent wetlands with dense stands of cattails (*Typha* spp.) and bulrush (*Schoenoplectus* spp.) interspersed with areas of deep, open water; forage and rest on large, deep bodies of water. Summer resident in southern California. Owens Valley management area used during pre-breeding migration and occasionally for breeding. Occurrences in Owens Lake, Owens Valley, and historical sightings in Fish Slough management areas (eBird 2020).
Southwestern willow flycatcher *Empidonax traillii extimus*	FE/SE	Likely	CNDDB, CAFSD	Indirect	Dense brushy thickets within riparian woodland often dominated by willows and/or alder, near permanent standing water. Reliant on groundwater-dependent riparian vegetation, including for nest sites that are typically located near slow-moving streams, or side channels and marshes with standing water and/or wet soils (Rohde et al 2019). Feeds on insects, fruits, and berries. Occurrences in Fish Slough and Owens Valley management areas (CDFW 2019).

Common name *Scientific name*	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Summer tanager *Piranga rubra*	–/SSC	Likely	CAFSD, eBird	Indirect	Open mixed lowland forests, nesting in mature riparian cottonwood forests. Feed on bees, wasps, and other insects. Owens Valley and Fish Slough management areas are used for breeding. Occurrences documented in Owens Valley management area, and in the vicinity of Owens Lake management area (eBird 2020).
Swainson's hawk *Buteo swainsoni*	–/ST	Likely	CNDDB, eBird	Indirect	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields. Swainson's hawks rely on groundwater-dependent vegetation in riparian woodland areas for nesting (Rohde et al 2019). Preys on mammals and insects. Occurrences in Owens Valley, Tri-Valley (CDFW 2019, eBird 2020), Owens Lake, Fish Slough, management areas (eBird 2020).
Tricolored blackbird *Agelaius tricolor*	–/ST	Unlikely	CAFSD	Indirect	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water with dense tall emergent vegetation, a protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey. Relies on groundwater dependent ecosystems for breeding and roosting (Rohde et al 2019). No listed occurrences in management areas, outside of the species' range (eBird 2020).
Western snowy plover *Charadrius alexandrinus nivosus*	–/SSC	Likely	CNDDB	Indirect	Barren to sparsely vegetated beaches, barrier beaches, salt-evaporation pond levees, and shores of alkali lakes; also nests on gravel bars in rivers with wide flood plains; needs sandy, gravelly, or friable soils for nesting. Western snowy plovers can nest near wetlands that may be supported by groundwater, including near freshwater wetlands (Rhode et al. 2019). Occurrences in Owens Valley and Owens Lake management areas (CDFW 2019).

Common name ***Scientific name***	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT, FSS, BLMS/SE	Likely;	CNDDB, CAFSD	Indirect	Summer resident of valley foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation. Reliant on groundwater-dependent riparian vegetation for habitat (Rhode et al. 2019). Documented in the vicinity of Owens Valley management area (CDFW 2019). USFWS Critical habitat overlaps with Owens Valley management areas.
Yellow-breasted chat *Icteria virens*	–/SSC	Likely	CNDDB, CAFSD, eBird	Indirect	Early-successional riparian habitats with a dense shrub layer and an open canopy. Foraging in dense vegetation for insects and berries. Owens Valley, Owens Lake area, and Fish Slough are heavily used for breeding and migration. Occurrences in Owens Lake, Owens Valley (CDFW 2019, eBird 2020), and Fish Slough management areas (eBird 2020).
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	–/SSC	Likely	CAFSD, eBird	Indirect	Breeds almost entirely in open marshes with relatively deep water and tall emergent vegetation, such as bulrush (*Schoenoplectus* spp.) or cattails (*Typha* spp.); nests are typically in moderately dense vegetation, in colonies; forage within wetlands and surrounding grasslands and croplands. Feeds primarily on insects and seeds, foraging in marshes, fields, or sometimes catching prey in the air. Owens Valley and Fish Slough are used during breeding season, and pre- and post- breeding migration (eBird 2020). Occurrences in Owens Valley, Owens Lake, and Fish Slough management areas (eBird 2020).
Reptiles					
Desert tortoise *Gopherus agassizii*	FT/ST	Likely	CNDDB	Indirect	Prefers arid desert climates including sandy flats and rocky foothills to alluvial fans, washes, and canyons. May rely on groundwater-dependent vegetation for food sources (e.g., grasses, wildflowers, wild fruit, and herbs) and water intake from these food sources (Rhode et al. 2019). Occurrences in Owens Valley and Owens Lake management areas (CDFW 2019).

Common name *Scientific name*	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Panamint alligator lizard *Elgaria panamintina*	BLMS, FSS/SSC	Likely	CNDDB	Indirect	Secretive species inhabiting rocky, sagebrush, canyon bottoms near streams and springs of the pinyon-juniper zone. Endemic to California, found in desert mountain ranges (elevation 2,500–7,500 feet), including Panamint Mountains, the White Mountains, the Inyo Mountains, the Nelson Mountains, and the Cosos Mountains. Occurrences in Owens Valley and the vicinity of Fish Slough management areas (CDFW 2019).
Amphibians					
Inyo Mountains slender salamander *Batrachoseps campi*	FSS, BLMS/SSC	Likely	CNDDB	Direct	Lungless, nocturnal salamander; inhabiting springs, seeps, and surrounding riparian areas in dry mountain habitats of Inyo Mountains. Breeding occurs terrestrially in moist environments. Typical elevation range of 1,800–8,600 feet. Occurrences in the vicinity of Owens Valley and Owens Lake management areas (CDFW 2019).
Northern leopard frog *Lithobates pipiens*	–/SSC	Unlikely	CNDDB, CAFSD	Direct	Native to Northern California and Owens Valley (California native populations thought to be extinct, introduced populations in central valley, Southern California coast, and Northern California); inhabits grasslands, wet meadows, forests, woodlands, and other locations with permanent water below 6,500 feet. Breeding and hibernation both occur aquatically in a variety of permanent and semi-permanent water bodies. Historical Occurrences documented in Owens Valley management area, most recent occurrence is dated 1994 (CDFW 2019).
Sierra Nevada yellow-legged frog *Rana sierrae*	FE, FSS/ST	Likely;	CNDDB, CAFSD	Direct	Found in high elevation lakes, ponds, and streams in montane riparian, lodgepole pine, subalpine conifer, and wet meadow habitats. Typical elevation range from 984 feet. to over 12,000 feet. elevation. Distribution and USFWS critical habitat within the Owens Valley management area.

Common name *Scientific name*	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Southern mountain yellow-legged frog *Rana muscosa*	FE, FSS/SE	None	CNDDB, CAFSD	Direct	Inhabits high elevation lakes, ponds, marshes, meadows and streams. Tadpoles take two to four years to reach metamorphosis. Typical elevation range from 4,500 to 12,000 feet. Distribution, USFWS critical habitat, and observations outside of groundwater basin.
Yosemite toad *Anaxyrus canorus*	FE/SSC	None	CAFSD	Direct	Inhabits high-elevation wet mountain meadows, willow thickets, boarders of forests, and areas with permanent water sources. Found in the Sierra Nevada Mountains from Ebbets Pass south to Spanish Mountains, between 4,800 to 12,000 feet elevation. Breeds in shallow pools, margins of lakes, and quite streams. Diet consists of small invertebrates, including beetles, ants, siders, bees, wasps, flies, and millipedes. Distribution, USFWS critical habitat, and observations outside of groundwater management areas.
Fish					
Owens pupfish *Cyprinodon radiosus*	FE/SE, SFP	Likely	CNDDB	Direct	Occupies springs, marshes, sloughs, and other wetland-type habitats with a silt or sand bottom and aquatic vegetation where they form small schools and feed primarily on aquatic insects. The Owens pupfish is directly dependent on spring-fed pools and other surface waters that are largely supported by groundwater (Rohde et al. 2019). Likely occurs in the Owens Lake and Fish Slough management areas (CDFW 2019).
Owens tui chub *Siphateles bicolor snyderi*	FE/SE	Unlikely	CNDDB	Direct	The Owens tui chub lives in low-velocity waters with abundant submerged vegetation for cover, habitat, and food. Aquatic vegetation provides important food web support for its macroinvertebrate prey, as well as cover from predators and refuge from high water velocities. Owens tui chub is considered directly dependent on groundwater, as groundwater provides water to most of the isolated springs and headwater streams in which it occurs (Rhode et al. 2019). Occurrence in Owens Lake management area, last verified in 2008 (CDFW 2019)).
Owens speckled dace *Rhinichthys osculus ssp.*	BLMS/SSC	Likely	CNDDB	Direct	Owens speckled dace are habitat generalists, occupying a variety of habitat types including coldwater streams, irrigation ditches, and hot springs. They feed opportunistically on a variety of aquatic

Common name *Scientific name*	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
					invertebrates. The Owens speckled dace is directly dependent on groundwater, which feeds many of the springs and other aquatic habitats it occupies. Occurrences in Fish Slough management area (CDFW 2019, Moyle et al. 2015).
Owens sucker *Catostomus fumeiventris*	–/SSC	Unlikely	CNDDB	Indirect/ uncertain	The Owens sucker prefers aquatic stream habitats. Feed by scraping algae, invertebrates, and detritus from rocky substrates. Owens suckers may be vulnerable to groundwater pumping and diversion of surface water, which have reportedly lowered the water table and may have affected riparian vegetation in the Owens Valley (Zektser et al. 2005, as cited in Moyle et al. 2015). Occurrences are outside management areas (CDFW 2019).
Mollusks					
California floater *Anodonta californiensis*	FSS/–	Likely	CNDDB, CAFSD	Direct	Lakes and slow, large rivers on soft substrates (mud-sand). Occurrence in the vicinity of Owens Valley management area (CDFW 2019).
Owens Valley springsnail *Pyrgulopsis owensensis*	FSS/–	Likely	CNDDB	Direct	Freshwater springsnail that is endemic to eight springs along the Inyo Mountain and White Mountain escarpments on the east side of the Owens Valley. Typically found on bits of travertine, stone, or watercress (Hershler 1989). Occurrences in Fish Slough, Tri-Valley, and Owens Valley management areas (CDFW 2019).
Wong's springsnail *Pyrgulopsis wongi*	FSS/–	Likely	CNDDB, CAFSD	Direct	Habitat includes seeps and stream fed streams, common in watercress, on small bits of travertine, or on stone. Inhabits Owens Valley; along eastern escarpment of Sierra Nevada (from pine creek south to Little Lake), along western side of the valley (French Spring to Marble Creek), also found in a few sites in Long, Adobe, and Deep Springs (Hershler 1989). Occurrences in Owens Valley, Owens Lake, Fish Slough, and Tri-Valley management areas (CDFW 2019).

Common name *Scientific name*	**Status[1] Federal/State**	**Potential to occur in GDE management areas**	**Query source[2]**	**GDE association[3]**	**Habitat and documented occurrences in management areas**
Insects					
Crotch bumble bee *Bombus crotchii*	–/SCE	Likely	CNDDB	No known reliance on groundwater	Inhabits open grassland and scrub habitats in Coastal California east towards the Sierra-Cascade Crest. Nests are often located underground in abandoned rodent burrows, or above ground in tufts of grass, rock piles, or tree cavities. Occurrences in Owens Valley and Owens Lake management areas (CDFW 2019).
San Emigdio blue butterfly *Plebulina emigdionis*	FSS/–	Likely	CNDDB	Indirect	Occurs locally in Southern California, south San Joaquin Valley and Mojave Desert to Victorville and Owens Valley. Inhabits dry river courses, streamsides, and adjacent flats. Known hostplant is *Atriplex canescens*, caterpillars consume *A.canescens*, while adults are nectarivores. Occurrence in Owens Lake management area (CDFW 2019).
Crustaceans					
Vernal pool fairy shrimp *Branchinecta lynchi*	FT/–	Unlikely	CAFSD	Direct	Vernal pools; also found in sandstone rock outcrop pools. Critical habitat is outside of groundwater basin. No listed occurrences in groundwater management areas.

[1] **Status codes:**

Federal
FE = Listed as endangered under the federal Endangered Species Act
FT = Listed as threatened under the federal Endangered Species Act
FD = Federally delisted
FPE = Federally proposed as endangered
FPT = Federally proposed as threatened
BGEPA = Federally protected under the Bald and Golden Eagle Protection Act
FSS = Forest Service Sensitive Species
BLMS = Bureau of Land Management Sensitive Species

State
S = Sensitive
SE = Listed as Endangered under the California Endangered Species Act
ST = Listed as Threatened under the California Endangered Species Act
SCE = State Candidate Endangered
SSC = CDFW species of special concern
SFP = CDFW fully protected species

[2] **Query source:**
CAFSD: California Freshwater Species Database (TNC 2019a)
CNDDB: California Natural Diversity Database (CDFW 2019)
eBird: (eBird 2019)

[3] **Groundwater Dependent Ecosystem (GDE) association:**
Direct: Species directly dependent on groundwater for some or all water needs
Indirect: Species dependent upon other species that rely on groundwater for some or all water needs

Appendix 9-C

Rooting Depth of Common Plants in Fish Slough

Table C-1. Rooting depth of species in vegetation map units in the Fish Slough management area. Data from The Nature Conservancy (2020).

Vegetation type	Species	Maximum Rooting depth (ft)	Data Source
Alkaline Mixed Grasses and Forbs	Anemopsis californica	0.39	Stromberg (2013)
Alkaline Mixed Grasses and Forbs	Distichlis spicata	1.97	Stromberg (2013)
Alkaline Mixed Grasses and Forbs	Eleocharis rostellata	0.82	Stromberg (2013)
Alkaline Mixed Grasses and Forbs	Ivesia kingii	n/a	n/a
Alkaline Mixed Grasses and Forbs	Juncus arcticus (var. balticus, mexicanus)	0.69	Stromberg (2013)
Alkaline Mixed Grasses and Forbs	Muhlenbergia asperifolia	n/a	n/a
Alkaline Mixed Grasses and Forbs	Poa secunda	1.51	Spence (1937), as cited in Fan et al. (2017)
Alkaline Mixed Grasses and Forbs	Spartina gracilis	n/a	n/a
Alkaline Mixed Grasses and Forbs	Sporobolus airoides	n/a	n/a
Alkaline Mixed Scrub	Allenrolfea occidentalis	5.91	Naumovich (2017)
Alkaline Mixed Scrub	Atriplex canescens	39.37	Stromberg (2013)
Alkaline Mixed Scrub	Atriplex confertifolia	39.37	Canadell et al. (1996)
Alkaline Mixed Scrub	Atriplex parryi	n/a	n/a
Alkaline Mixed Scrub	Ericameria albida	n/a	n/a
Alkaline Mixed Scrub	Grayia spinosa	7.05	Link et al. (1994), as cited in Fan et al. (2017)
Alkaline Mixed Scrub	Suaeda moquinii	n/a	n/a
Big Sagebrush	Artemisia tridentata	9.84	Link et al. (1995), as cited in Fan et al. (2017)
Fremont Cottonwood	Populus fremontii	6.89	Stromberg (2013)
Greasewood	Sarcobatus vermiculatus	13.12	Donovan et al. (1996), as cited in Fan et al. (2017)
Rabbitbrush	Ericameria nauseosa	13.12	Stromberg (2013)
Tule-Cattail	Phragmites australis	8.20	Kohzu et al. (2003), as cited in Fan et al. (2017)
Tule-Cattail	Schoenoplectus acutus	1.97	Stromberg (2013)
Tule-Cattail	Schoenoplectus americanus	2.13	Stromberg (2013)
Tule-Cattail	Typha (angustifolia, domingensis, latifolia)	0.89	Stromberg (2013)
Willow (shrub)	Salix spp.	2.62	Pulling (1918), as cited in Fan et al. (2017)

References

Canadell, J., Jackson, R.B., Ehleringer, J.R., Mooney, H.A., Sala, O.E. & Schulze, E.D. (1996) Maximum rooting depth of vegetation types at the global scale. Oecologia, 108, 583–595.

Fan, Y., Miguez-Macho, G., Jobbágy, E.G., Jackson, R.B. and Otero-Casal, C., 2017. Hydrologic regulation of plant rooting depth. Proceedings of the National Academy of Sciences, 114(40), pp.10572-10577.

Lech Naumovich. 2017 TNC Crowdsourcing Campaign Survey Response.

Stromberg, J. 2013. Root patterns and hydrogeomorphic niches of riparian plants in the American Southwest. Journal of Arid Environments 94 (2013) 1-9. Appendix A. Rooting data for herbaceous plants

The Nature Conservancy. 2020. Groundwater Resources Hub Rooting Depth Database. Accessed December 2020. https://groundwaterresourcehub.org/public/uploads/pdfs/Plant_Rooting_Depth_Database_20180419.xlsx

Owens Valley Groundwater Basin Water Budgets Technical Memorandum

Prepared for

Owens Valley Groundwater Authority

OWENS VALLEY GROUNDWATER AUTHORITY

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December 9, 2021

Certification

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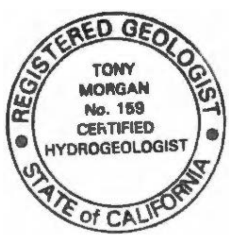

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Date signed: December 9, 2021

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1. Introduction

This section provides a quantitative description of the water budget for the Owens Basin, which includes the headwater basin and the Owens Valley groundwater basin. DWR GSP regulations was used to develop this water budget analysis. The Basin Characterization Model (BCM) was used to develop the water budget. The Department of Water Resources handbook for Water Budget Development recommends using BCM for basins with no existing models. Los Angeles Department of Water and Power (LADWP) has developed a groundwater model based on MODFLOW but OVGA was not granted access to this model and hence BCM was chosen to quantify the water budget.

BCM is a regional water balance model (Flint et al., 2013) that mechanistically models the transformation of precipitation into evapotranspiration, infiltration into soils, runoff, or recharge below the root zone. BCM primarily quantifies the land system budget, but also quantifies recharge that is an important hydrologic input to the Owen Valley groundwater basin. Since LADWP model of the Owen's Valley groundwater basin was not available for use in developing the water budget, BCM simulated total runoff, recharge when compared to LADWP reported export of surface water, and pumped groundwater provides a measure of sustainability of the system. When the BCM simulated total runoff and recharge are higher than the water export from the Owens Valley groundwater basin it is reasonable to assume that the surface water and groundwater system are in balance. This criterion is used to demonstrate that the surface water budget derived from BCM and export of both surface and groundwater by LADWP from the groundwater basin are sustainable in the recent (1986-2016) historical period.

2. Historical and Current Water Budget

BCM output archived by USGS at https://ca.water.usgs.gov/projects/reg_hydro/basin-characterization-model.html (accessed, August 2020) were used in the development of the water budget. The historical period for the water budget spans 1986-2016 and the current period spans from 2006-2016.

The BCM is a grid-based model that calculates water balance at each grid at the monthly time step. Numerous grids each with spatial resolution of 300 m x 300m represent the Owens Basin. The Owens Basin is spatially divided into the headwater basin where most of the runoff and recharge is generated and the water budget for this spatial area is referred to as the contributing area water budget. Water budget outputs from the BCM grids within the Owens Valley groundwater basin are computed and are referred to as the groundwater budget. Figure 1 below shows the spatial areas that represent the headwater/contributing area and the groundwater basin.

Figure 1. Map showing contributing area (headwater) and the groundwater basin for Owens Basin.

Water budget for the contributing area for the historical and current periods are shown below in Figure 2 and Figure 3.

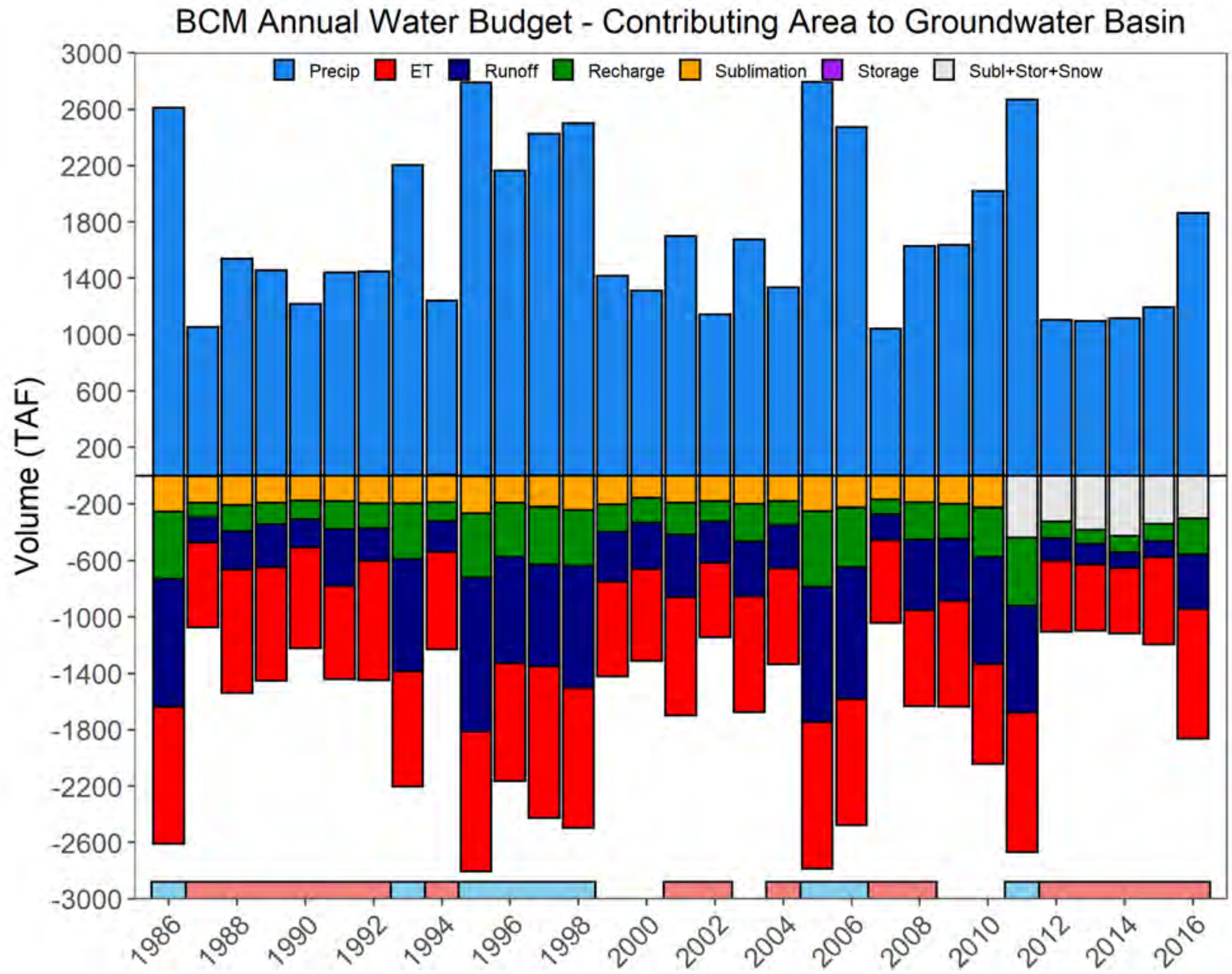

Figure 2. Historical water budget for the contributing area (headwater) to groundwater basin. Wet and dry years shown as blue and red bars at the bottom of the graph.

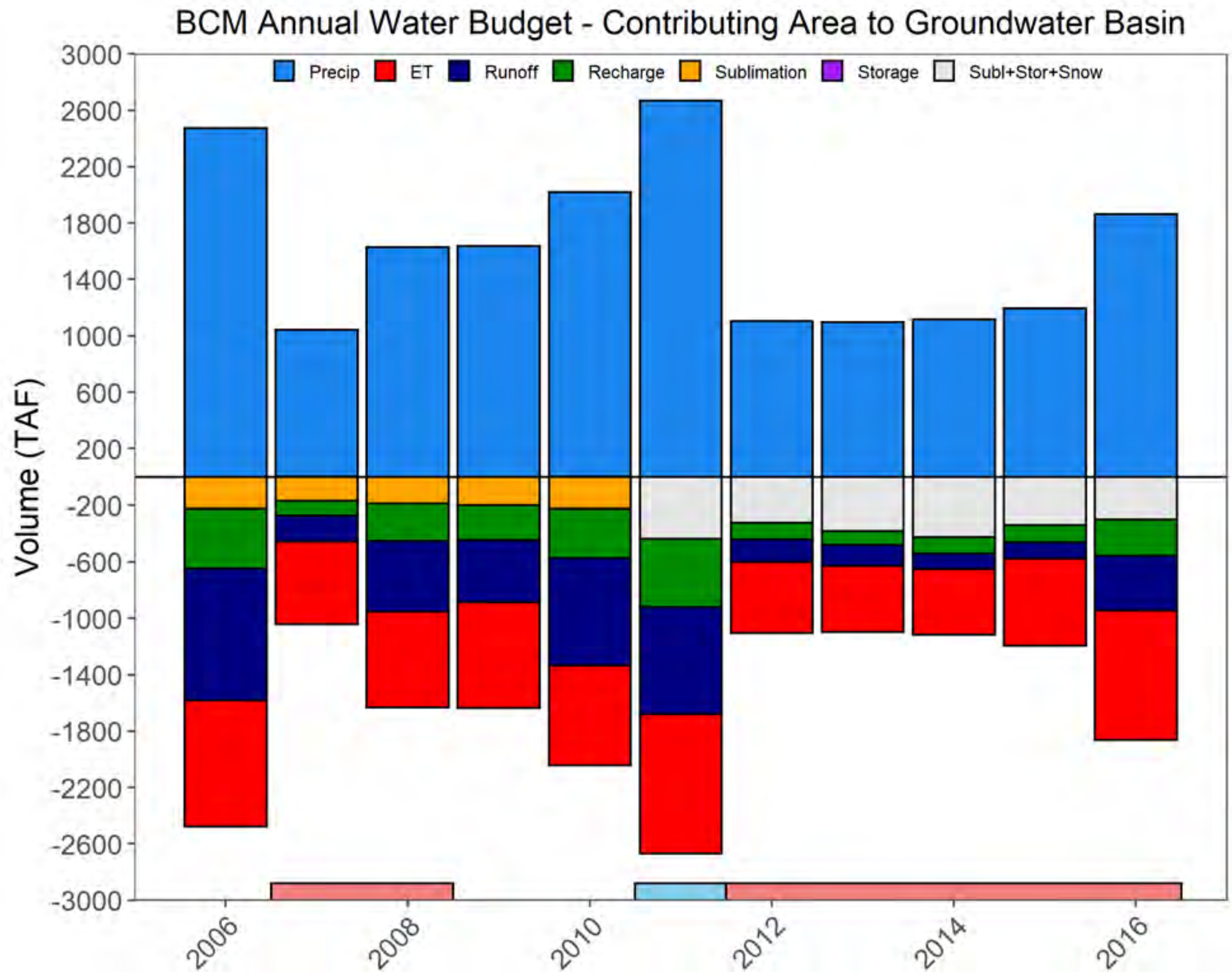

Figure 3. Current water budget for the contributing area (headwater) to groundwater basin. Wet and dry years shown as blue and red bars at the bottom of the graph.

Water budget for the Owens valley groundwater basin for the historical and current periods are shown below in Figure 4 and Figure 5

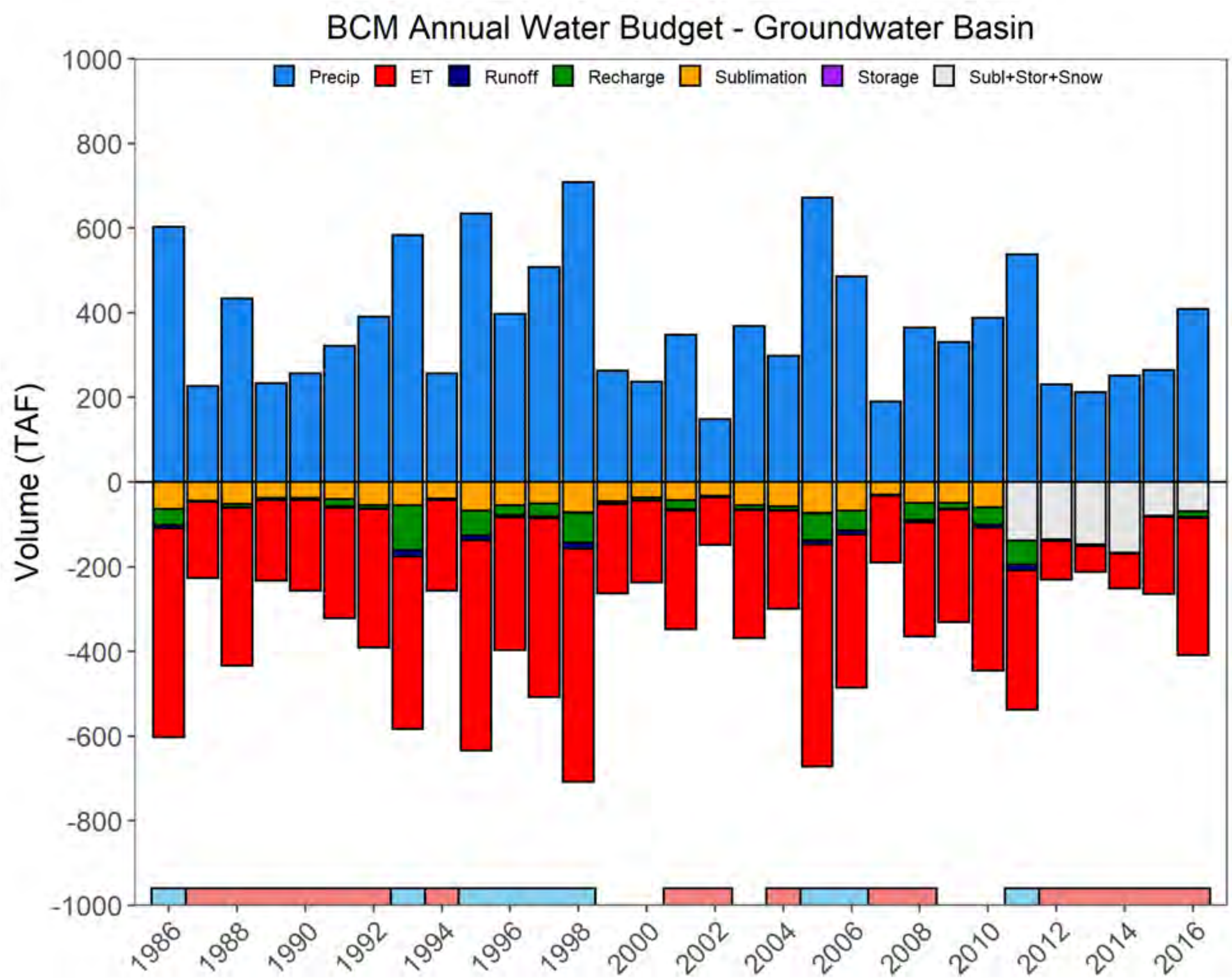

Figure 4. Historical water budget for the Owens Valley groundwater basin. Wet and dry years shown as blue and red bars at the bottom of the graph.

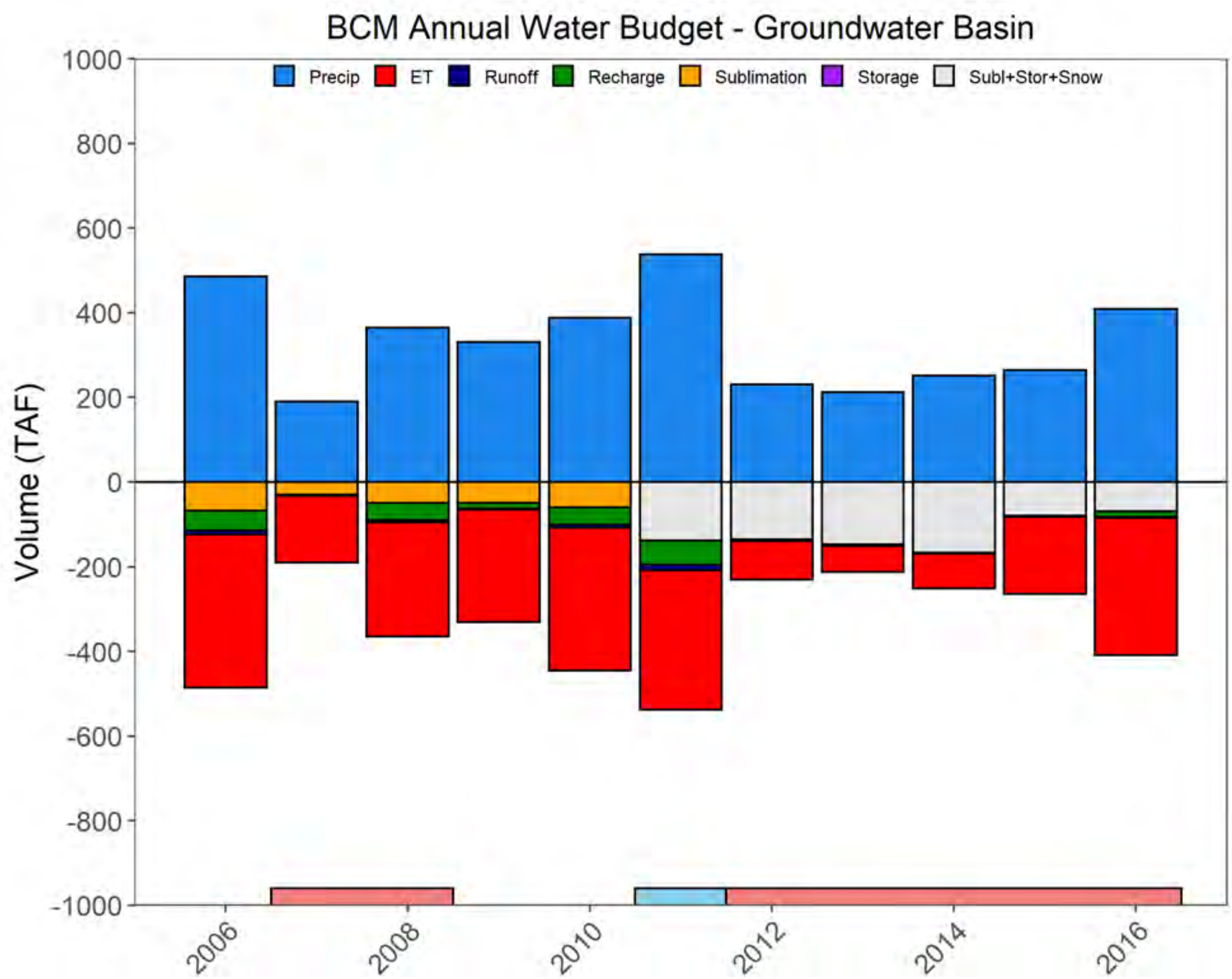

Figure 5. Current water budget for the Owens Valley groundwater basin. Wet and dry years shown as blue and red bars at the bottom of the graph.

The Owens basin was further divided into three management areas, Owens Valley, Fish Slough and Tri Valley and Owens Lake. Figure 6 shows a map of the contributing and groundwater basin for the three-management areas.

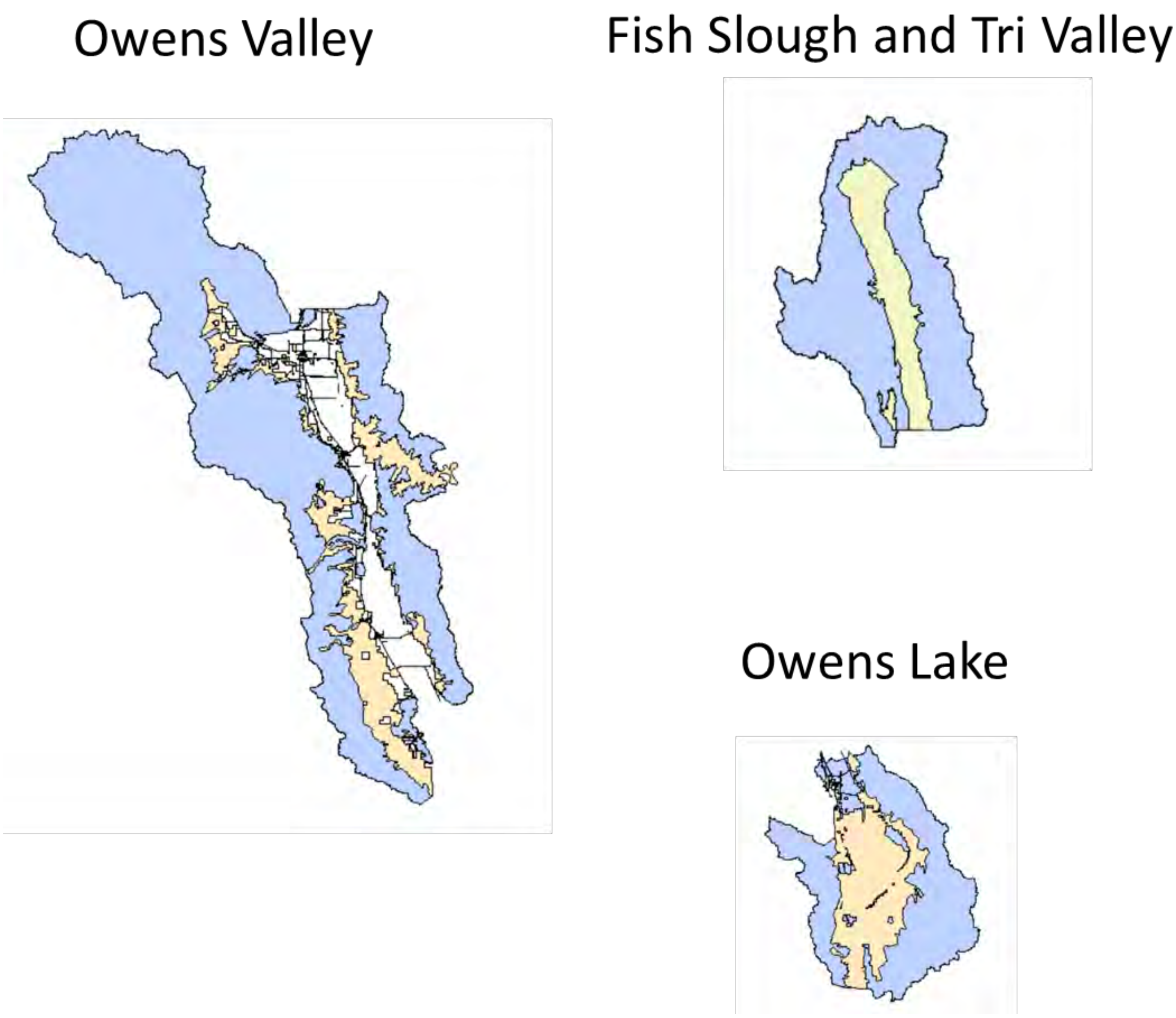

Figure 6. Map showing contributing area (headwater) shown in blue and the groundwater basin for the three management areas within the Owens Basin.

The historical and current water budget for the contributing area to the Owens Valley project management area is shown in Figure 7 and Figure 8.

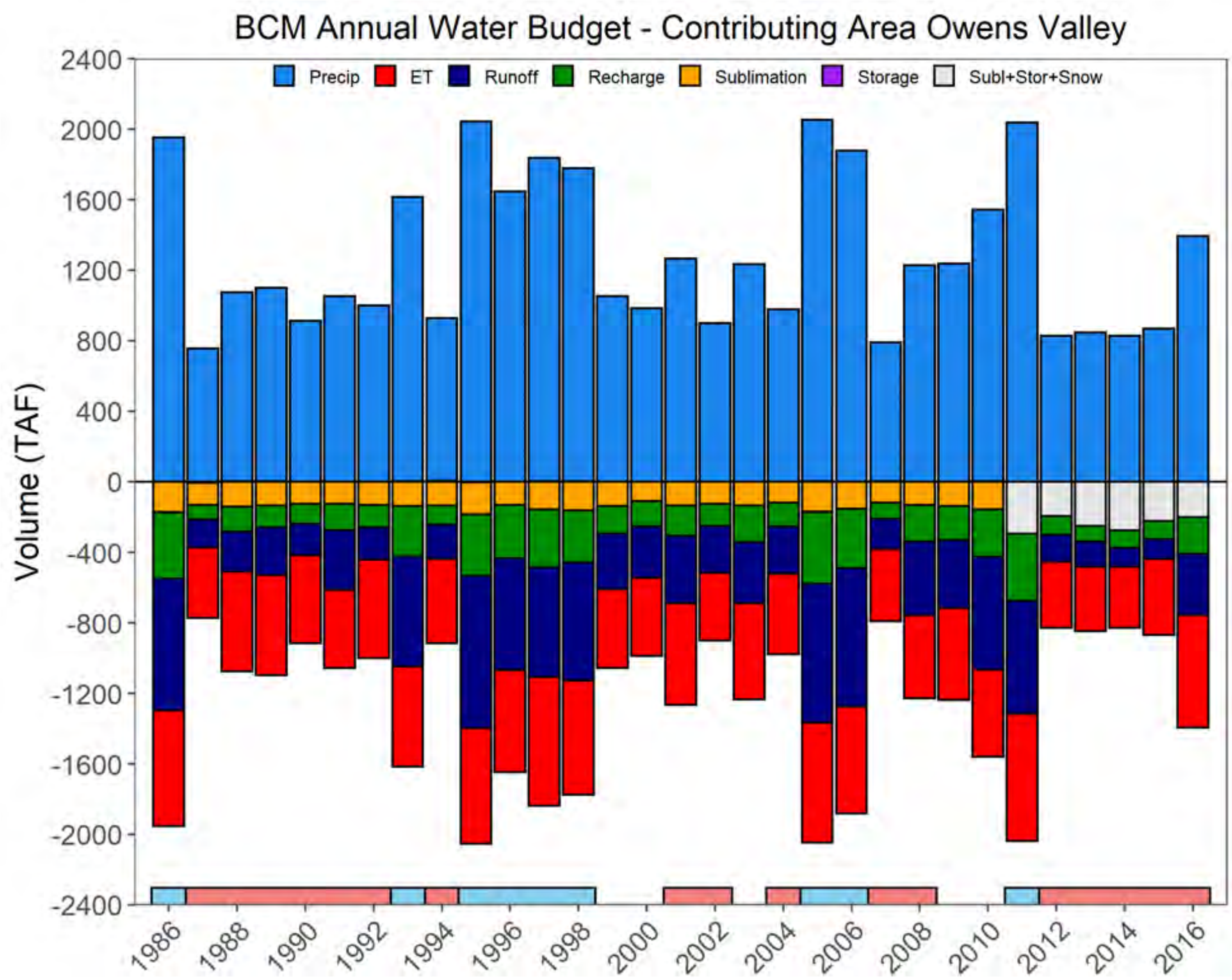

Figure 7. Historical water budget for the Owens Valley management area contributing area (headwater). Wet and dry years shown as blue and red bars at the bottom of the graph.

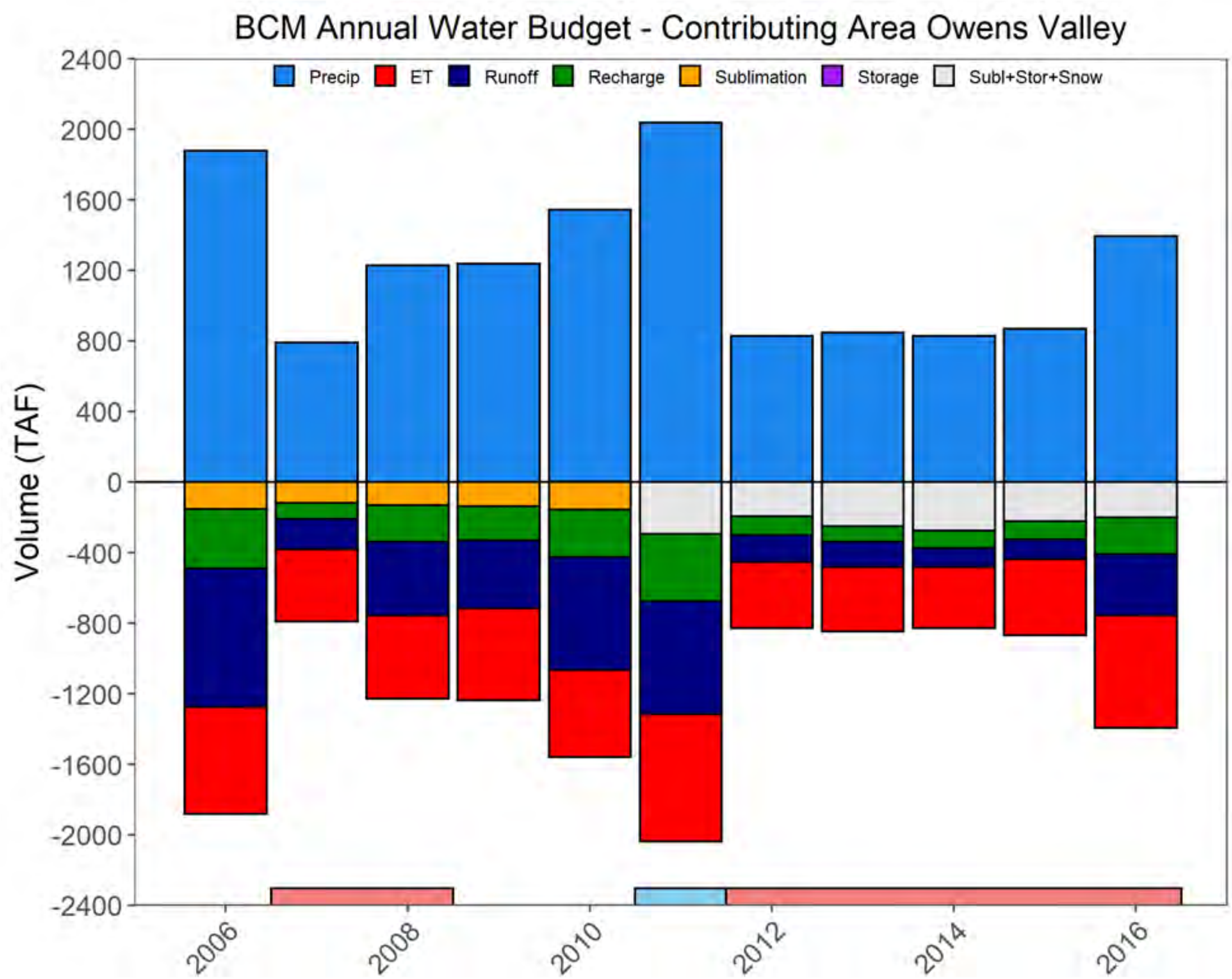

Figure 8. Current water budget for the Owens Valley management area contributing area (headwater). Wet and dry years shown as blue and red bars at the bottom of the graph.

The historical and current water budget for the groundwater basin in the Owens Valley project management area is shown in Figure 9 and Figure 10.

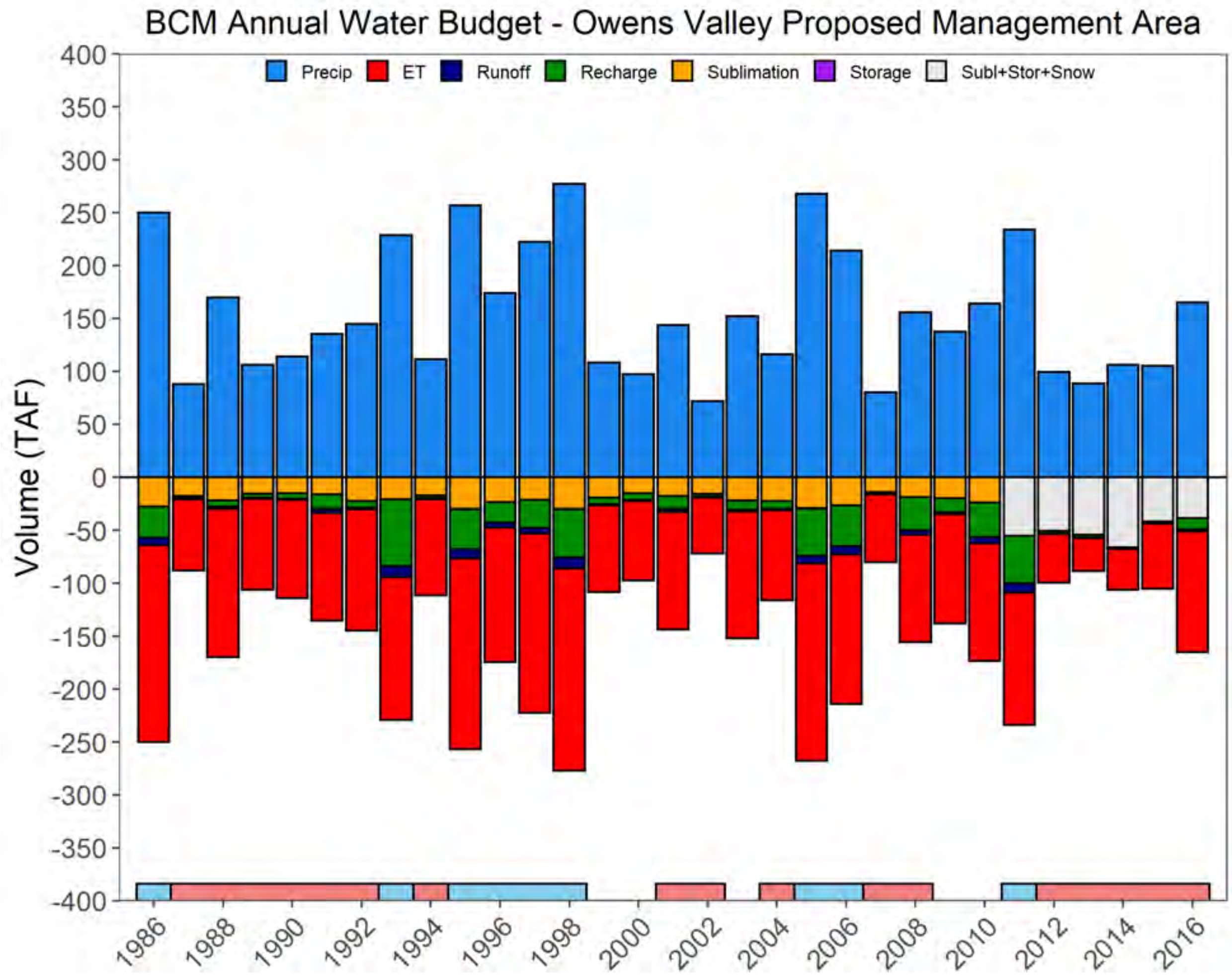

Figure 9. Historical water budget for the groundwater basin in the Owens Valley management area. Wet and dry years shown as blue and red bars at the bottom of the graph.

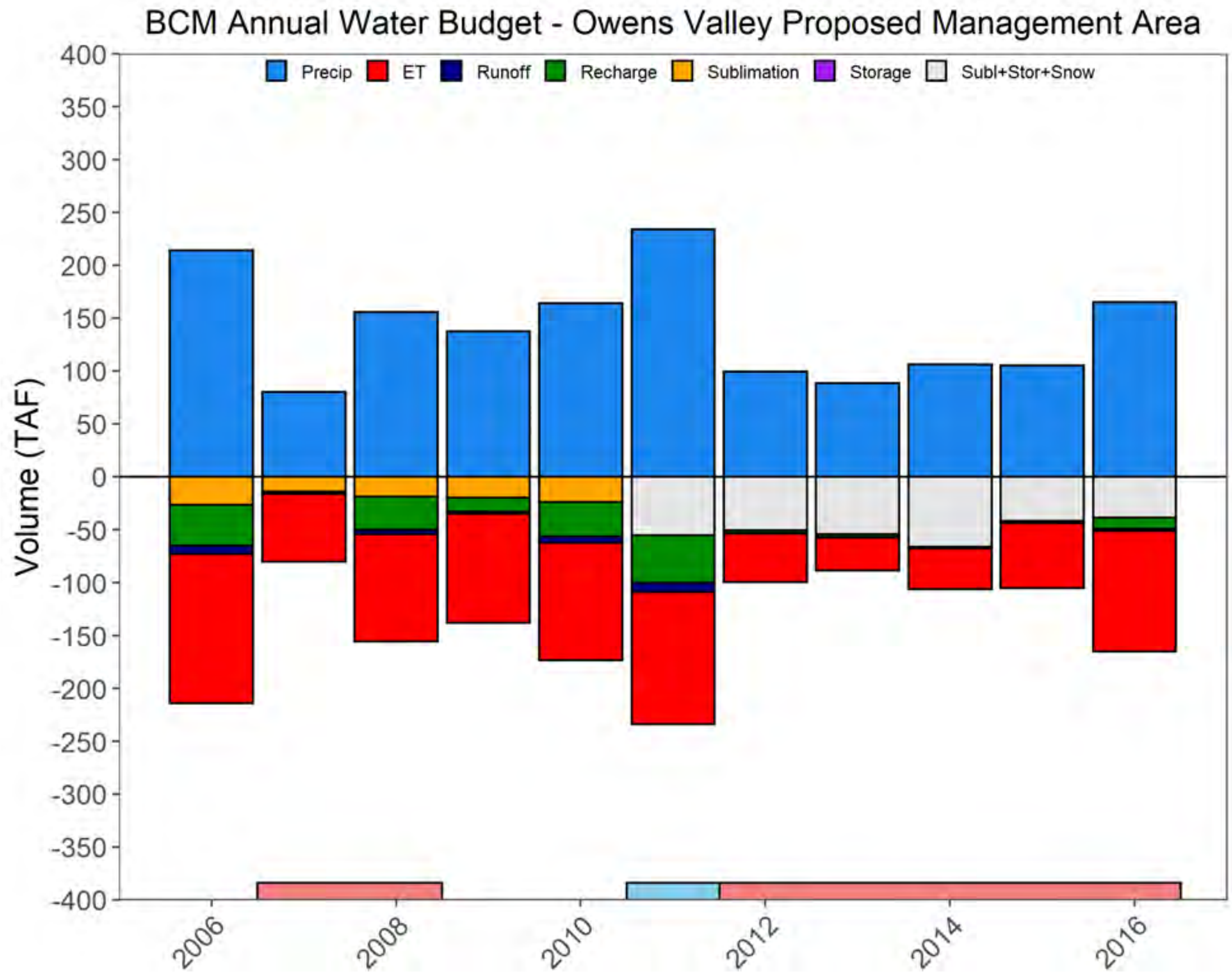

Figure 10. Current water budget for the groundwater basin in the Owens Valley management area. Wet and dry years shown as blue and red bars at the bottom of the graph.

The historical and current water budgets for the contributing area to the Fish Slough and Tri-Valley project management area are shown in Figure 11 and Figure 12.

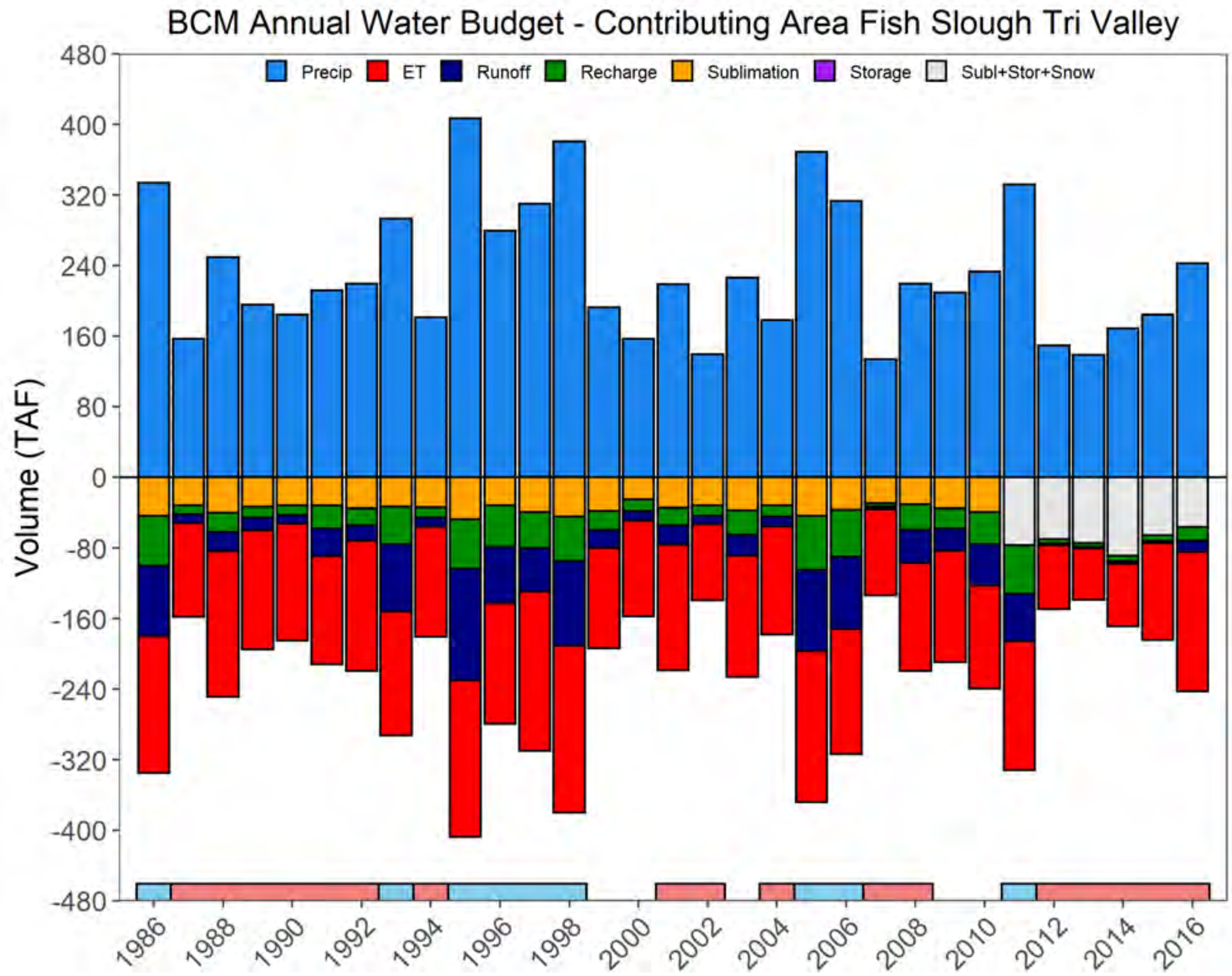

Figure 11. Historical water budget for the Fish Slough and Tri-Valley management area contributing area (headwater). Wet and dry years shown as blue and red bars at the bottom of the graph.

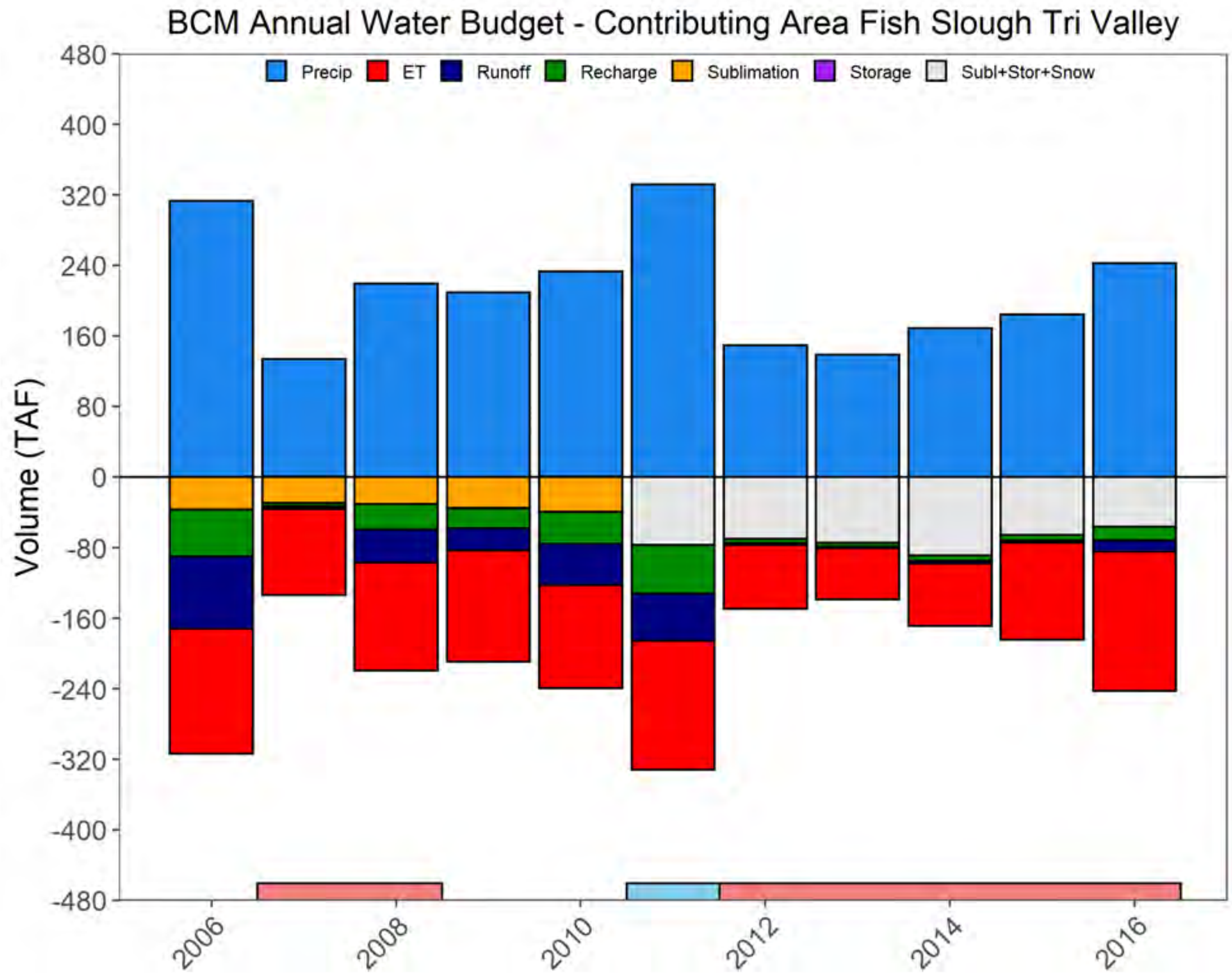

Figure 12. Current water budget for the Fish Slough and Tri-Valley management area contributing area (headwater). Wet and dry years shown as blue and red bars at the bottom of the graph.

The historical and current water budgets for the groundwater basin in the Fish Slough and Tri-Valley project management area are shown in Figure 13 and Figure 14.

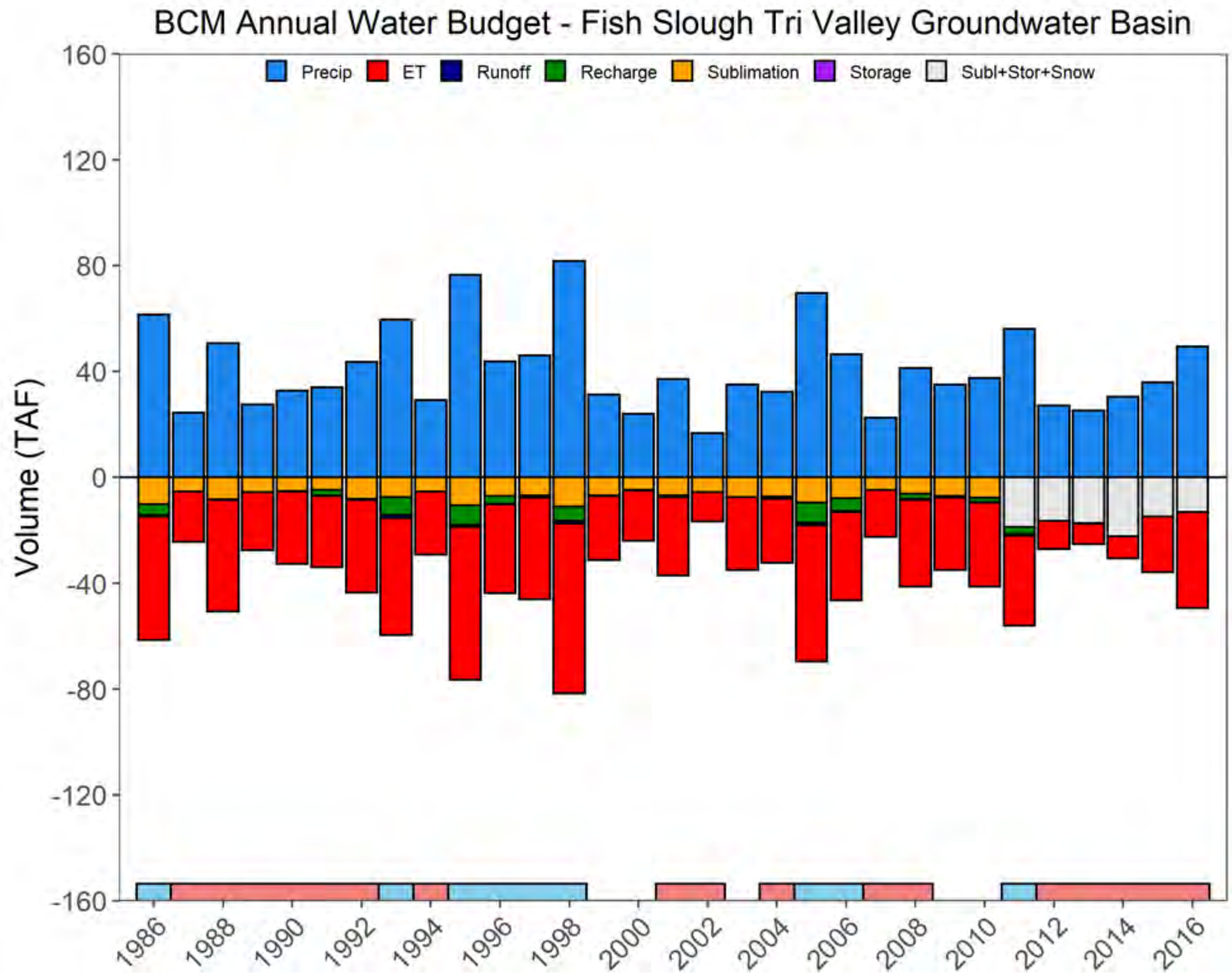

Figure 13. Historical water budget for the groundwater basin in the Fish Slough and Tri-Valley management area. Wet and dry years shown as blue and red bars at the bottom of the graph.

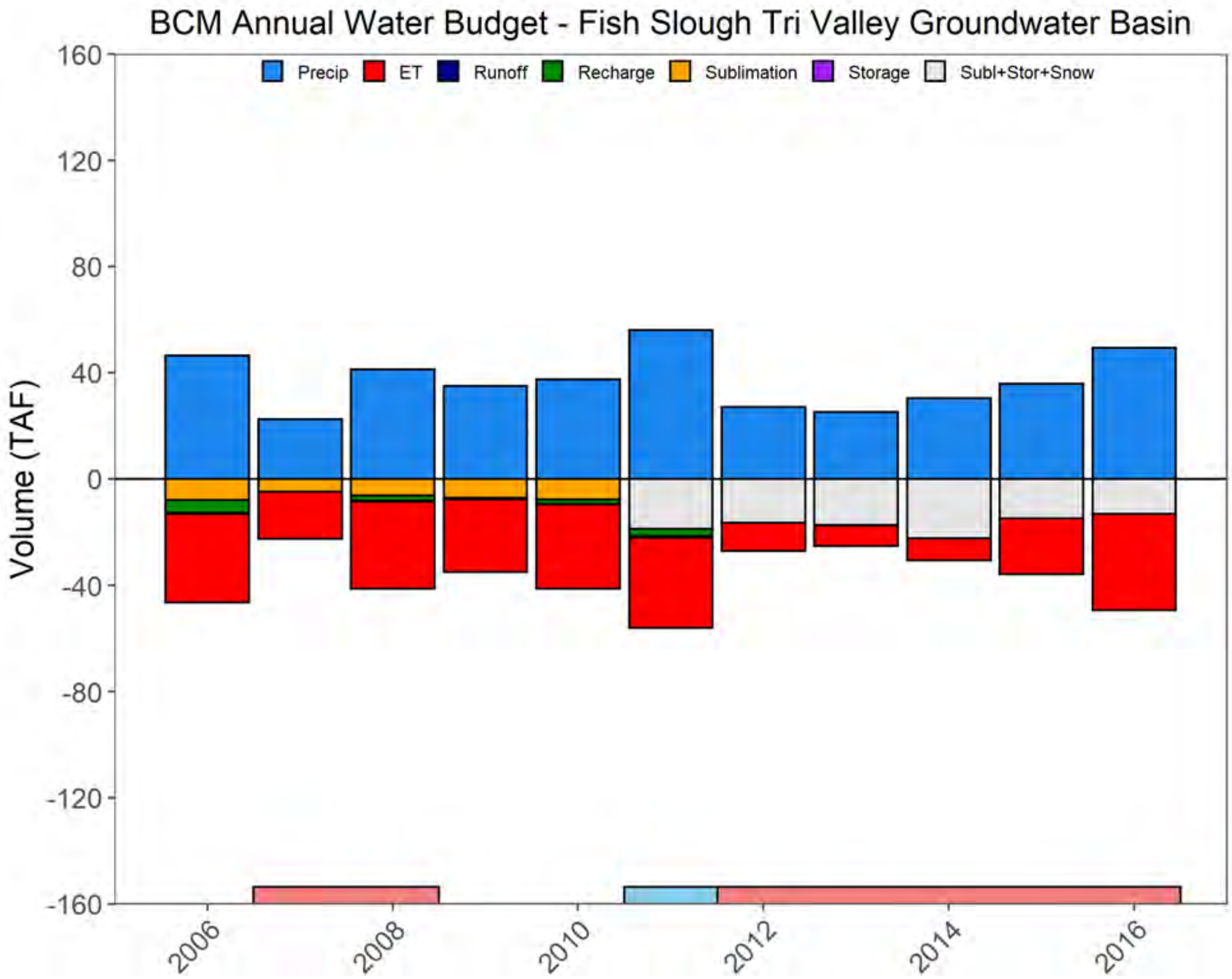

Figure 14. Current water budget for the groundwater basin in the Fish Slough and Tri-Valley management area. Wet and dry years shown as blue and red bars at the bottom of the graph.

A Distributed Parameter Watershed Model (DPWM) was also developed for the Fish Slough and Tri-Valley areas. The modeling domain for this DPWM model is different from the BCM model. Figure 15 shows an annual water budget from the DPWM for Fish Slough and Tri-Valley. Since this is a different model from BCM the accounting for the water budget is different so many of the water budget fluxes are not directly comparable between DPWM and BCM. However, the average recharge simulated by both DPWM and BCM are approximately in the range of 20 - 30 TAF in both models (see Figure 15 and Figure 11).

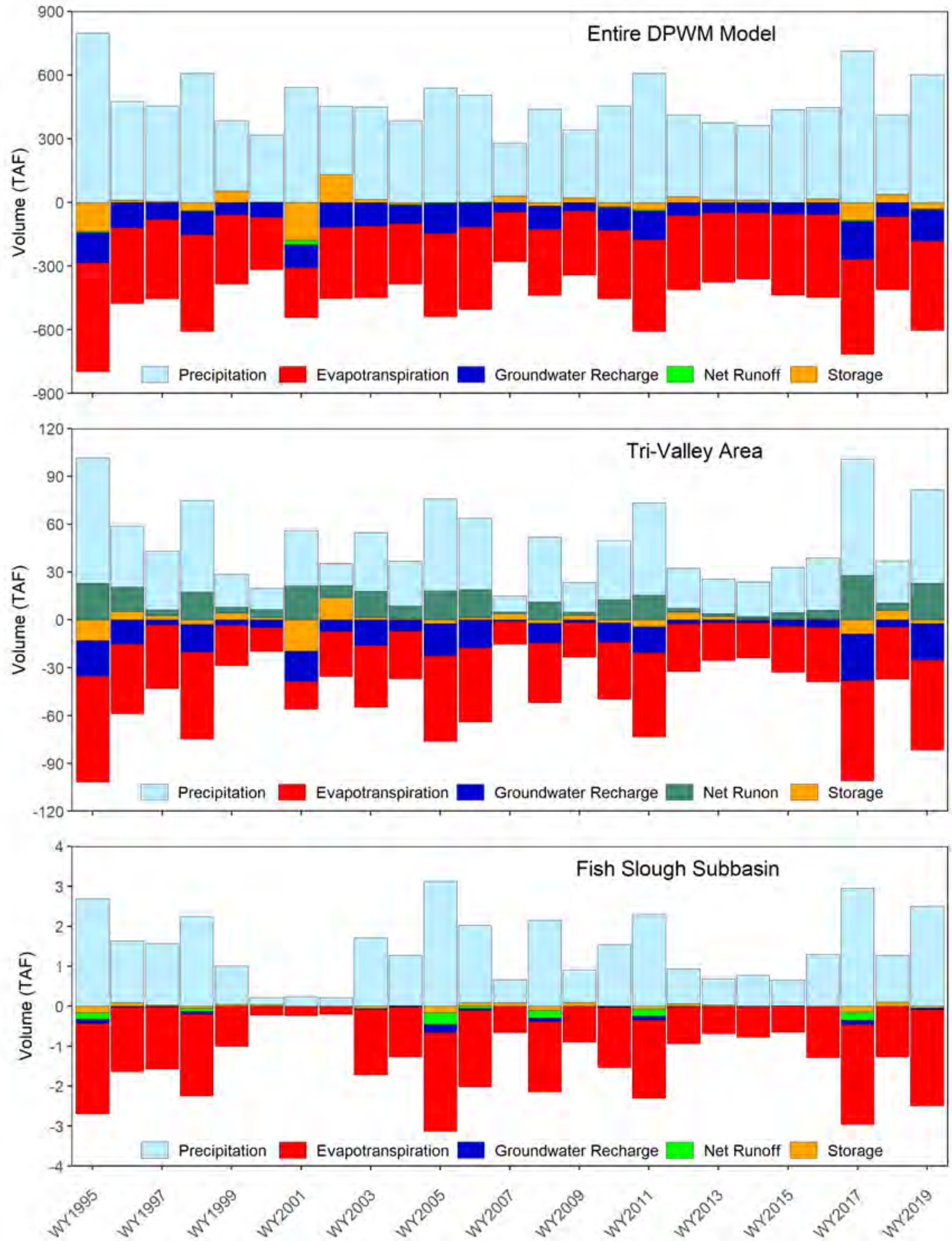

Figure 15. DPWM annual water budget for Fish Slough and Tri-Valley

The historical and current water budget for the contributing area to the Owens Lake project management area is shown in Figure 16 and Figure 17.

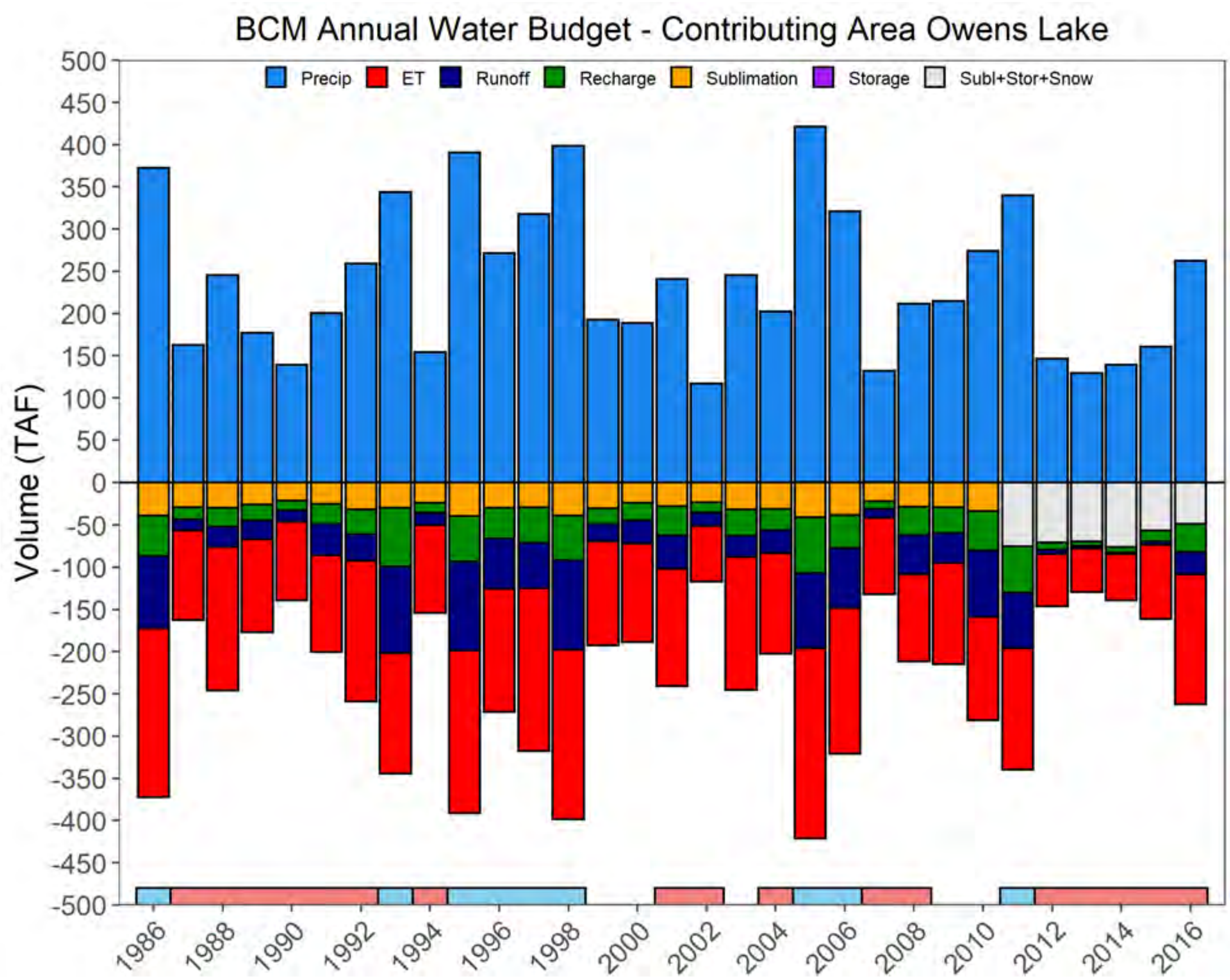

Figure 16. Historical water budget for the Owens Lake management area contributing area (headwater). Wet and dry years shown as blue and red bars at the bottom of the graph.

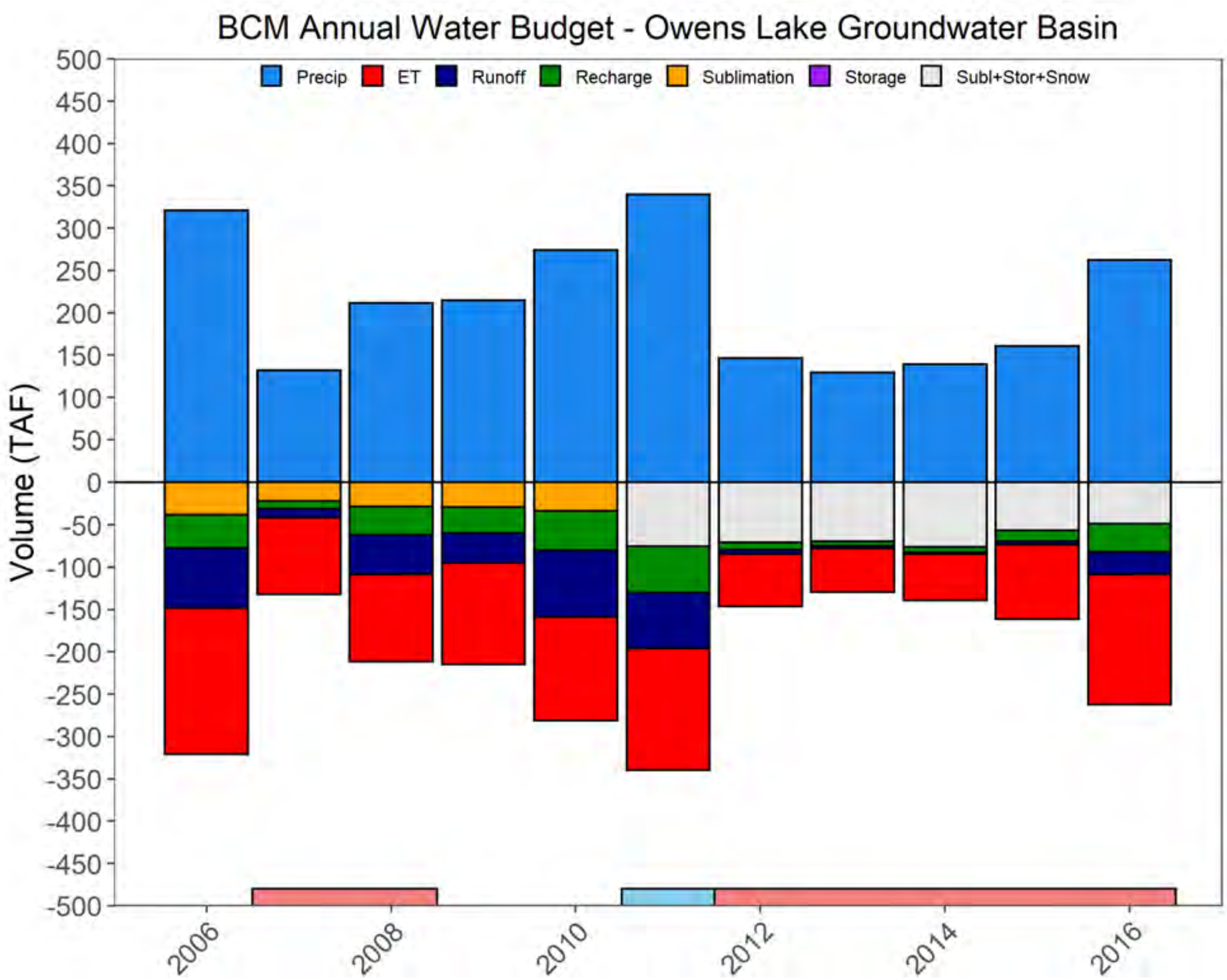

Figure 17. Current water budget for the Owens Lake management area contributing area (headwater). Wet and dry years shown as blue and red bars at the bottom of the graph.

The historical and current water budgets for the groundwater basin in the Owens Lake project management area are shown in Figure 18 and Figure 19.

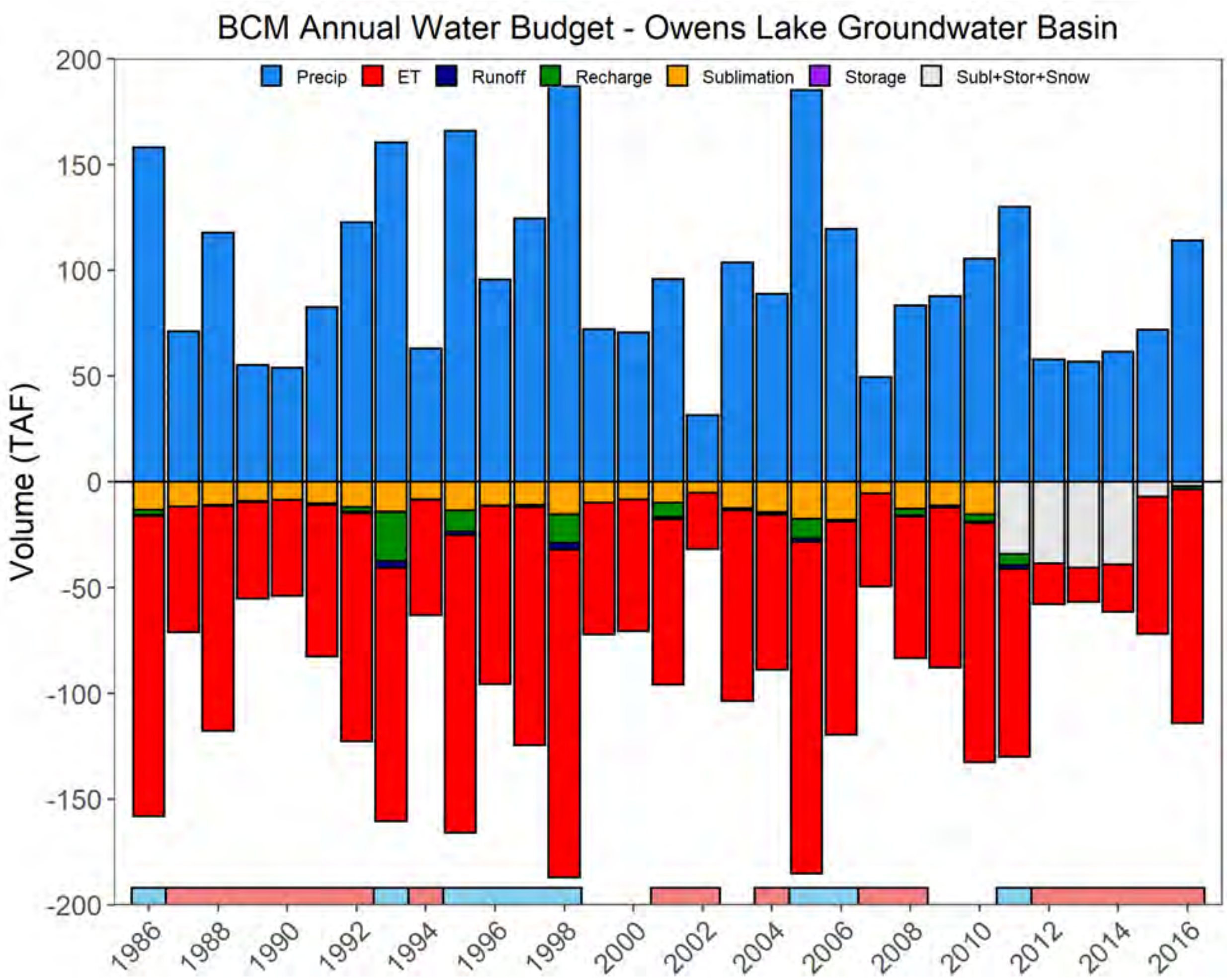

Figure 18. Historical water budget for the groundwater basin in the Owens Lake management area. Wet and dry years shown as blue and red bars at the bottom of the graph.

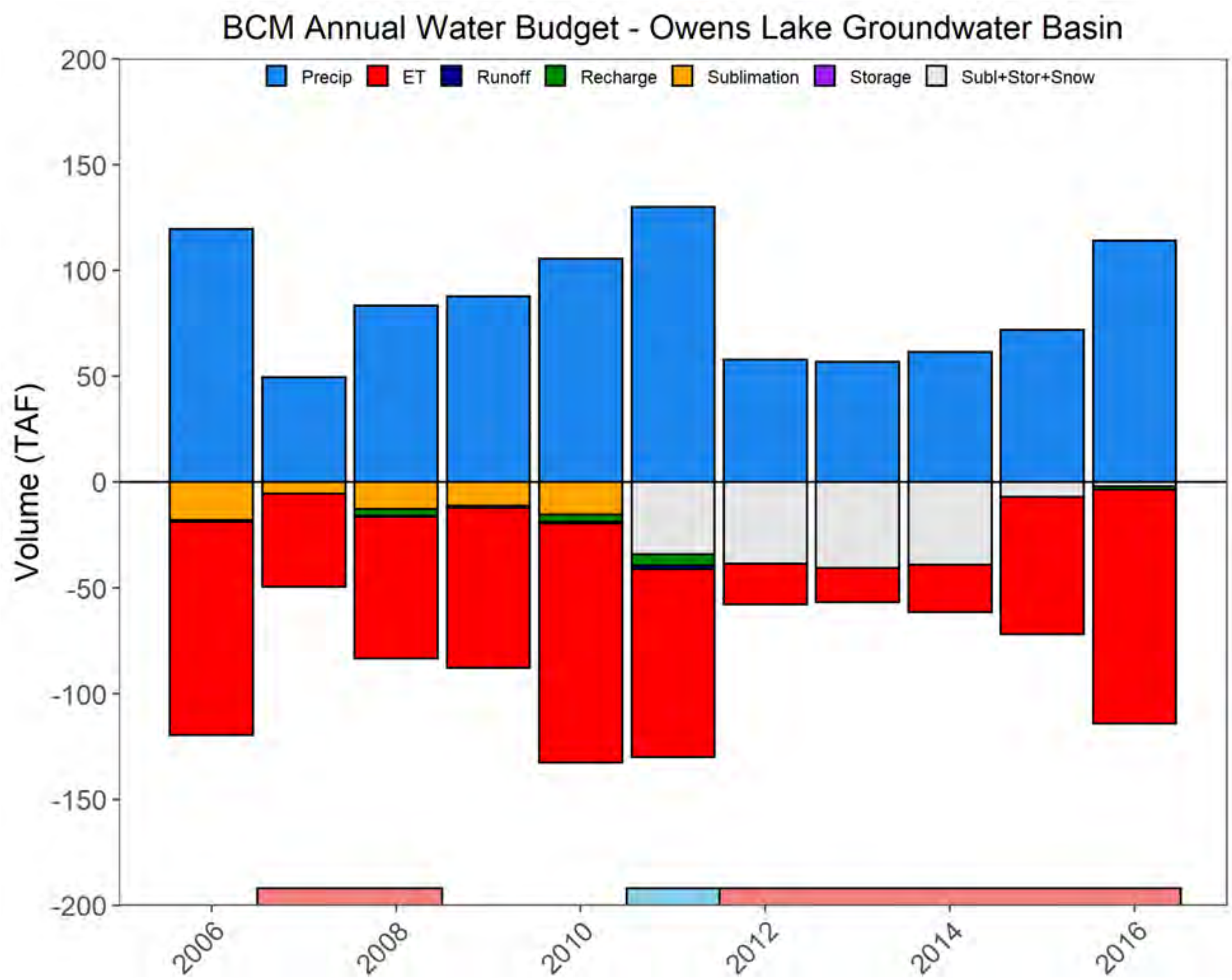

Figure 19. Current water budget for the groundwater basin in the Owens Lake management area. Wet and dry years shown as blue and red bars at the bottom of the graph.

2.1 Summary of current land system water budget

The land system water budget are presented in graphical format thus far. Table 1 presents a summary of the current (2006-2016) land system water budget for Owens basing and the three management areas.

Table 1. Summary of current land system water budget

Area	Average Annual Volume (TAF)				
	Precip	ET	Runoff	Recharge	Storage
Owens Basin CA	1622	689	410	234	289
Owens GWB	333	224	4	20	85
Owens Valley CA	1225	489	356	188	192
Owens Valley MA	141	85	3	16	36
Fish Slough and Tri-Valley CA	211	111	25	22	54
Fish Slough and Tri-Valley MA	37	24	0	1	12
Owens Lake CA	212	106	32	25	49
Owens Lake MA	85	66	0	1	18

CA = Contributing Area; MA = Management Area

3. Sustainability in Owens Basin

The criteria used to ascertain if the Owens Basin is in balance is based on runoff and recharge from the contributing area (headwater basin) entering the Owens Valley groundwater basin is in excess of the export of water by LADWP. This criterion is simple to evaluate since the BCM model water budget outputs provide the values of runoff and recharge entering the groundwater basin. Since LADWP did not provide access to the groundwater model for Owens Valley, we had to rely on LADWP annual reports to estimate the amount of water transferred outside the basin. Figure 20 shows the annual amount of water pumped by LADWP and Figure

21 shows the total export of water via the LA Aqueduct. LADWP pumping in the most recent thirty years 1986-2016 has been below 100 TAF and the export of water via the LA Aqueduct has been below 400 TAF. From the BCM model water budget analysis the total long term average runoff entering Owens valley is 470 TAF and the recharge from the contributing area (headwater) to the valley is 252 TAF. Since the BCM estimated runoff and recharge are higher than the reported pumping and export of water it is reasonable to assume that the basin is in balance if these historical values are accurate and are maintained in the future.

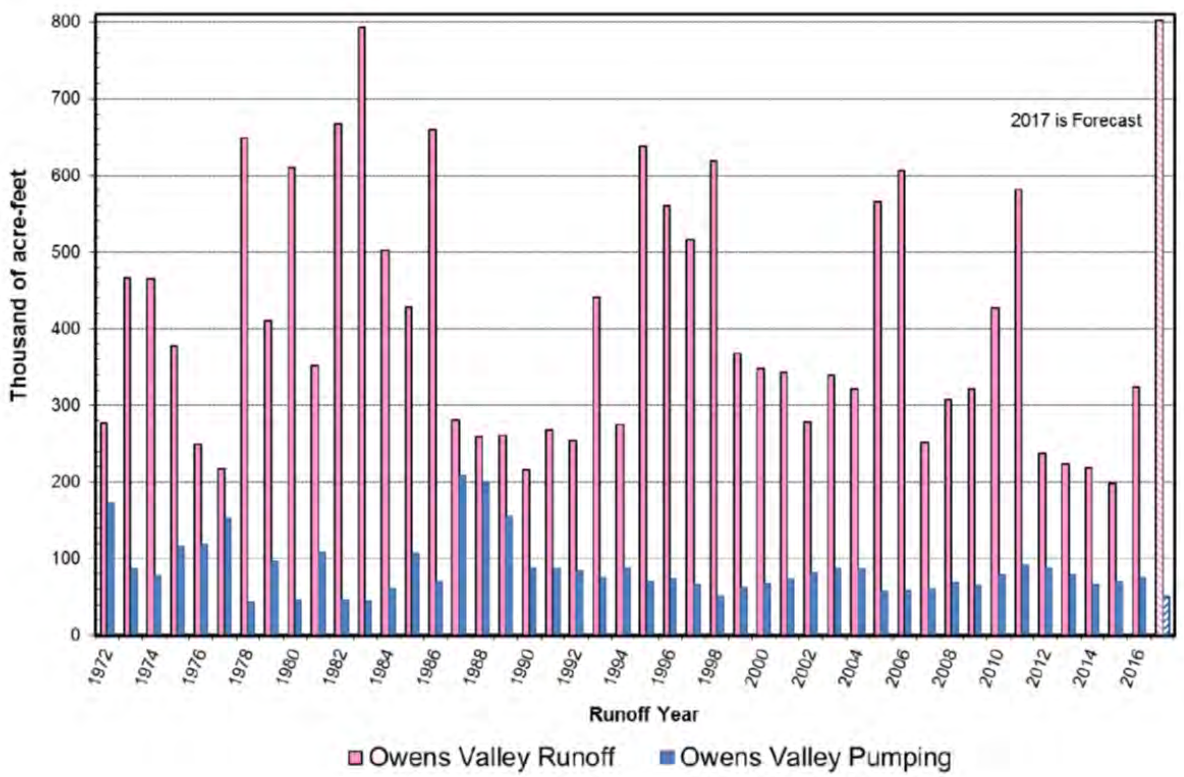

Figure 20. Groundwater pumping in Owens Valley. Source: 2017 LADWP Annual Report

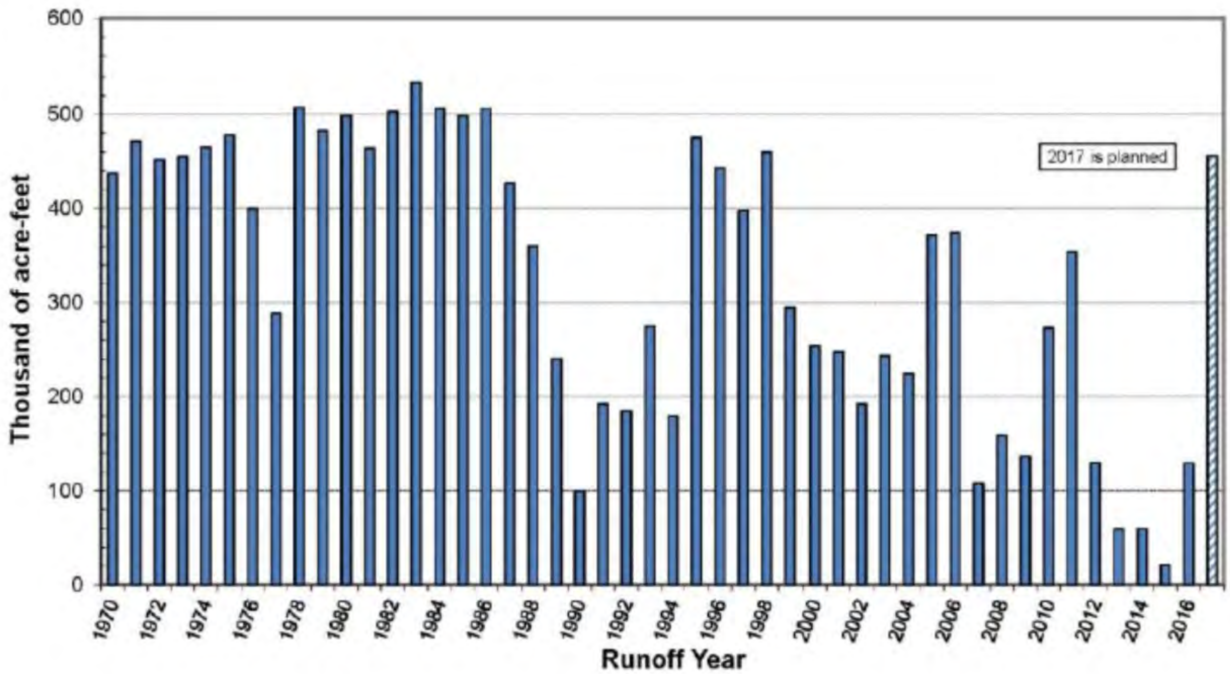

Figure 21. Water export from the Owens Basin via the LA Aqueduct. Source: 2017 LADWP Annual report

4. Future water balance

DWR future climate change factors for the Owens basin suggest that the temperatures will increase by approximately 2.6 degree F by mid-century and precipitation increases by 0.3%. The USGS has already made future climate runs using the BCM model for a subset of climate model inputs, CCSM4; CNRM-CM5; GFDL-CM3; MIROC5. For the purpose of this GSP the CCSM4 scenario 8.5 was selected for the Owens Basin to evaluate future water budget as this scenario showed similar delta change in temperature as suggested by DWR.

Figure 22 shows the future (mid-century) water budget for the contributing area to the groundwater basin. Figure 23 shows the future water budget for the groundwater basin.

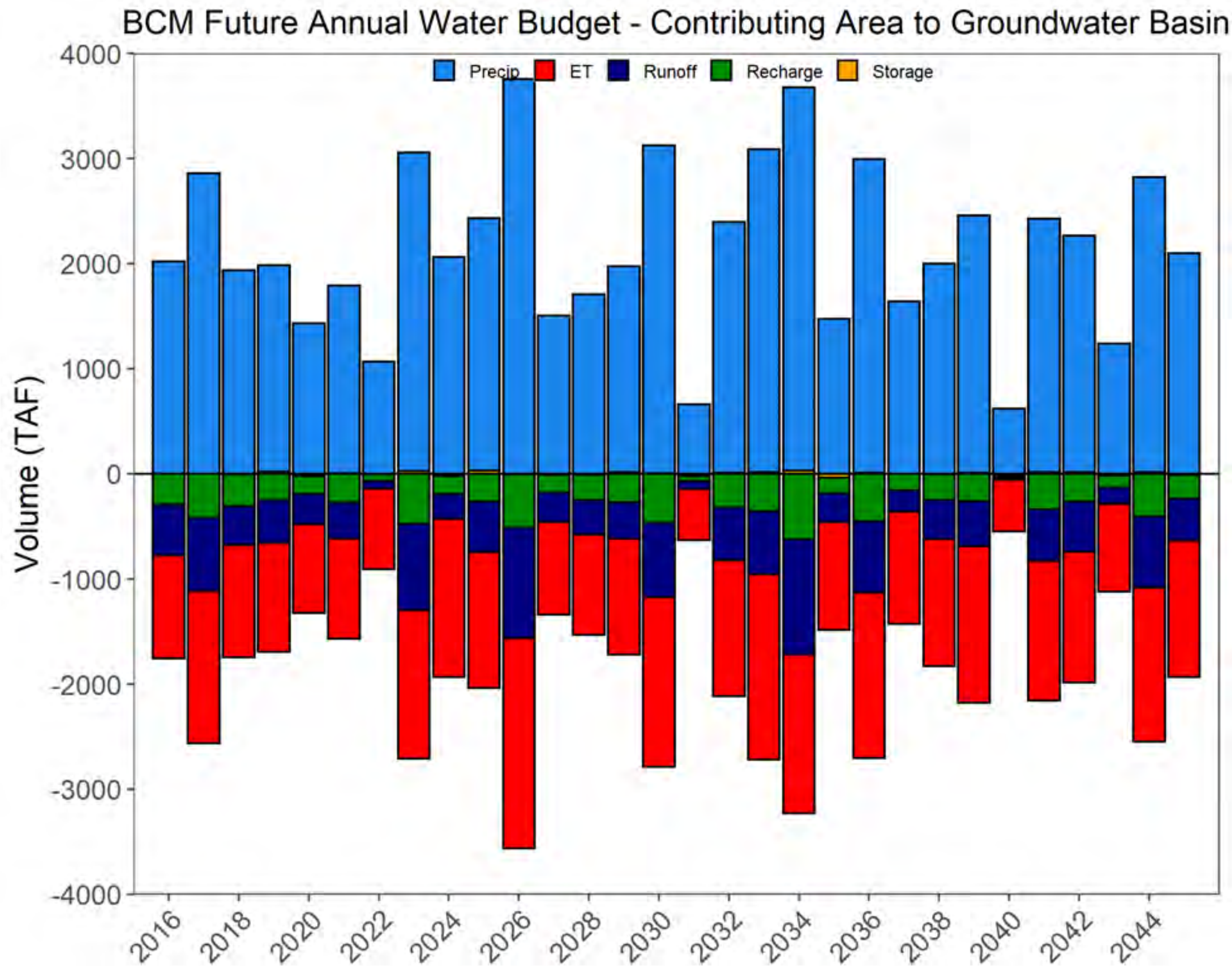

Figure 22. Future water budget for the Owens basin contributing area (headwater).

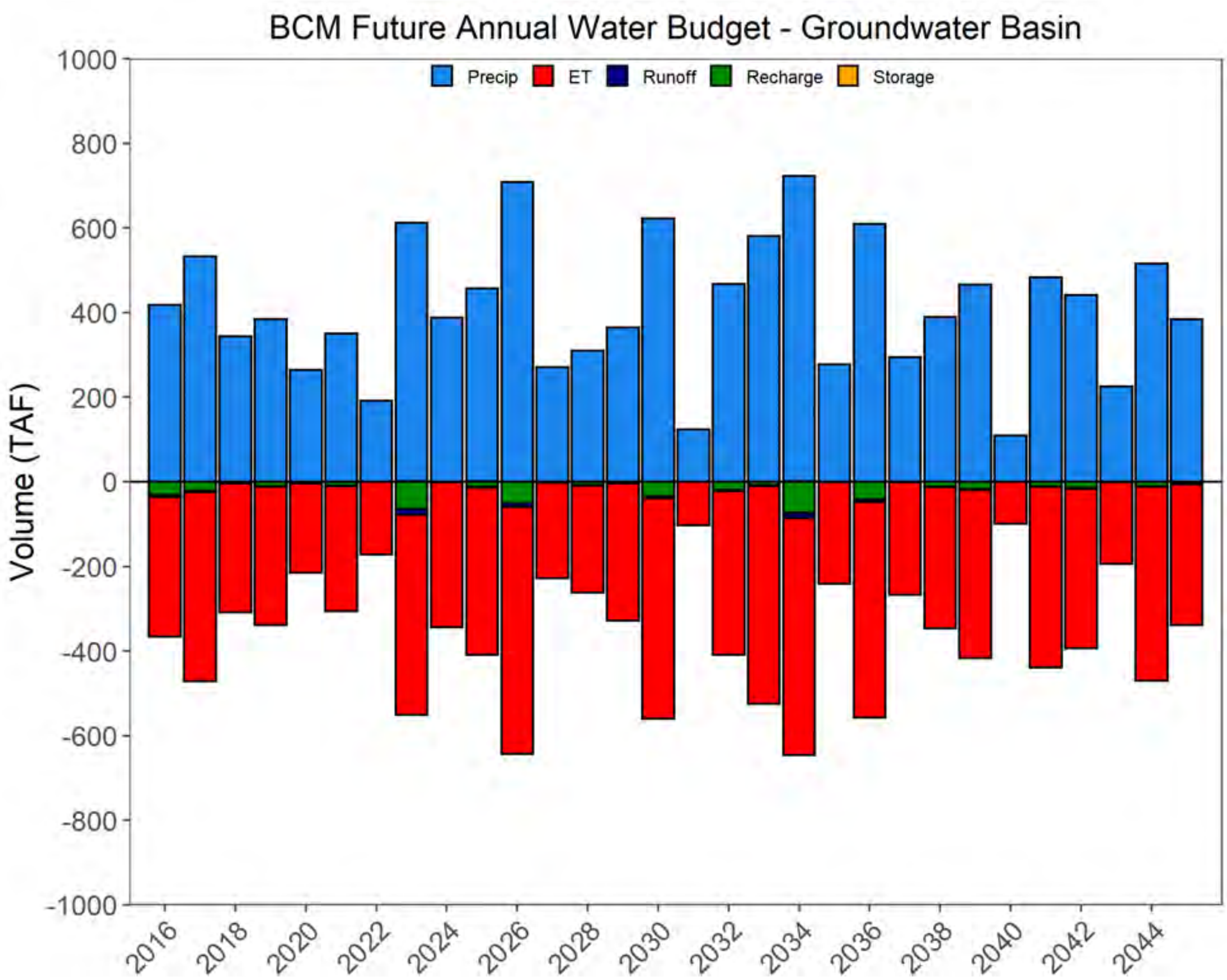

Figure 23. Future water budget for the Owens groundwater basin.

References

Flint, L.E., Flint, A.L., Thorne, J.H., and Boynton, R., 2013, Fine-scale hydrologic modeling for regional landscape applications: the California Basin Characterization Model development and performance: Ecol. Processes 2:25.

Appendix 11

Tri-Valley Well Vulnerability Assessment

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Tri-Valley Well Vulnerability Assessment

Due to the observed, multi-decadal downward trends in the limited number of monitoring wells in the Benton, Hammil and Chalfant valleys, OVGA staff conducted an initial vulnerability survey to determine if potential impacts were possible to area wells. The purpose of this desk-top survey was to determine whether a data gap exists regarding well vulnerability in the Tri-Valley area and whether future efforts should be considered by the OVGA to address this potential issue.

Based on the results from this survey, OVGA staff suggest that it is possible that impacts could occur to area production wells both in the near future and within the 20-year planning horizon and that further investigation, including potential field event(s), should be considered as part of GSP implementation process.

Data Acquisition

To conduct this vulnerability assessment, staff used DWR's online Well Completion Report Map Application (https://data.cnra.ca.gov/showcase/well-completion-report-map-app). California Water Code Section 13752 allows for the release of copies of well completion reports to governmental agencies and to the public. DWR has redacted the personal information from the approximately 800,000 reports on file. The DWR GIS mapper application allows users to search for well completion reports (WCRs) which contain information about a given well collected during its initial drilling, installation, and development. DWR's GIS based mapper is spatial organized by counties and Township/Range/Section grids.

OVGA staff investigated all available WCRs from the Mount Diablo, Township 01S, Range 31E, Section 06 in the northwest corner to the southeast corner at the Inyo-Mono County line's intersection Mount Diablo, Township 06S, Range 33E, Section 01. This search area overlapped and extended beyond the Tri-Valley portion of the Owens Valley Groundwater Basin itself, but was deemed necessary as many wells are poorly located in the DWR system. Only wells found to be completed within the OVGB were retained.

Individual WCRs were reviewed for location and data content and then downloaded as pdfs if deemed useful. Individual wells were located by varying methods based on the available information in each individual log; these data sources included latitude and longitude, county APN numbers, addresses and other spatial information contained in the driller's site map, etc. The majority of WCRs contain enough information to accurately locate them within at least a 1-mile radius. Essential WCR information included date completed, total depth, screen interval, and initial groundwater level (either first or static water).

Table 1 presents the results from this data collection effort (attached at end). Wells were sorted by valley (Benton, Hammil and Chalfant) and then by approximate region within the given valley. It is very likely that additional wells are physically present in the Tri-Valley area but not captured in Table 1. It is also likely that a portion of the wells in Table 1 are either no longer active or have been abandoned. Field reconnaissance or well verification was beyond the scope of this initial survey.

Well Summary Information

Available well data:

In the Benton area there are 41 wells and more than 90% are domestic (8″ or less diameter). In the Hammil area there are 50 wells, mixed between domestic and agricultural wells (10″ or greater diameter) with approximately 25% being agricultural wells. In the Chalfant area there are 103 wells and more than 90% are domestic.

Well Age (as of 2020)

Benton has comparatively older wells with more than 50% being older than 30 years; average well age is 31 years, median well age is 30 years old. Hammill has primarily younger wells with only 15% being more than 30 years old; average well age is 22 years, median well age is 21 years old. Chalfant is a mix of ages with 40% younger than 20 years old, 30% between 20-30 years old, and 30% more than 30 years old; average well age is 25 years, median well ag e Is 23 years old.

Well Total Depths

Benton wells are comparatively shallow with 90% of wells less than 300 ft deep and 85% ranging between 100-300 feet deep. Benton wells are an average of 214 ft deep with a median total depth of 207 ft. Hammil wells are significantly deeper than Benton and Chalfant with 70% greater than 300 feet deep and 30% deeper than 400 ft. This is in part due to the greater number of agricultural wells and also due to deeper groundwater levels. Hammil wells are an average of 372 ft deep with a median total depth of 348 ft. Chalfant wells are similar to Benton but shallower with 95% of wells less than 300 ft deep and 90% ranging between 100-300 ft deep. Chalfant wells are an average of 172 ft deep with a median total depth of 160 ft.

Initial Groundwater Levels

Initial groundwater levels in Benton are comparatively shallow with 40% less than 50 ft deep and 80% less than 100 ft deep. In Benton, the average initial groundwater level averaged 82 ft deep with a median depth of 60 ft. Hammil groundwater levels are significantly deeper than Benton and Chalfant with only 20% shallower than 100 ft and 80% between 100 and 200 ft deep. In Hammil the average initial groundwater level averaged 123 ft deep with a median depth of 122 ft. Chalfant groundwater levels are similar but shallower than Benton with 80% less than 50 ft deep and 95% less than 100 ft deep. In Chalfant the average initial groundwater level averaged 47 ft deep with a median depth of 44 ft.

Potential Impacts

Several potential impacts to well owners due to declining groundwater levels were considered for this assessment. Potential impacts include increased lift costs associated with pumping water from greater depth in the well, pump longevity and operability impacts due to increase load/running time to produce an equivalent amount of water, the potential need to lower and/or replace existing pumps with higher horsepower pumps, and finally the need to modify or redrill a well due to lowered in-well water column. Table 2 summarizes these impacts in terms of significance and relative cost.

Table 2

Undesirable Result	Potential Impact	Estimated Expense
Lowered water level in well	Increased lift costs and reduced pump life	Dollars to tens of dollars (per year)
Water level is at or below necessary pumping level	Pump needs to be lowered or replaced with greater hp pump	Hundreds to thousands of dollars (one-time cost)
Water level drops below minimum operability level (within 30′ of bottom of well)	Well needs to be deepened or re-drilled	Tens of thousands of dollars (one-time cost)

Vulnerability Method

Due to the lack of available data, several assumptions were made in order to conduct this initial vulnerability survey. General assumptions included the in-well depth of either submersible or vertical turbine pump intakes, the height of water column required to protect existing pumps, the long-term rate of drawdown in the three valleys, and changes in well efficiency/yield based on well age.

Several vulnerability thresholds were considered. The most conversative approach would be to assume the in-well pump is located above the well's screen interval. This is standard practice for medium and large capacity wells (industrial, agricultural, CSD or MWC sized wells) to prevent in-well cascading of groundwater and air-entrainment. Hanging a pump in the water column above the top of the screen also protects the well screen from pressure stress associated with pumping and also decreases the potential amount of subsurface materials that are drawn into the well.

However, based on the review of WCRs, Tri-Valley wells are primarily (more than 85%) smaller diameter wells installed for domestic uses with capacities measured in gallons per minute versus larger wells with capacities measured in cubic feet per second. From the WCRs it is also apparent that local drilling practices place the top of the screen interval within 25 feet of initial water levels in approximately 33% of the domestic wells. Based on previous conversations with local drillers (from the Benton area in the north to Antelope Valley in the south) and first-hand experience with Eastern Sierra domestic wells, it was assumed that pumps were hung near the bottom of the well, inside the screen interval itself. This assumption is likely accurate for the majority of Tri-Valley domestic wells but likely inaccurate for the larger diameter agricultural wells (which are more properly designed with the large capacity turbine pumps hung above the well's screen interval).

Therefore, a less conservative, but more realistic method to determine vulnerability was used instead of comparing water level to top-of-screen. The assumptions for the selected method include the following. A pump hanging at a height of 15 feet above well bottom was used. Data on dynamic drawdown (from in-well pumping) in Tri-Valley wells was not available, so an estimate of 10 feet was used. Maintaining a minimum of 5 feet of water column above the pump at all times was also included to bring the total necessary water column height to 30 ft above the bottom of the well for purposes of well vulnerability. The total depth listed in the WCR was used as the bottom of the well. If the static water column were to fall to within 30' of the total depth of the well it is likely that owners would see pumping impacts and would be force to pay for significant and costly well modifications (deepening, widening, or redrilling).

The rate of groundwater decline used for this vulnerability assessment was based on the average annual rate of groundwater decline from monitoring wells in a given valley over a recent period of time. For Benton, the average rate of decline was based on the past 20 years of water levels from MW-1 at the Benton Landfill. This long-term rate of decline is 0.5 feet/year (ft/yr). For Hammil, the rate is based on observations in one private well from 2007-2019, resulting in an average rate of decline of 1.8 ft/yr. In Chalfant, the rate of decline was based on the past 20 years of water levels from MW-1 at the Chalfant Landfill, resulting in an average rate of decline of 0.5 ft/yr. The rate of decline for each valley was assumed to be constant moving backward and forward in time for the purposes of this assessment.

No data was found on the decline of well yield or specific capacity over time due to lowering water levels, incrustation, bio-fouling, sand influx, or other screen damage or corrosion in Tri-Valley wells. Also no localized or seasonal corrections were used based on proximity to a larger diameter/capacity (agricultural) well's localize and/or seasonal cone of depression as pumping data was not available.

As noted in the descriptions above, this vulnerability rationale does **not** use the most conservative metric of keeping water levels above the top of screen. Using the minimum of 30-feet of water column method, wells failing into the vulnerable category would clearly represent an undesirable result related to lowered groundwater levels. Therefore, this vulnerable category should be interpreted to mean that risk potential does exist and that more investigation should occur in the initial 5-year GSP implementation period to close data gaps and develop a more accurate assessment.

Results

Table 3 presents the results of this assessment. The current year (2020) was used as the starting assessment year. The technical work necessary to meet the 2021 GSP submittal deadline and the future 5-year and 20 year SGMA-mandated GSA/GSP reporting requirements needs to be conducted at east one-year prior to the deadlines. Therefore the vulnerability year-categories are 2020, 2025, and 2040. An additional 30-year prediction was analyzed based on the standard length of a mortgage (2050).

Table 3

Valley	Total Number of Wells*	Total Number of Vulnerable Wells At Year			
		2020	2025	2040	2050
Benton	37	2 5%	3 8%	3 8%	5 14%
Hammil	50	3 6%	3 6%	6 12%	10 20%
Chalfant	102	3 3%	5 5%	7 7%	11 11%
Tri-Valley Totals	189	8 4%	11 6%	16 8%	26 14%

*: Total number of wells with Initial water level and total depth data available to make assessment

The wells that are vulnerable as of 2020 or which become vulnerable within the first 5-year GSP implementation period are primarily older wells constructed prior to 1985. As can be seen from Table 3, domestic wells in the Tri-Valley are potentially vulnerable if the observed multi-decadal declining groundwater levels continue. Additional work is warranted during GSP implementation to close the substantial data gaps that exist in this assessment and develop future actions to protect domestic wells.

Future Actions

The results of this initial well vulnerability survey will be used to inform GSP Sections 3.5.4 "Assessment and Improvement of Monitoring Network" and also Section 4 "Projects and Management Actions to Achieve Sustainability." One of the goals of the proposed management actions will be to close both monitoring and modeling gaps in the Tri-Valley area. The OVGA also distributed a survey to Tri-Valley residents in summer 2021 and planned to conduct additional outreach in fall 2021 to identify potential domestic well owners who are willing to participate in a groundwater level monitoring program. It is anticipated that within the initial 5-year implementation period that there will be field events to measure DTWs in area domestic wells and to match these wells with their WCRs to determine water level change since drilling and actual current water column heights above well total depth and screen intervals.

Comparisons from field results to this assessment can then be made to reduce uncertainties and more accurately assess future vulnerability. Also included in the GSP's Section 4 future actions is development of a numeric groundwater model for the Tri-Valley/Fish Slough area to more accurately quantify the amount of overdraft in the basin and to develop strategies for sustainable groundwater management in this area.

Tri-Valley Well Vulnerability Assessment Table 1

Well Completion Report	Area	General Location	Age as of 2020 (yrs)	Diameter (in)	Total Depth (ft)	Top of Screen (ft)	Bottom Screen (ft)	Initial Water Level* (ft)
01S32E06_0904272.pdf	Benton	Northern	15	8	180	140	180	42
01S32E06_231845.pdf	Benton	Northern	37	14	260	20	260	147
01S32E06_365137.pdf	Benton	Northern	39	8	293	68	293	**ND**
01S32E16_139420.pdf	Benton	Northern	41	6	315	265	315	230
01S32E16_231837.pdf	Benton	Northern	37	6	500	360	500	350
01S32E20_0931704.pdf	Benton	Northern	11	6	262	120	262	127
01S32E20_139452.pdf	Benton	Northern	41	6	200	175	200	138
01S31E25_542596.pdf	Benton	West Central	25	15	305	90	305	**ND**
01S31E31_231853.pdf	Benton	West Central	37	6	135	60	135	60
01S31E35_395742.pdf	Benton	West Central	27	6	260	180	260	180
01S31E36_256664.pdf	Benton	West Central	32	6	330	200	325	215
01S32E31_060655.pdf	Benton	Central	40	6	110	80	110	83
01S32E31_060658.pdf	Benton	Central	40	8	225	68	178	88
01S32E31_0904264.pdf	Benton	Central	15	6	220	180	220	78
01S32E31_317437.pdf	Benton	Central	30	8	284	80	284	65
01S32E32_060659.pdf	Benton	Central	40	10	200	80	180	**ND**
01S32E32_0931699.pdf	Benton	Central	10	6	190	80	190	79
01S32E32_146285.pdf	Benton	Central	42	6	160	120	160	50
01S32E32_146292.pdf	Benton	Central	42	6	155	130	155	90
01S32E32_231283.pdf	Benton	Central	38	6	215	95	215	80
01S32E32_231801.pdf	Benton	Central	39	6	160	30	160	45
01S32E32_231892.pdf	Benton	Central	35	6	146	65	146	59
01S32E32_256622.pdf	Benton	Central	33	6	200	80	180	50
01S32E32_344581.pdf	Benton	Central	30	6	200	80	176	83
01S32E32_401085.pdf	Benton	Central	26	6	220	90	220	75
01S32E32_533075.pdf	Benton	Central	25	2	170	140	170	86
02S31E_27007.pdf	Benton	Central	63	8	112	74	112	50
02S31E05_0912007.pdf	Benton	Central	26	6	205	80	205	25
02S32E05_317457.pdf	Benton	Central	30	6	215	65	215	50
02S32E05_317468.pdf	Benton	Central	30	6	270	76	270	37
02S32E05_452935.pdf	Benton	Central	23	6	140	40	140	20
02S32E06_770228.pdf	Benton	Central	20	6	185	125	185	20
01S32E32_0931743.pdf	Benton	Southern	13	6	215	80	215	75
01S32E32_737102.pdf	Benton	Southern	18	6	207	58	207	54
01S32E32_796510.pdf	Benton	Southern	16	6	225	165	225	37
02S32E05_060648.pdf	Benton	Southern	40	6	373	233	373	28
02S32E05_0904288.pdf	Benton	Southern	14	6	210	140	210	**ND**
02S32E05_256650.pdf	Benton	Southern	32	6	123	63	123	40
02S32E08_486631.pdf	Benton	Southern	28	6	139	79	139	28
02S32E17_0931729.pdf	Benton	Southern	11	8	233	73	233	48
02S33E_8447.pdf	Benton	Southern	64	8	40	ND	40	25
02S32E02_0912031.pdf	Hammil	Northern	15	8	610	200	610	200
02S32E28_E001207.pdf	Hammil	Northern	22	12	200	40	200	10
03S32E11_396043.pdf	Hammil	Northern	25	6	255	189	249	189
03S32E11_542595.pdf	Hammil	Northern	25	14	440	200	440	150
03S32E11_701063.pdf	Hammil	Northern	22	6	346	240	346	238
03S32E11_806916.pdf	Hammil	Northern	17	8	410	210	410	196
03S32E14_060693.pdf	Hammil	Northern	40	8	280	120	280	135
03S32E13_060694.pdf	Hammil	Northern	39	8	440	100	440	135
03S32E13_231287.pdf	Hammil	Northern	38	8	255	90	255	130
03S32E13_317469.pdf	Hammil	Northern	30	6	335	155	355	166

Well Completion Report	Area	General Location	Age as of 2020 (yrs)	Diameter (in)	Total Depth (ft)	Top of Screen (ft)	Bottom Screen (ft)	Initial Water Level* (ft)
03S32E13_422743.pdf	Hammil	Northern	23	15	640	196	640	110
03S32E14_775622.pdf	Hammil	Northern	18	8	350	270	350	143
03S32E11_496977.pdf	Hammil	Northern	15	12	390	ND	390	163
03S32E14_770238--001.pdf	Hammil	Central	20	6	310	240	300	145
03S32E13_396379.pdf	Hammil	Central	27	8	259	199	259	121
03S32E23_350073.pdf	Hammil	Central	28	6	240	120	240	115
03S32E24_0904257.pdf	Hammil	Central	15	6	335	175	335	20
03S32E24_770244.pdf	Hammil	Central	19	8	365	285	365	127
03S32E23_0912032.pdf	Hammil	Central	15	8	420	140	420	130
03S32E23_139403.pdf	Hammil	Central	42	8	200	160	200	70
03S32E23_146267.pdf	Hammil	Central	42	6	150	100	150	84
03S32E23_231839.pdf	Hammil	Central	37	6	215	100	215	100
03S32E23_317449.pdf	Hammil	Central	30	8	320	100	320	100
03S32E23_503238.pdf	Hammil	Central	21	16	597	246	597	40
03S32E23_700777.pdf	Hammil	Central	21	8	420	210	420	117
03S32E23_770233.pdf	Hammil	Central	20	6	350	190	350	125
03S32E23_770246.pdf	Hammil	Central	20	6	340	220	340	125
03S32E23_E0267689.pdf	Hammil	Central	5	16	710	520	700	165
03S32E24_796536.pdf	Hammil	Central	17	6	300	260	300	123
03S33E23_700776.pdf	Hammil	Central	21	6	360	240	360	117
03S32E23_0904285.pdf	Hammil	Central	14	6	315	255	315	110
03S32E23_0904289.pdf	Hammil	Central	14	6	310	230	310	105
03S32E23_1091065.pdf	Hammil	Central	14	6	355	295	355	47
03S32E23_1091095.pdf	Hammil	Central	13	6	255	195	255	112
03S32E23_700784.pdf	Hammil	Central	21	6	400	300	400	117
03S32E24_796531.pdf	Hammil	Central	17	6	315	275	315	140
03S32E23_396201.pdf	Hammil	Central	26	8	359	279	359	123
03S32E23_422745.pdf	Hammil	Central	23	12	400	120	400	126
03S32E23_434205.pdf	Hammil	Central	25	8	350	269	249	113
03S32E24_396381.pdf	Hammil	Central	27	8	265	199	265	114
03S32E24_396382.pdf	Hammil	Central	27	8	257	197	257	130
03S32E25_425681.pdf	Hammil	Southern	20	16	615	150	615	104
03S32E25_775628.pdf	Hammil	Southern	18	6	310	270	310	110
03S32E25_E0221155.pdf	Hammil	Southern	6	16	698	198	698	166
03S32E26_256603.pdf	Hammil	Southern	34	6	178	76	178	100
03S32E26_396165.pdf	Hammil	Southern	26	8	299	199	299	111
03S32E26_491342.pdf	Hammil	Southern	28	16	640	210	640	120
03S32E36_1091064.pdf	Hammil	Southern	14	6	355	295	355	109
04S32E01_WCR2019-004713.pdf	Hammil	Southern	1	16	580	180	580	146
04S32E01_1076829.pdf	Hammil	Southern	16	16	500	260	500	140
04S33E31_0904295.pdf	Chalfant	Northern	14	6	195	155	195	20
05S33E08_317439.pdf	Chalfant	Northern	30	6	305	143	305	145
05S33E04_0931666.pdf	Chalfant	Northern	13	8	415	130	415	130
04S33E31_0912039.pdf	Chalfant	Northern	15	6	235	95	235	118
04S33E31_1091092.pdf	Chalfant	Northern	13	6	196	156	196	135
05S33E05_775632.pdf	Chalfant	Northern	18	6	150	130	150	40
05S33E05_775620.pdf	Chalfant	Northern	18	6	160	120	160	**ND**
05S33E05_231264.pdf	Chalfant	Eastern	39	8	105	40	105	42
05S33E08_231272.pdf	Chalfant	Eastern	38	6	78	30	78	40
05S33E08_231277.pdf	Chalfant	Eastern	38	8	130	60	130	60
05S33E08_256627.pdf	Chalfant	Eastern	33	6	160	40	140	40
05S33E08_452941.pdf	Chalfant	Eastern	22	6	156	60	156	45
05S33E08_737083.pdf	Chalfant	Eastern	[illegible]	6	300	120	300	45

Well Completion Report	Area	General Location	Age as of 2020 (yrs)	Diameter (in)	Total Depth (ft)	Top of Screen (ft)	Bottom Screen (ft)	Initial Water Level* (ft)
05S33E08_0931732.pdf	Chalfant	Eastern	11	6	214	114	214	52
05S33E09_139436.pdf	Chalfant	Eastern	41	6	100	60	100	30
05S33E09_146265.pdf	Chalfant	Eastern	42	6	100	70	100	28
05S33E09_146286.pdf	Chalfant	Eastern	42	6	100	70	100	22
05S33E09_146300.pdf	Chalfant	Eastern	42	6	100	75	100	27
05S33E09_231290.pdf	Chalfant	Eastern	38	6	115	40	115	35
05S33E09_231854.pdf	Chalfant	Eastern	37	6	118	40	118	35
05S33E09_231856.pdf	Chalfant	Eastern	36	6	110	50	110	45
05S33E09_231882.pdf	Chalfant	Eastern	35	8	166	35	166	38
05S33E09_401087.pdf	Chalfant	Eastern	26	6	210	100	210	40
05S33E09_452927.pdf	Chalfant	Eastern	23	6	110	60	110	60
05S33E09_770227.pdf	Chalfant	Eastern	21	6	150	90	150	39
05S33E09_796488.pdf	Chalfant	Eastern	17	5	150	110	150	40
05S33E09_0904281.pdf	Chalfant	Eastern	15	6	200	160	200	47
05S33E09_0904293.pdf	Chalfant	Eastern	14	6	175	155	175	45
05S33E09_0931753.pdf	Chalfant	Eastern	16	6	215	100	215	54
05S33E36_256672.pdf	Chalfant	Eastern	32	6	140	126	140	35
04S32E09_256606.pdf	Chalfant	Eastern	33	6	124	47	127	40
04S33E09_700786.pdf	Chalfant	Eastern	21	6	123	80	123	32
05S32E09_452805.pdf	Chalfant	Eastern	24	6	208	100	208	20
05S33E09_139419.pdf	Chalfant	Eastern	41	6	80	50	80	25
05S33E09_231271.pdf	Chalfant	Eastern	38	6	78	35	78	35
05S33E09_231279.pdf	Chalfant	Eastern	38	6	100	40	100	40
05S33E09_231865.pdf	Chalfant	Eastern	36	8	213	90	210	37
05S33E09_231868.pdf	Chalfant	Eastern	35	6	152	50	150	38
05S33E09_231895.pdf	Chalfant	Eastern	35	6	110	20	110	40
05S33E09_256601.pdf	Chalfant	Eastern	34	6	197	97	197	33
05S33E09_256688.pdf	Chalfant	Eastern	31	6	115	55	115	38
05S33E09_344582.pdf	Chalfant	Eastern	30	6	160	80	160	35
05S33E09_350065.pdf	Chalfant	Eastern	28	4	185	125	185	35
05S33E09_401086.pdf	Chalfant	Eastern	26	6	105	75	105	40
05S33E09_452812.pdf	Chalfant	Eastern	24	6	150	65	150	55
05S33E09_701057.pdf	Chalfant	Eastern	21	6	150	90	150	39
05S33E09_775614.pdf	Chalfant	Eastern	18	6	150	130	150	35
05S33E09_775618.pdf	Chalfant	Eastern	18	6	195	135	195	35
05S33E09_775644.pdf	Chalfant	Eastern	19	6	148	128	148	35
05S33E09_796508.pdf	Chalfant	Eastern	17	5	170	130	170	46
05S33E09_806900.pdf	Chalfant	Eastern	18	6	165	20	165	42
05S33E09_806924.pdf	Chalfant	Eastern	17	6	205	105	205	40
05S33E09_0904253.pdf	Chalfant	Eastern	16	6	175	135	175	46
05S33E09_0904254.pdf	Chalfant	Eastern	16	6	175	135	175	42
05S33E09_0904286.pdf	Chalfant	Eastern	14	6	155	135	155	39
05S33E09_0904302.pdf	Chalfant	Eastern	16	6	175	135	175	46
05S33E09_0912025.pdf	Chalfant	Eastern	15	6	155	20	155	48
05S33E09_0912037.pdf	Chalfant	Eastern	15	6	225	125	225	48
05S33E09_0931718.pdf	Chalfant	Eastern	11	6	205	115	205	45
05S33E09_0931741.pdf	Chalfant	Eastern	13	6	212	90	212	46
05S33E09_0931757.pdf	Chalfant	Eastern	9	6	215	110	215	49
05S33E09_343805.pdf	Chalfant	Eastern	30	2	102	72	102	80
05S33E09_343806.pdf	Chalfant	Eastern	30	2	79	49	79	52
05S33E09_343807.pdf	Chalfant	Eastern	30	2	78	48	78	53
05S33E22_054928.pdf	Chalfant	Eastern	40	12	250	50	250	55
05S33E08_139426.pdf	Chalfant	Western	41	12	180	130	180	30

Well Completion Report	Area	General Location	Age as of 2020 (yrs)	Diameter (in)	Total Depth (ft)	Top of Screen (ft)	Bottom Screen (ft)	Initial Water Level* (ft)
05S33E08_231816.pdf	Chalfant	Western	36	6	136	40	136	40
05S33E08_231817.pdf	Chalfant	Western	11	6	134	40	134	40
05S33E08_231840.pdf	Chalfant	Western	37	6	140	40	140	45
05S33E08_256624.pdf	Chalfant	Western	34	6	173	33	173	35
05S33E08_256652.pdf	Chalfant	Western	32	6	142	42	142	40
05S33E08_317425.pdf	Chalfant	Western	31	6	150	50	150	45
05S33E08_317444.pdf	Chalfant	Western	30	6	160	40	160	40
05S33E08_317456.pdf	Chalfant	Western	30	6	210	40	210	45
05S33E08_350066.pdf	Chalfant	Western	28	6	195	50	195	49
05S33E08_350067.pdf	Chalfant	Western	28	6	195	50	195	49
05S33E08_395710.pdf	Chalfant	Western	26	6	170	50	170	50
05S33E08_439236.pdf	Chalfant	Western	22	6	160	100	160	43
05S33E08_439237.pdf	Chalfant	Western	22	6	104	20	104	51
05S33E08_452934.pdf	Chalfant	Western	23	6	105	60	105	44
05S33E08_453011.pdf	Chalfant	Western	19	6	150	70	150	41
05S33E08_701062.pdf	Chalfant	Western	21	6	100	60	100	47
05S33E08_763301.pdf	Chalfant	Western	16	8	360	260	360	46
05S33E08_775606.pdf	Chalfant	Western	18	6	160	140	160	50
05S33E08_775630.pdf	Chalfant	Western	18	6	160	140	160	45
05S33E08_775637.pdf	Chalfant	Western	19	6	180	140	180	40
05S33E08_796500.pdf	Chalfant	Western	17	5	210	170	210	48
05S33E08_796520.pdf	Chalfant	Western	16	8	365	260	365	46
05S33E08_796534.pdf	Chalfant	Western	17	5	220	180	220	51
05S33E09_452939.pdf	Chalfant	Western	23	6	155	60	155	48
05S33E09_796498.pdf	Chalfant	Western	17	5	210	170	210	52
05S33E17_231802.pdf	Chalfant	Western	39	6	117	37	117	38
05S33E17_231832.pdf	Chalfant	Western	4	6	118	35	115	35
05S33E17_344578.pdf	Chalfant	Western	30	6	210	45	210	48
05S33E17_452809.pdf	Chalfant	Western	24	6	195	60	195	45
05S33E17_452991.pdf	Chalfant	Western	20	6	195	100	195	65
05S33E17_796506.pdf	Chalfant	Western	18	6	180	140	180	48
05S33E17_796533.pdf	Chalfant	Western	17	5	215	175	215	62
05S33E17_806917.pdf	Chalfant	Western	17	6	205	105	205	64
05S33E17_85739.pdf	Chalfant	Western	41	6	215	165	215	60
05S33E32_401082.pdf	Chalfant	Southern	26	6	120	40	120	41
05S33E33_452808.pdf	Chalfant	Southern	24	8	256	75	256	35
05S33E34_231826.pdf	Chalfant	Southern	35	10	500	135	490	125

ND: No data

* Initial water level is "Static Water" level from WCR if available, otherwise "First Water" from WCR

Appendix 12

Hydrographs of Representative Monitoring Wells

Hydrographs of Representative Monitoring Wells

The purpose of this appendix to the Owens Valley Groundwater Authority's SGMA Groundwater Sustainability Plan is to present data on the Owens Valley Groundwater Basin's representative monitoring wells. Hydrographs that compare groundwater levels over time with their associated Sustainable Management Criteria (minimum thresholds and measureable objectives) are presented in tabular and graphical form. The rationale and methodology for selecting these specific monitoring points and determining corresponding SMCs can be found in the GSP's Sections 3.3 through 3.5 with additional details found in Appendix 3 of the OVGA GSP.

Tables of Representative Monitoring Wells with Minimum Threshold and Measurable Objective Values listed by Management Area

Table 1. Tri-Valley management area minimum thresholds for groundwater level declines and groundwater storage reductions at representative monitoring points. Values rounded to the nearest foot.

Representative Monitoring Well	Minimum Threshold Elevation (ft amsl)	Minimum Threshold Depth to Water (ft RP)
BT-MW1	5,301	134
Hammil 2	4,401	183
CH-MW2	4,204	76
FS-2	4,214	6
FS-3D	4,179	16
T397	4,199	31

a. Newly established representative monitoring point or data not currently available. MT or MO will be established in future GSP updates.

Table 2. Owens Valley management area minimum thresholds for groundwater level declines and groundwater storage reductions at representative monitoring points. Values rounded to the nearest foot.

Representative Monitoring Well	Minimum Threshold Elevation (ft amsl)	Minimum Threshold Depth to Water (ft RP)
ICWCSD 4	4,249	37
T001	3,867	630
T362	4,047	49
T364	3,898	25
T384	4,165	18
T389	4,216	20
T391	4,296	15
T480	3,994	11
T513	4,113	12
T574	4,067	20
T750	4,357	55
T751	4,373	39
T808	3,834	25
T809	3,823	19
T869	3,983	289
T871	3,850	120
T872	3,946	475
T873	4,954	89
V016GB	3,880	27
V151	3,827	67
V299	3,909	101
WCCSD 2	6,020	233
WCCSD 4	6,263	132

Table 3. Owens Lake management area minimum thresholds for groundwater level declines and groundwater storage reductions at representative monitoring points. Values rounded to the nearest foot.

Aquifer Unit	Representative Monitoring Well	Minimum Threshold Elevation (ft amsl)	Minimum Threshold Depth to Water (ft RP)
1	DVF South Upper	3,636	30
1	T901	3,607	-34
1	T904	3,626	5
1	T910	3,607	-26
2	DVF South Middle	3,639	27
2	Fault Test T3	3,620	-30
2	Fault Test T5	3,617	-27
2	Keeler-Swansea Lower	3,618	-9
2	River Site Lower	3,594	-4
3	DVF South Lower	3,640	26
3	OL92-2	3,605	-47
3	SFIP MW	3,511	54
3	T917	3,704	-25
4	DVF North MW	3,643	28
5	T899	3,617	-44
5	T902	3,631	0
5	T908	3,625	-43
5	T916	3,704	-25
Owens Lake	DELTA W(3)_10	3,562	5
Owens Lake	I10(7)_4	3,568	4
Unknown	KCSD	3,612	42
Unknown	O6(5)_4	3,567	5
Unknown	Rio Tinto[a]	--	--
Unknown	T348	3,630	12
Unknown	T588	3,685	23
Unknown	T858	3,666	13
Unknown	T860	3,708	30
Unknown	T920	3,600	213
Unknown	T922[a]	--	--
Unknown	T924	3,590	143
Unknown	T925[a]	--	--
Unknown	T929[a]	--	--

a. Newly established or data not currently available. MT or MO will be established in future GSP updates.

Table 4. Fish Slough and Tri-Valley management area measureable objectives for groundwater level declines and groundwater storage reductions at representative monitoring points. Values rounded to nearest foot.

Representative Monitoring Point	Groundwater Elevation (ft amsl)				Depth to Water (ft RP)
	5-year Interim Milestone	10-year Interim Milestone	15-year Interim Milestone	20-year Measurable Objective	20-year Measurable Objective
BT-MW1	5,303	5,303	5,306	5,309	126
Hammil 2[a]	--	--	--	--	--
CH-MW2	4,207	4,207	4,209	4,211	69
FS-2	4,215	4,215	4,216	4,217	3
FS-3D[a]	--	--	--	--	--
T397	4,199	4,199	4,200	4,201	29

a. Newly established representative monitoring point. Measureable objectives will be established in future GSP updates.

Table 5. Tri-Valley management area measureable objectives for interconnected surface-water depletions at representative monitoring points.

Representative Monitoring Point	Northeast Spring Flow Rate (cfs)			
	5-year Interim Milestone	10-year Interim Milestone	15-year Interim Milestone	20-year Measurable Objective
SW3208	0.1	0.1	0.3	0.5

Table 6. Owens Valley management area measureable objectives for groundwater level declines and groundwater storage reductions at representative monitoring points. Values rounded to the nearest foot.

Representative Monitoring Well	Measureable Objective Elevation (ft amsl)	Measureable Objective Depth to Water (ft RP)
ICWCSD 4	4,254	32
T001	3,880	617
T362	4,072	24
T364	3,903	20
T384	4,168	15
T389	4,224	12
T391	4,303	8
T480	3,995	10
T513	4,117	8
T574	4,071	16
T750	4,360	52
T751	4,379	33
T808	3,846	13
T809	3,829	13
T869	3,985	287
T871	3,852	118
T872	3,955	466
T873	4,963	80
V016GB	3,882	25
V151	3,834	60
V299	3,914	96
WCCSD 2	6,023	230
WCCSD 4	6,274	121

Table 7. Owens Lake management area measureable objectives for groundwater level declines and groundwater storage reductions at representative monitoring points. Values rounded to the nearest foot.

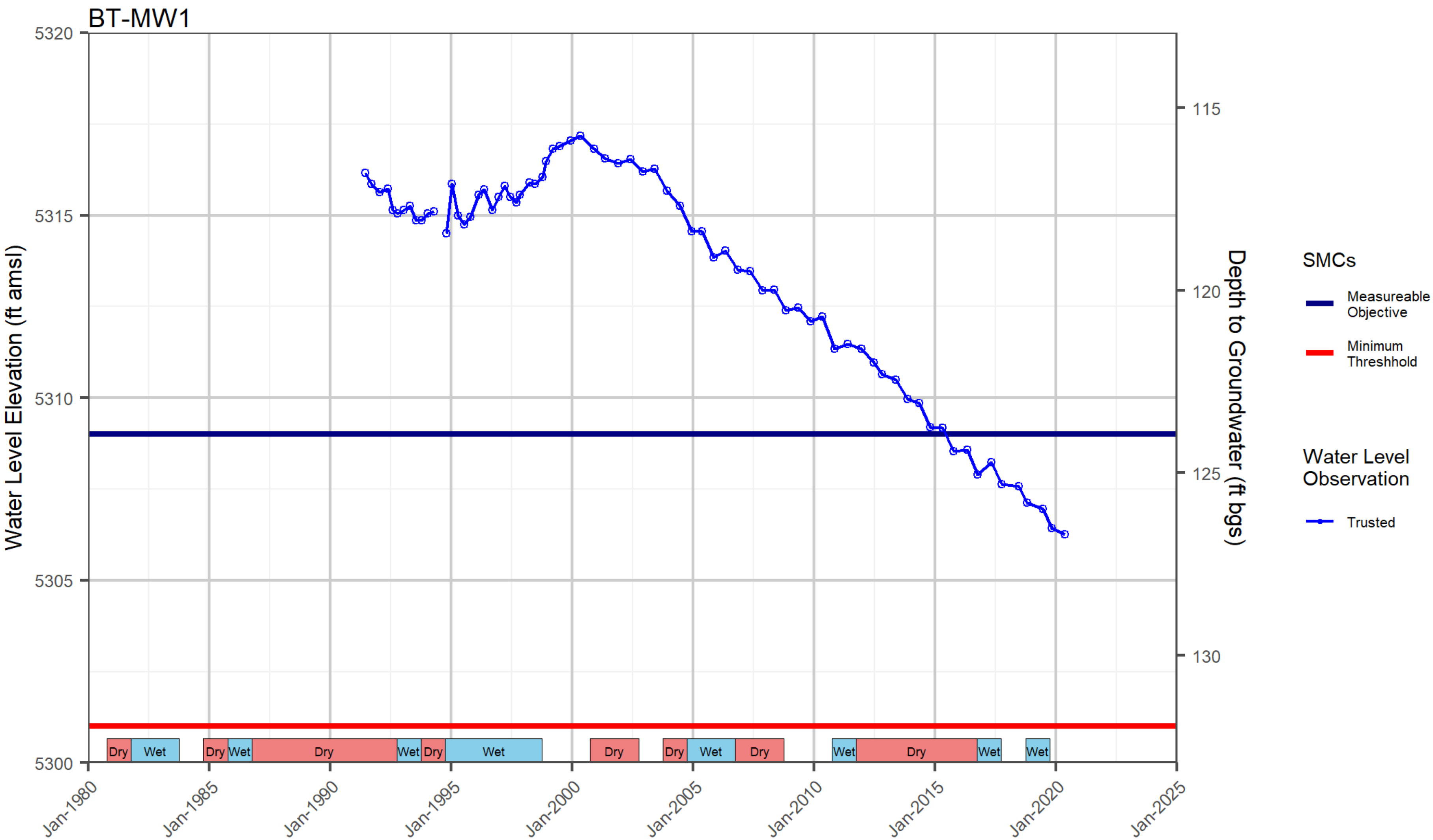
Aquifer Unit	Representative Monitoring Well	Measureable Objective Elevation (ft amsl)	Measureable Objective Depth to Water (ft RP)
1	DVF South Upper	3,641	25
1	T901	3,610	-37
1	T904	3,629	2
1	T910	3,608	-27
2	DVF South Middle	3,643	23
2	Fault Test T3	3,623	-33
2	Fault Test T5	3,623	-33
2	Keeler-Swansea Lower	3,618	-9
2	River Site Lower	3,633	-43
3	DVF South Lower	3,643	23
3	OL92-2	3,607	-49
3	SFIP MW	3,613	-48
3	T917	3,705	-26
4	DVF North MW	3,645	26
5	T899	3,618	-45
5	T902	3,632	-1
5	T908	3,627	-45
5	T916	3,704	-25
Owens Lake	DELTA W(3)_10	3,563	4
Owens Lake	I10(7)_4	3,570	2
Unknown	KCSD	3,613	41
Unknown	O6(5)_4	3,569	3
Unknown	Rio Tinto[a]	--	--
Unknown	T348	3,633	9
Unknown	T588	3,693	15
Unknown	T858	3,670	9
Unknown	T860	3,711	27
Unknown	T920	3,601	212
Unknown	T922[a]	--	--
Unknown	T924	3,592	141
Unknown	T925[a]	--	--
Unknown	T929[a]	--	--

a. Newly established or data not currently available. MT or MO will be established in future GSP updates.

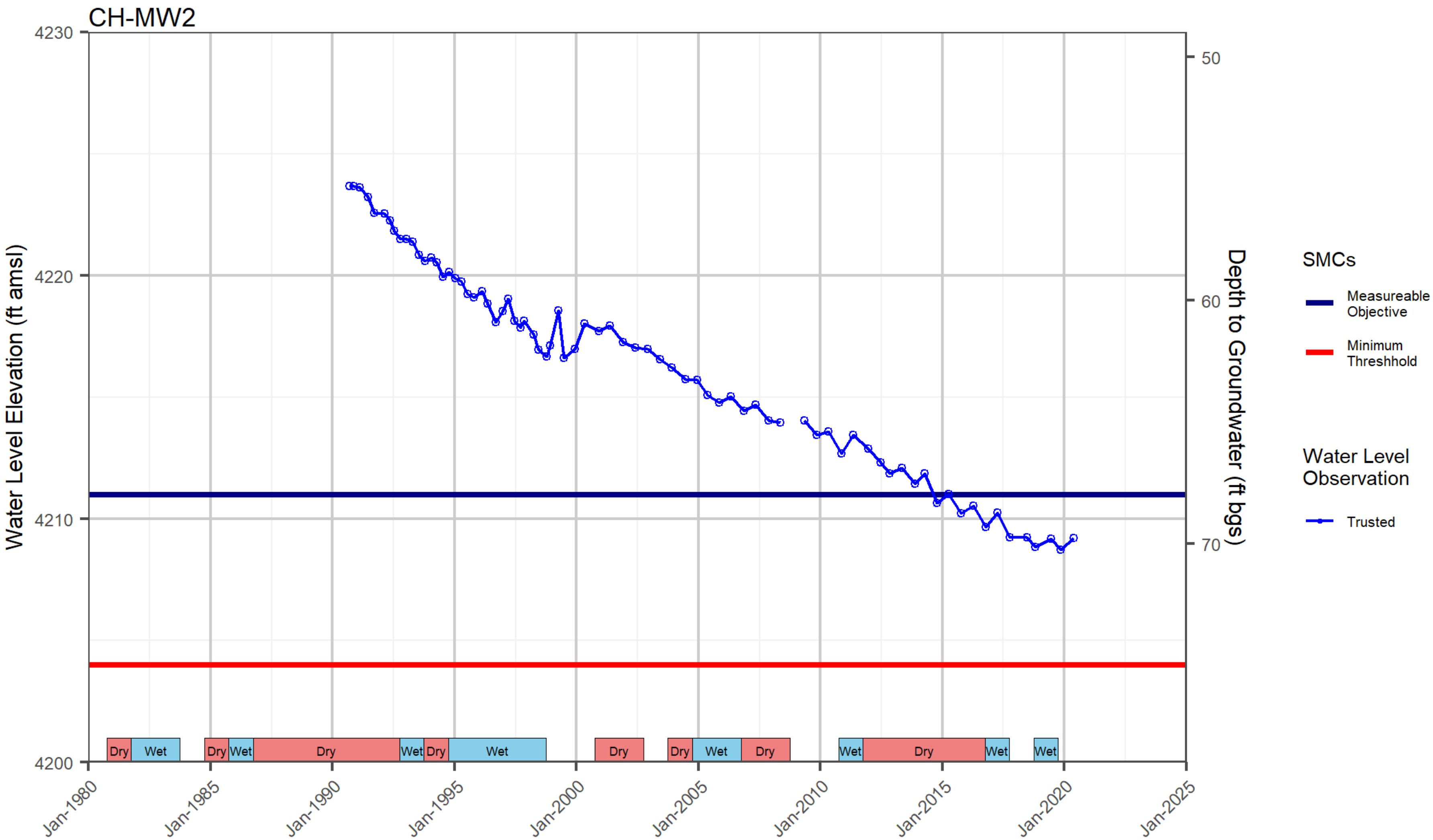
Figures of Representative Monitoring Wells with Minimum Threshold and Measurable Objective Values listed by Management Area

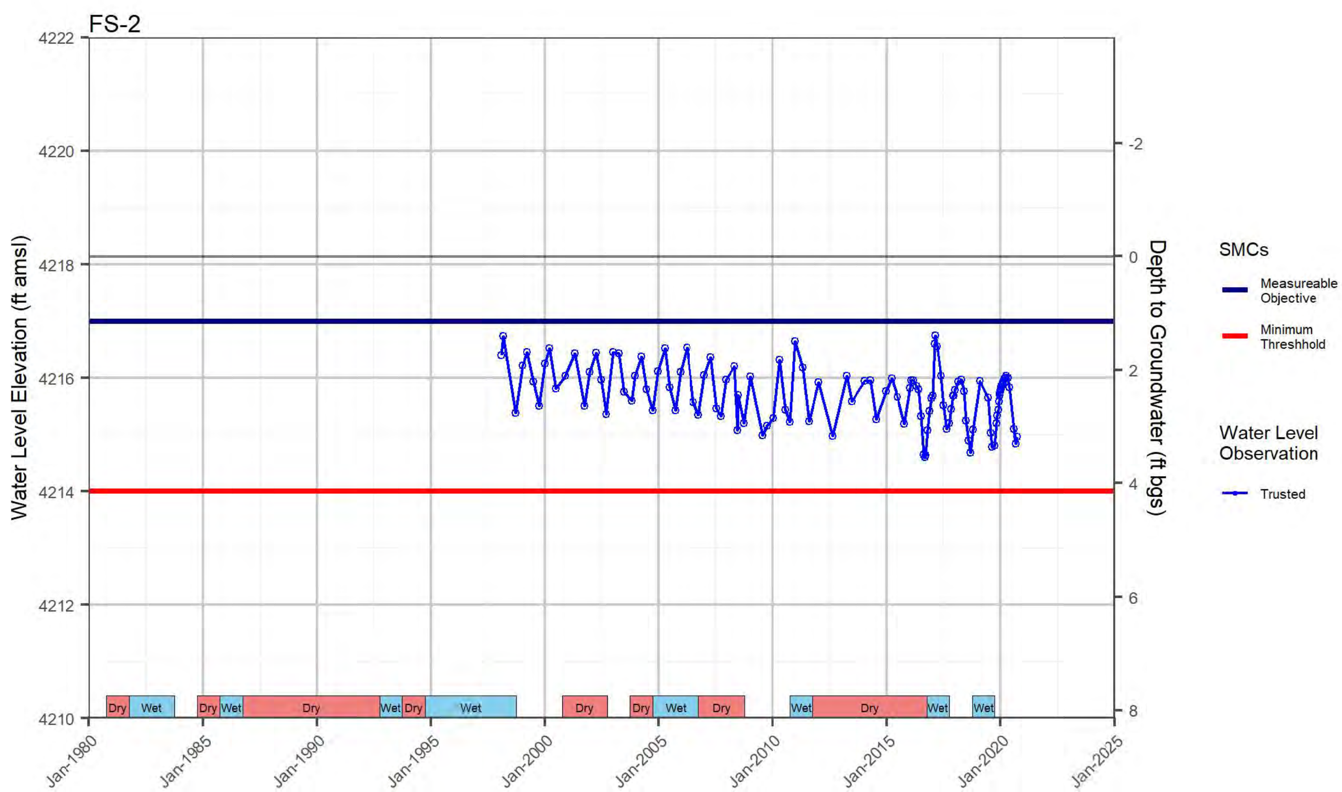
Tri-Valley Management Area

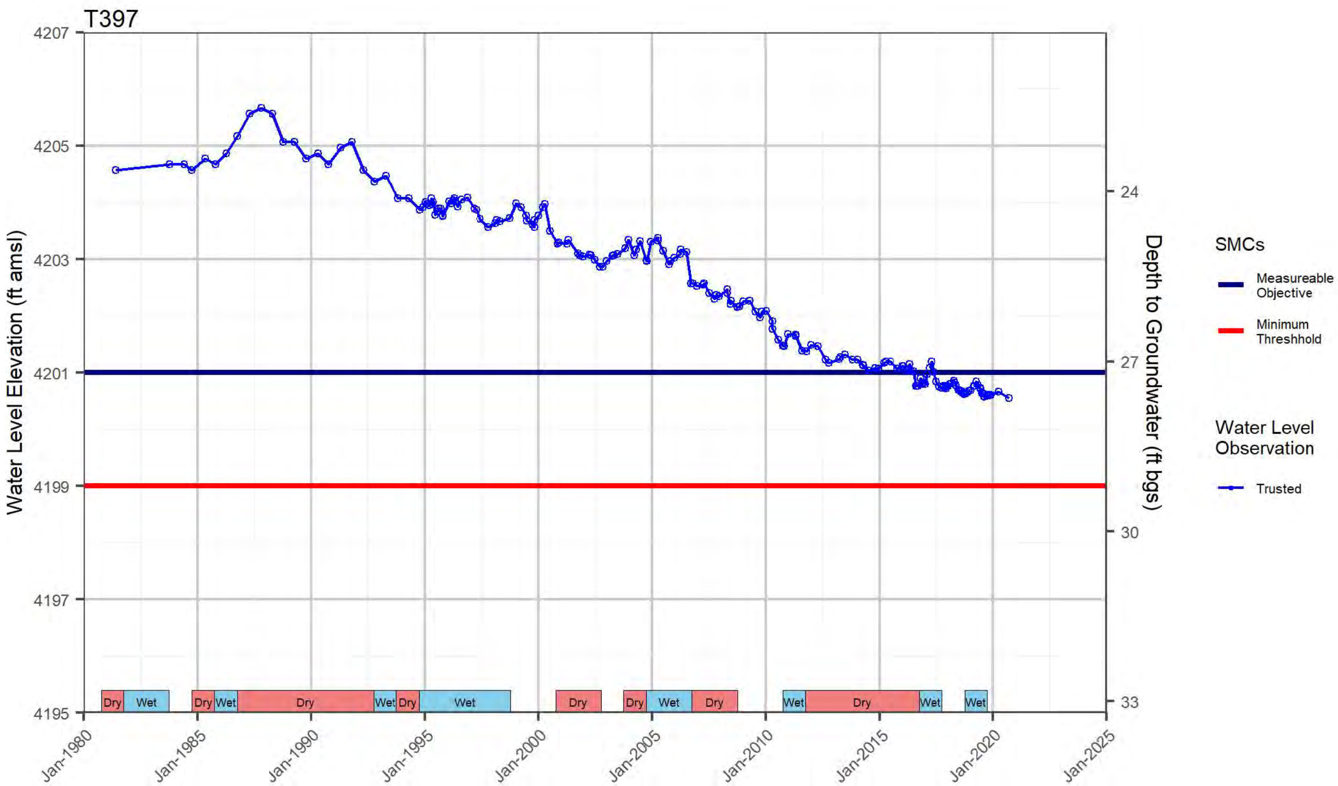
BT-MW1



BT-MW1
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
5300
5305
5310
5315
5320
115
120
125
130
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

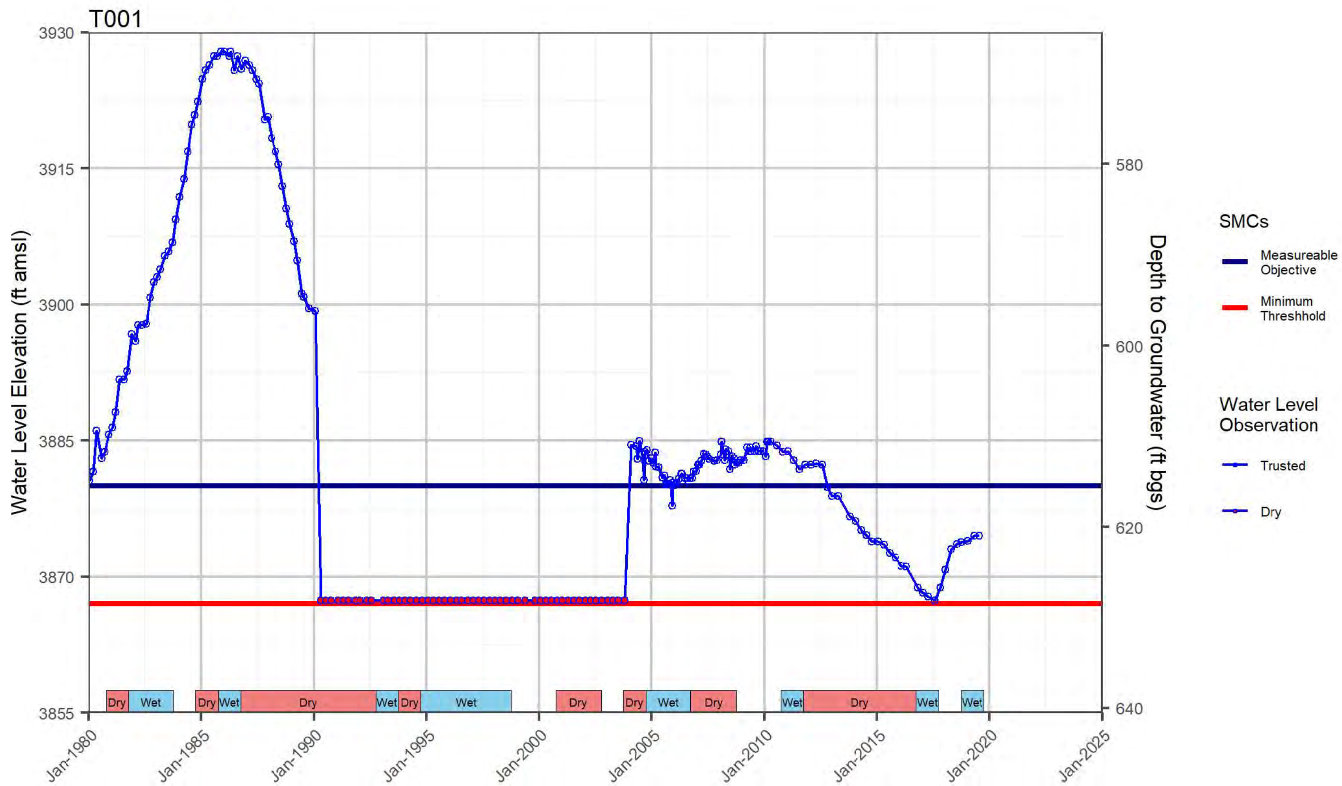

CH-MW2
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4230
4220
4210
4200
50
60
70
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

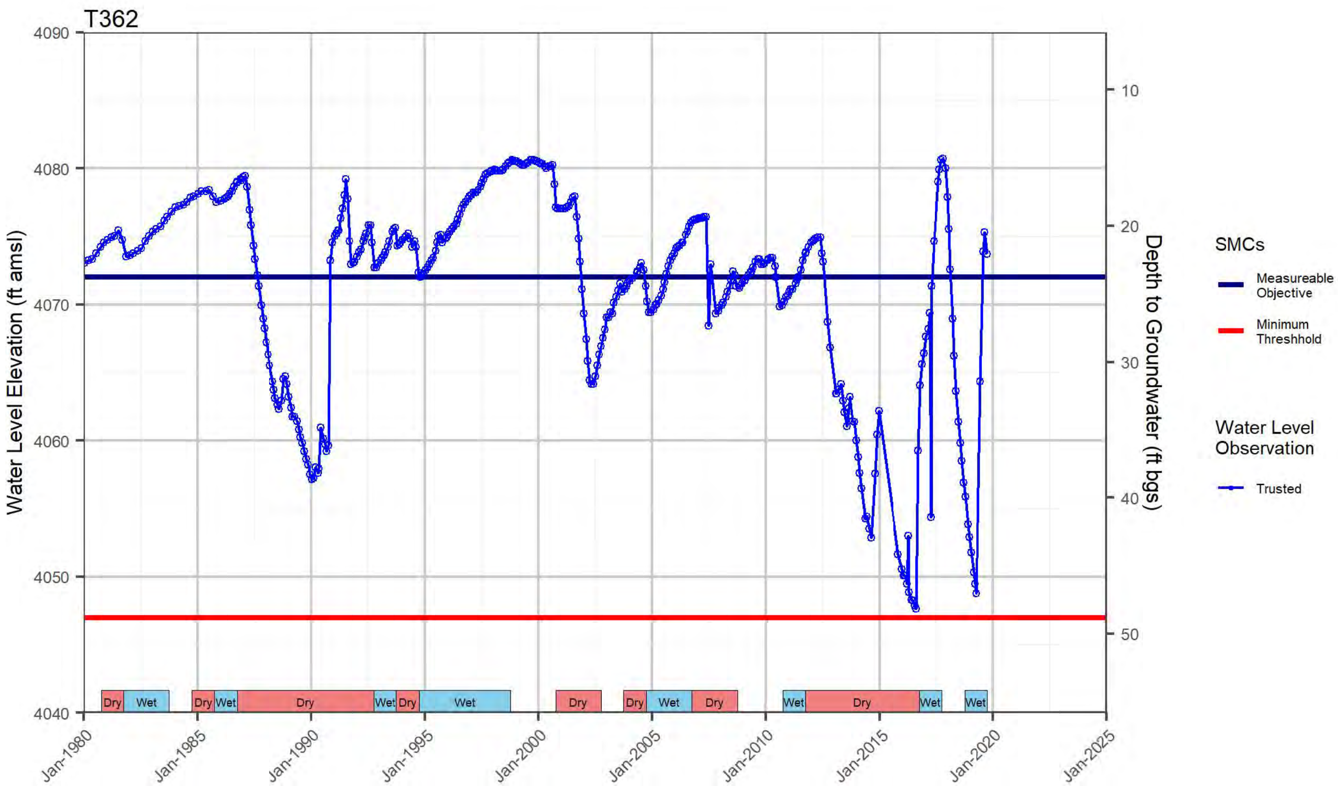

FS-2
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4222
4220
4218
4216
4214
4212
4210
-2
0
2
4
6
8
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


T397
4207
4205
4203
4201
4199
4197
4195
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
24
27
30
33
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

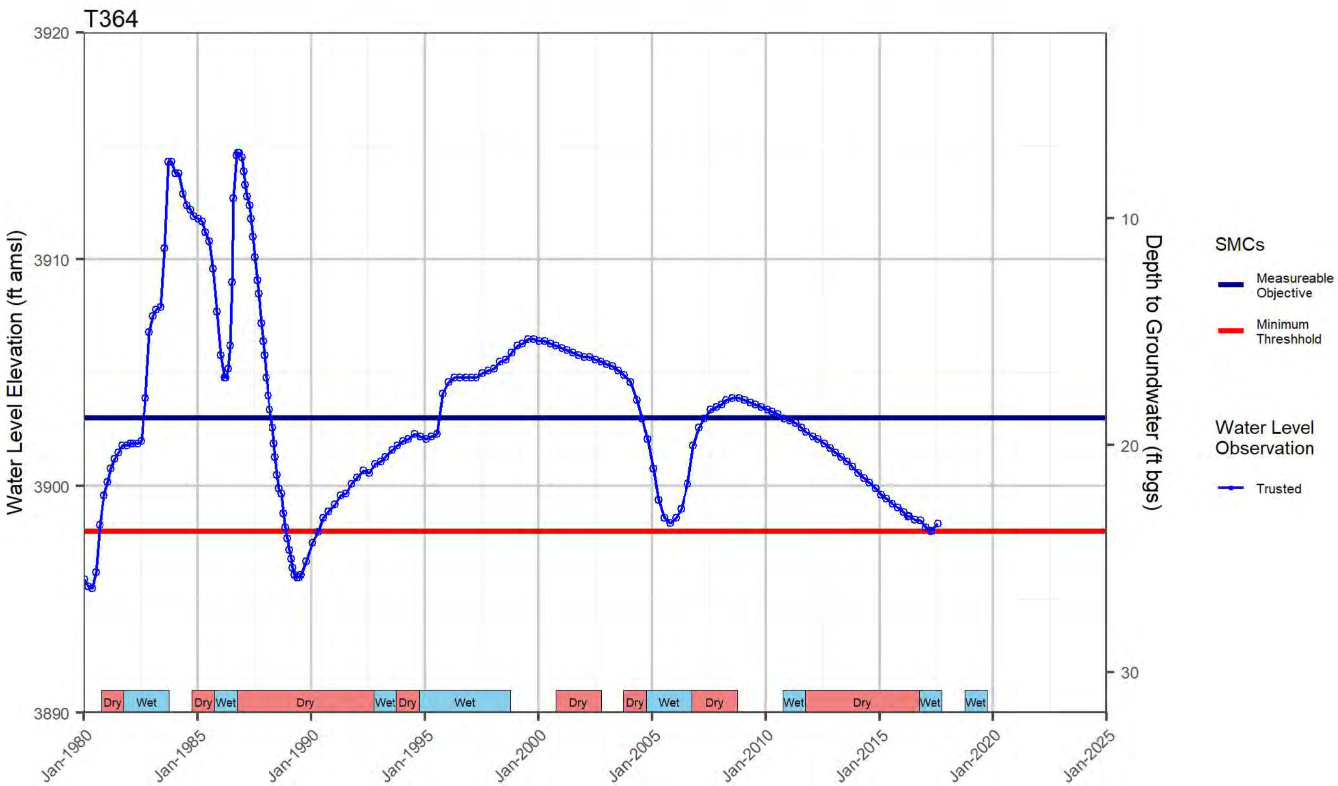
Owens Valley Management Area


ICWCSD 4
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4265
4260
4255
4250
4245
25
30
35
40
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

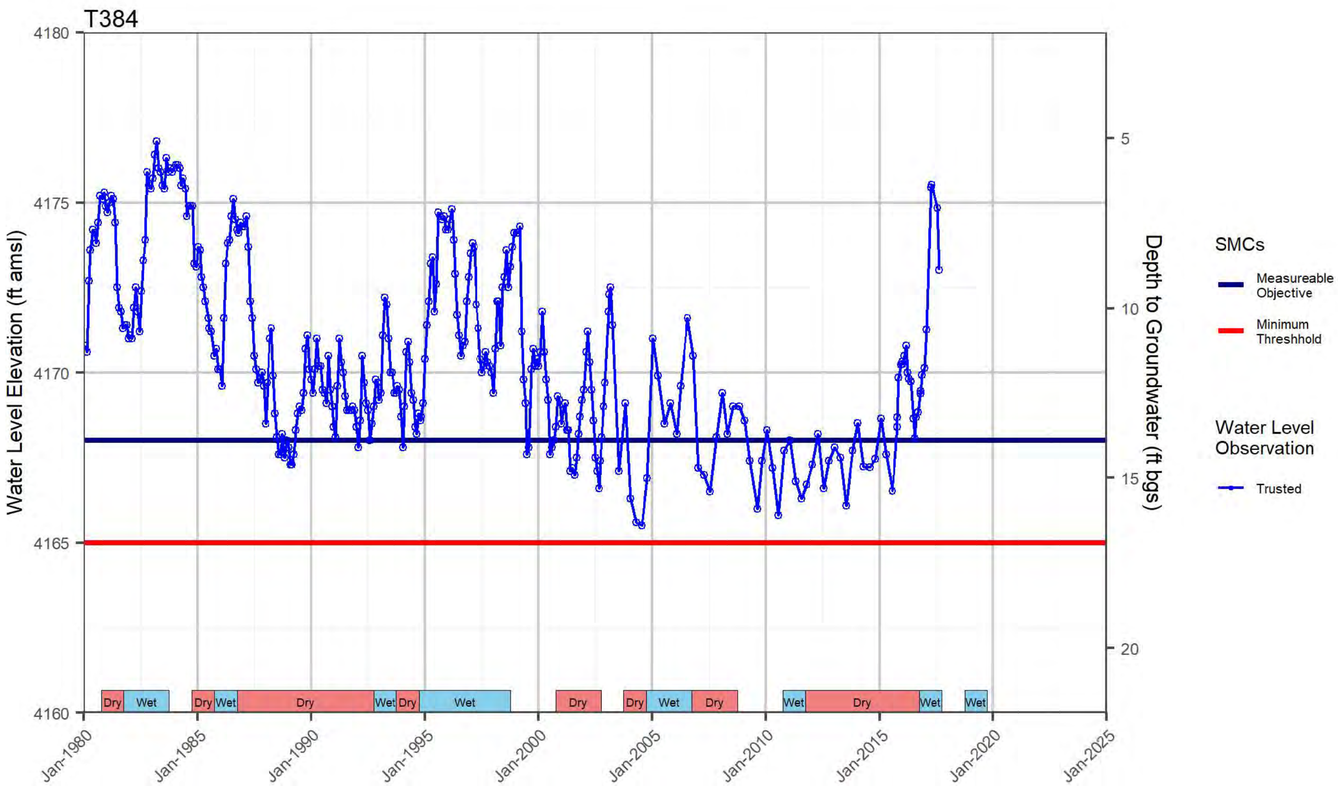

T001
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3930
3915
3900
3885
3870
3855
580
600
620
640
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted
Dry



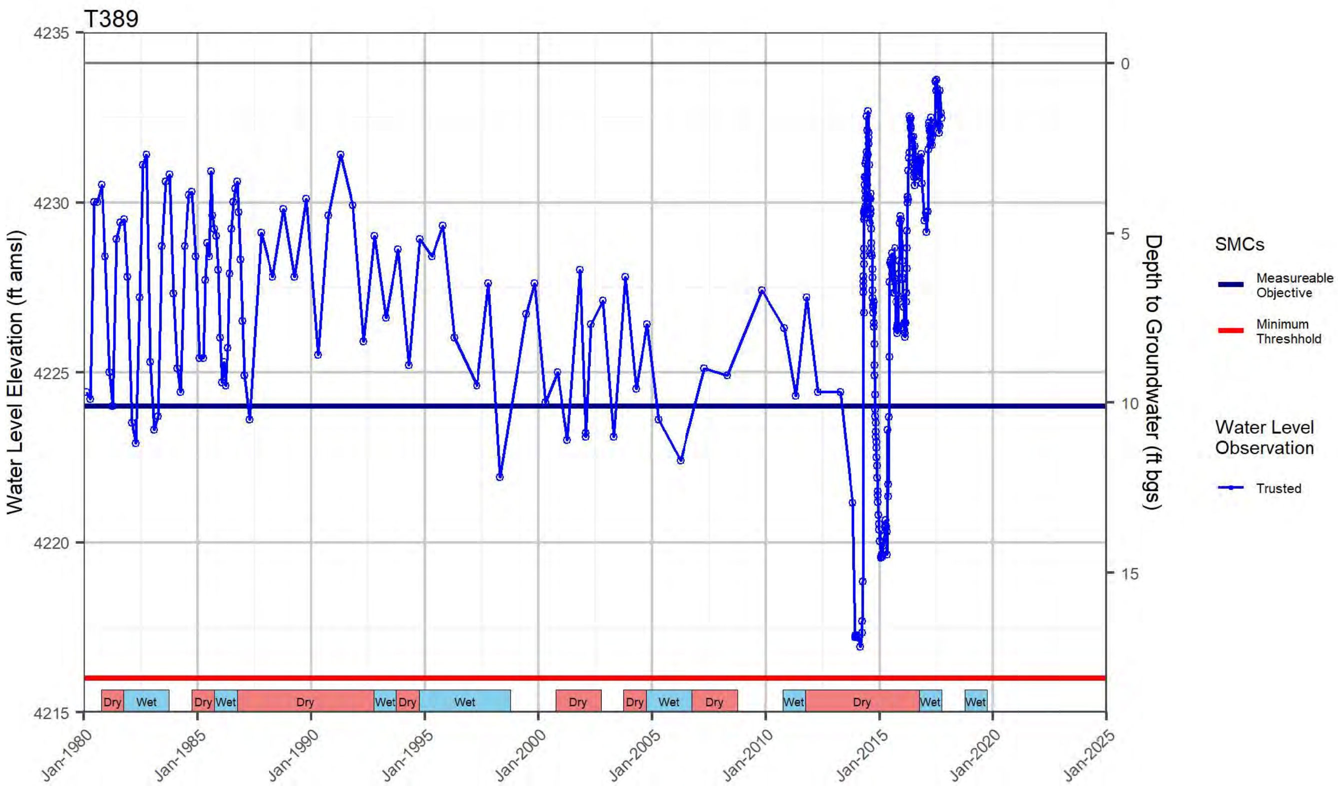
T362
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4090
4080
4070
4060
4050
4040
10
20
30
40
50
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

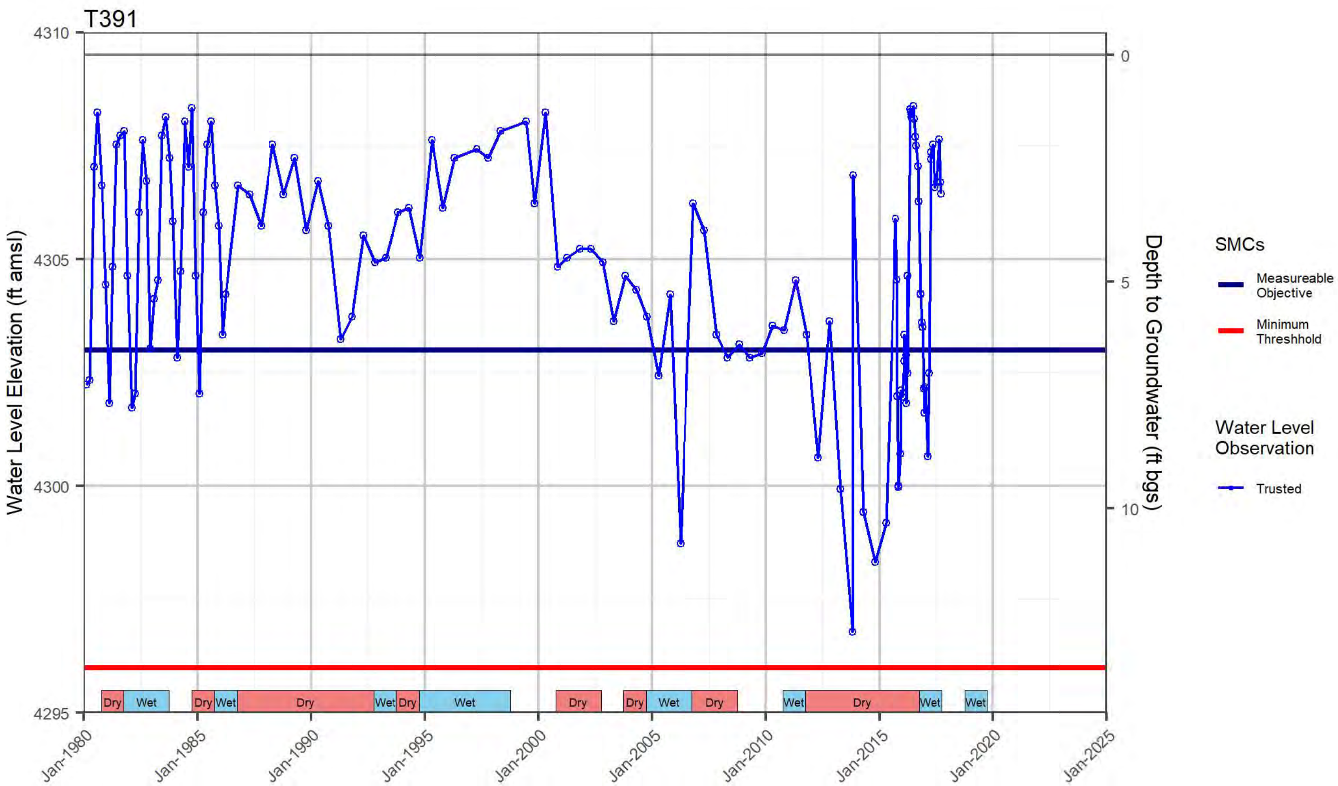


T364
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3920
3910
3900
3890
10
20
30
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry Wet Dry Wet Dry Wet Dry Wet Dry Dry Wet Dry Wet Dry Wet Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

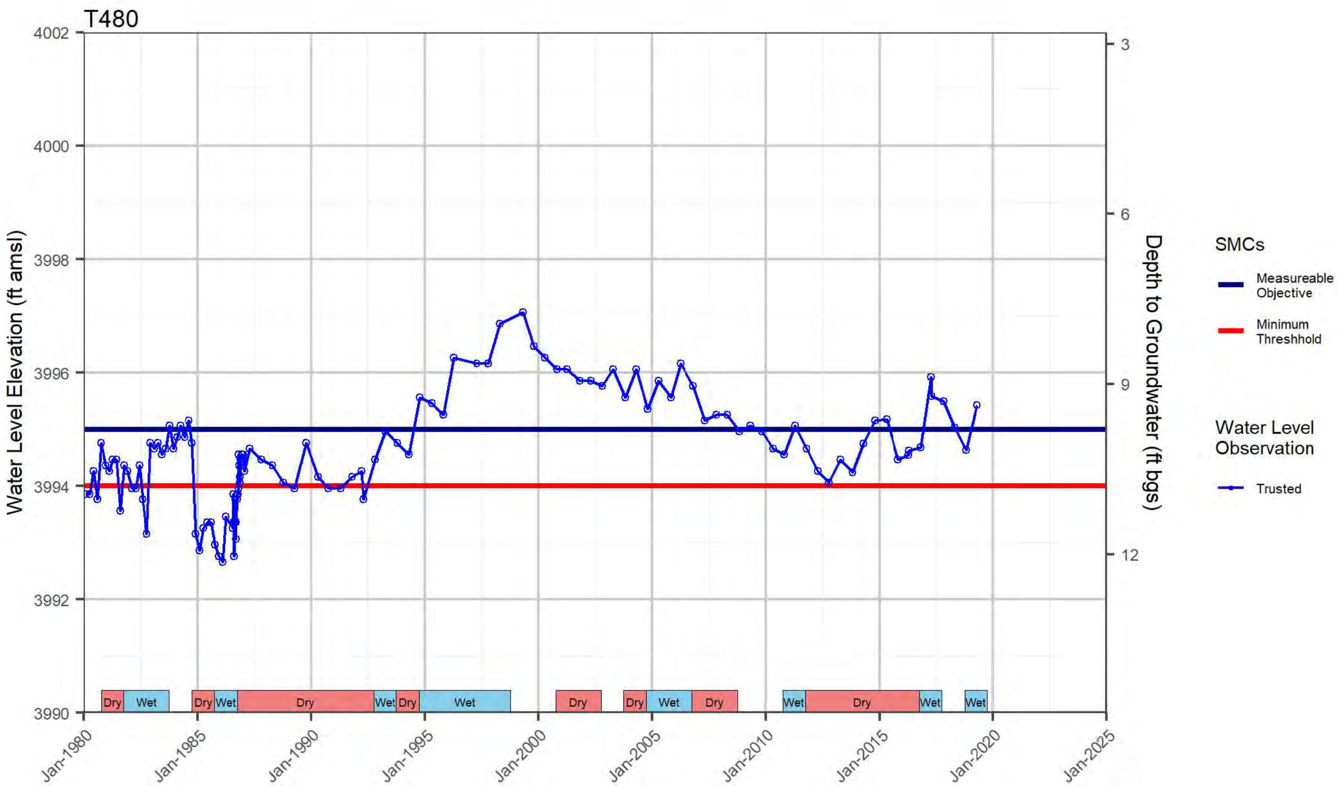


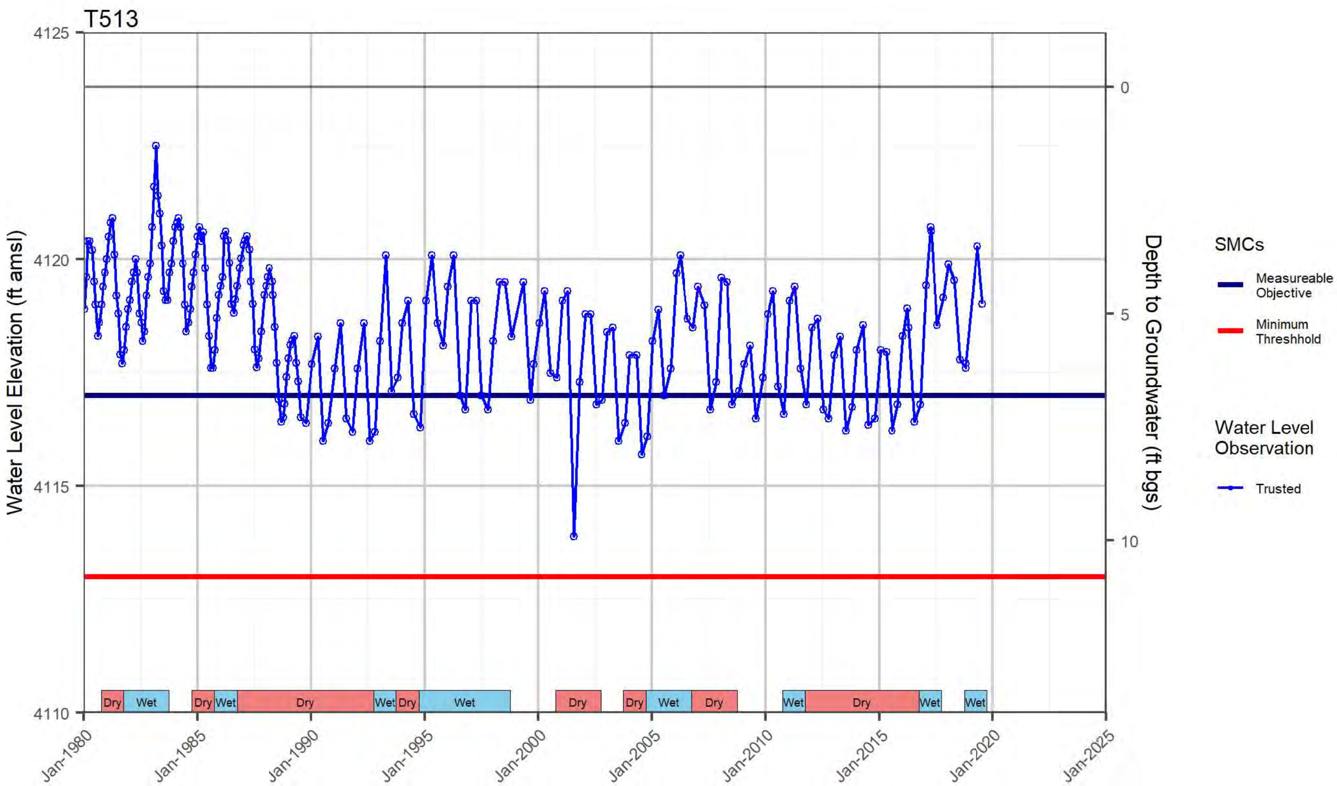
T384
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted
Dry
Wet

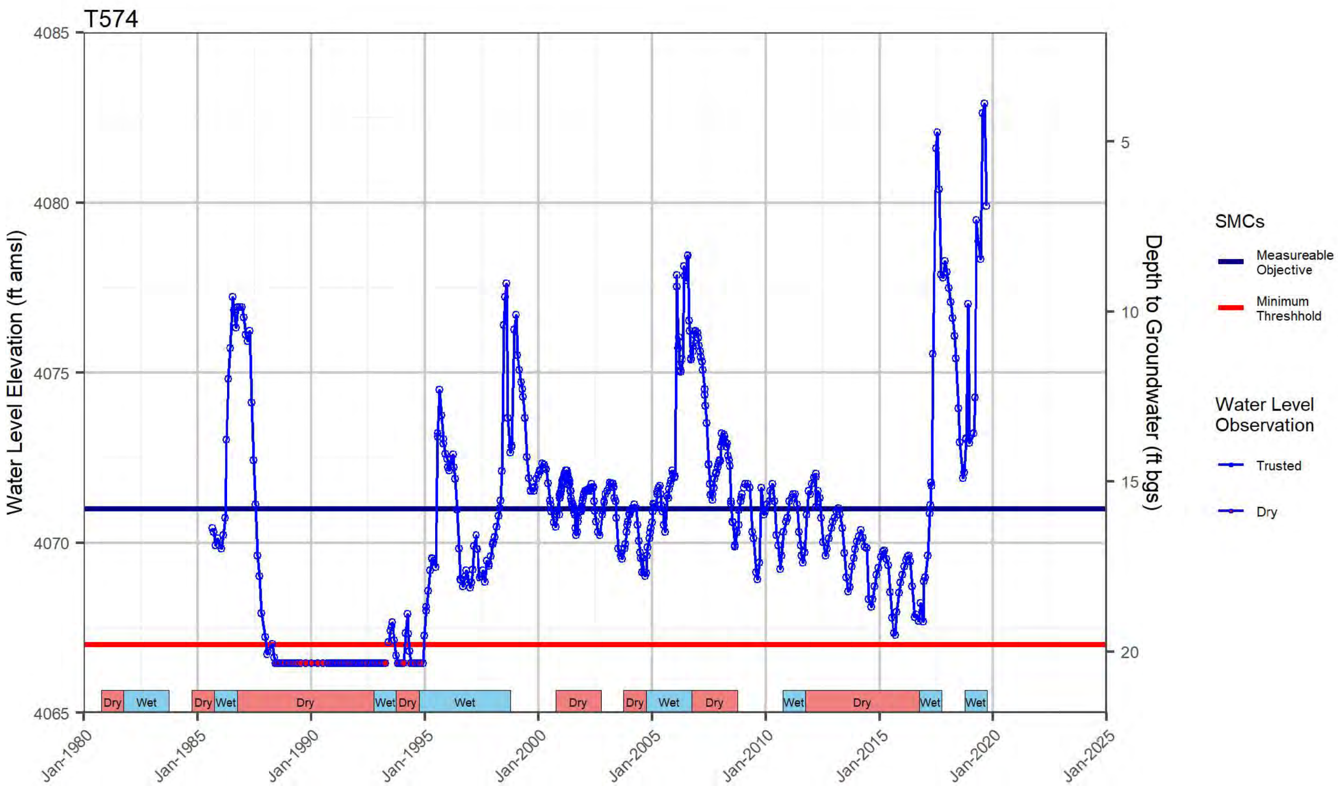

T389
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025



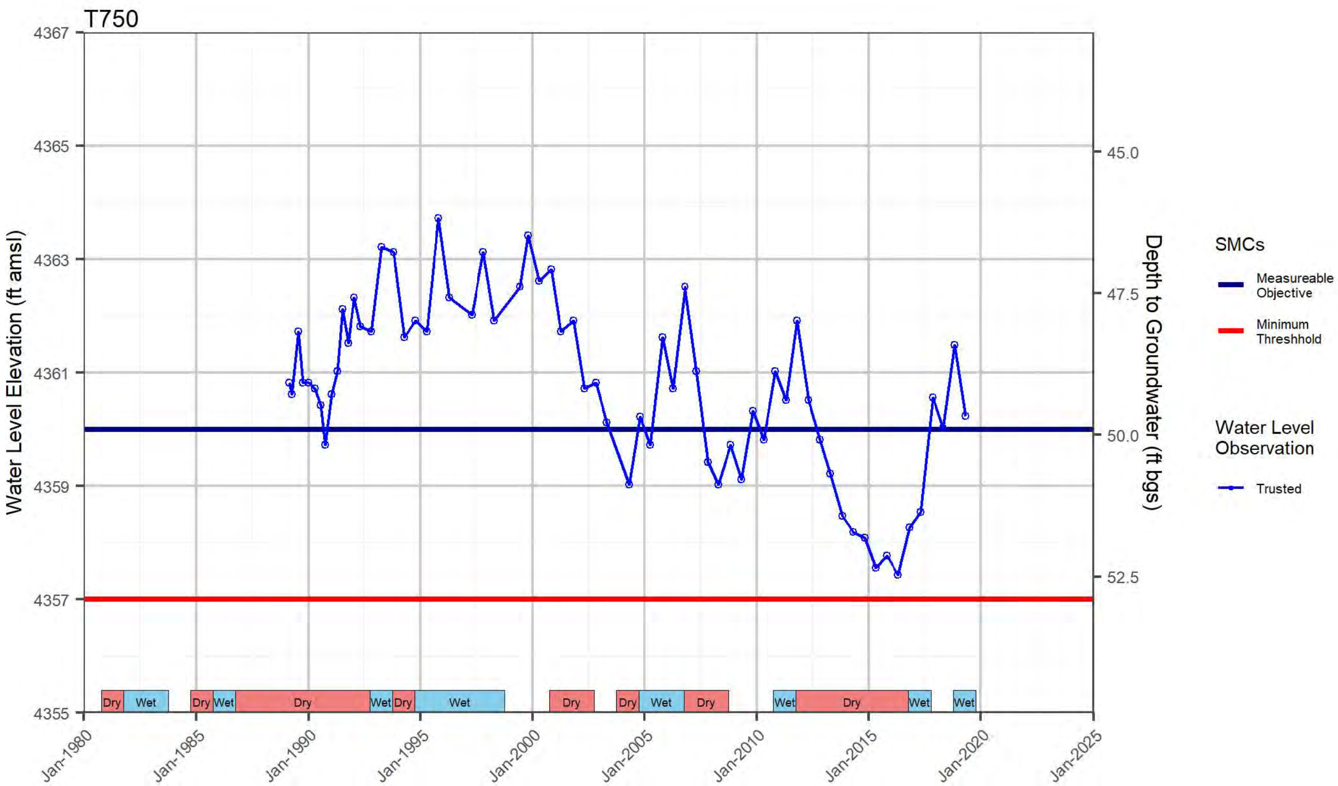
T391
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4310
4305
4300
4295
0
5
10
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


T480
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4002
4000
3998
3996
3994
3992
3990
3
6
9
12
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

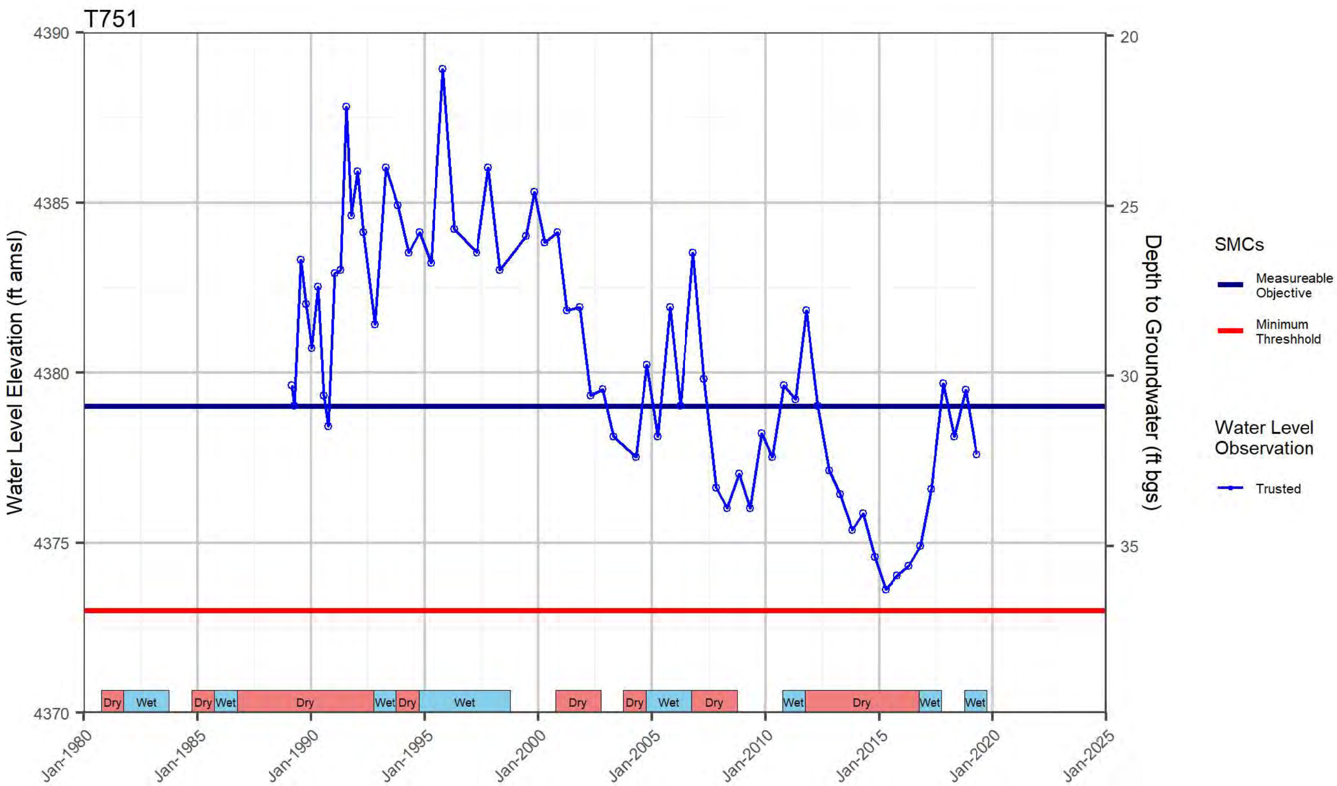

T513
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4125
4120
4115
4110
0
5
10
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



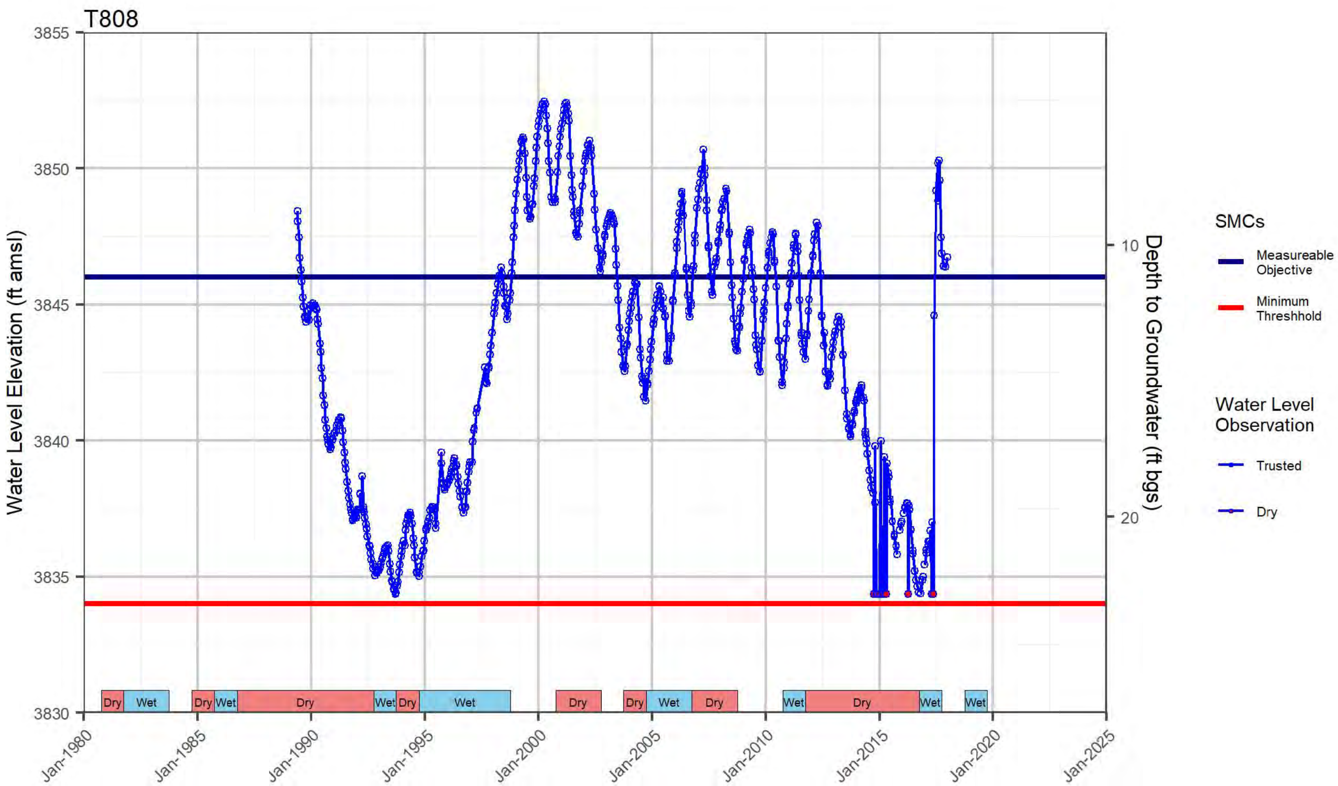
T574
4085
4080
4075
4070
4065
Water Level Elevation (ft amsl)
5
10
15
20
Depth to Groundwater (ft bgs)
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted
Dry



T750
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4367
4365
4363
4361
4359
4357
4355
45.0
47.5
50.0
52.5
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



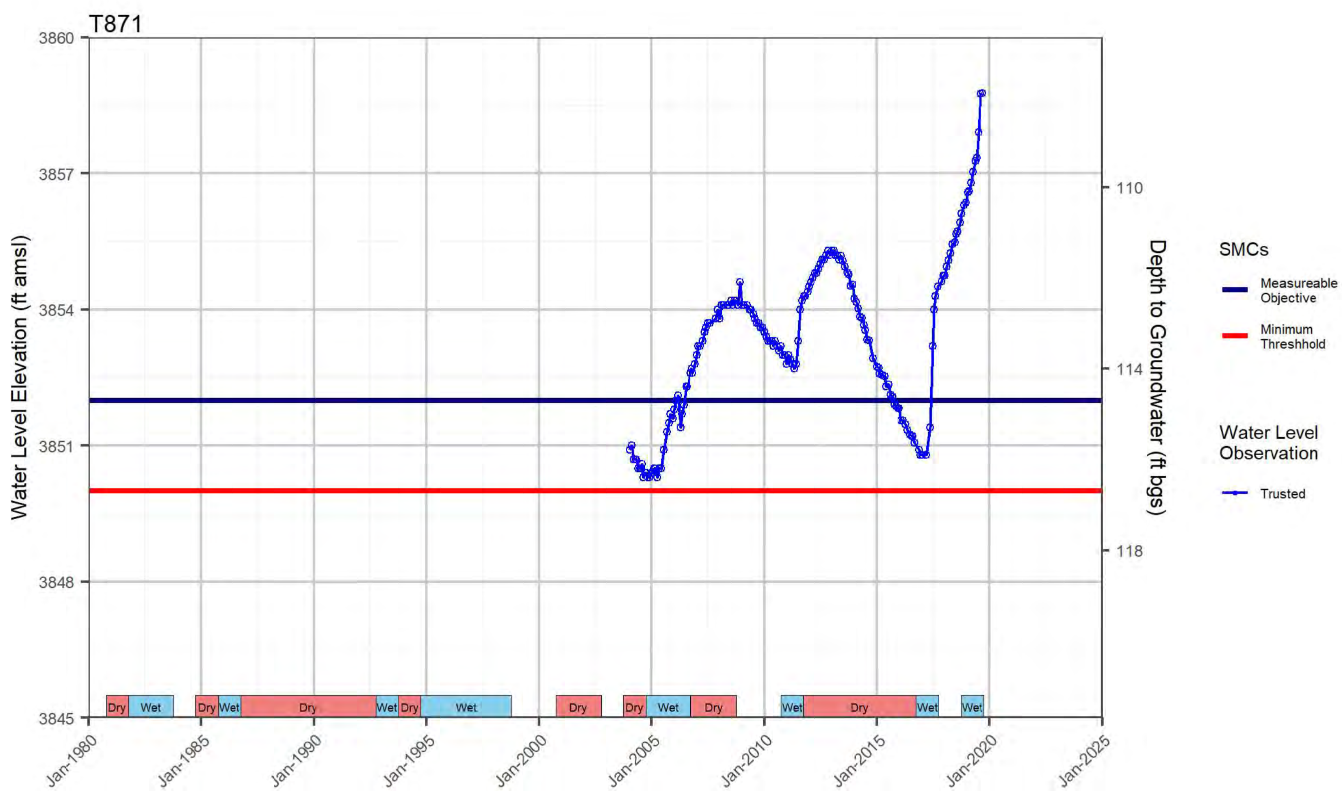
T751
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
4390
4385
4380
4375
4370
20
25
30
35
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



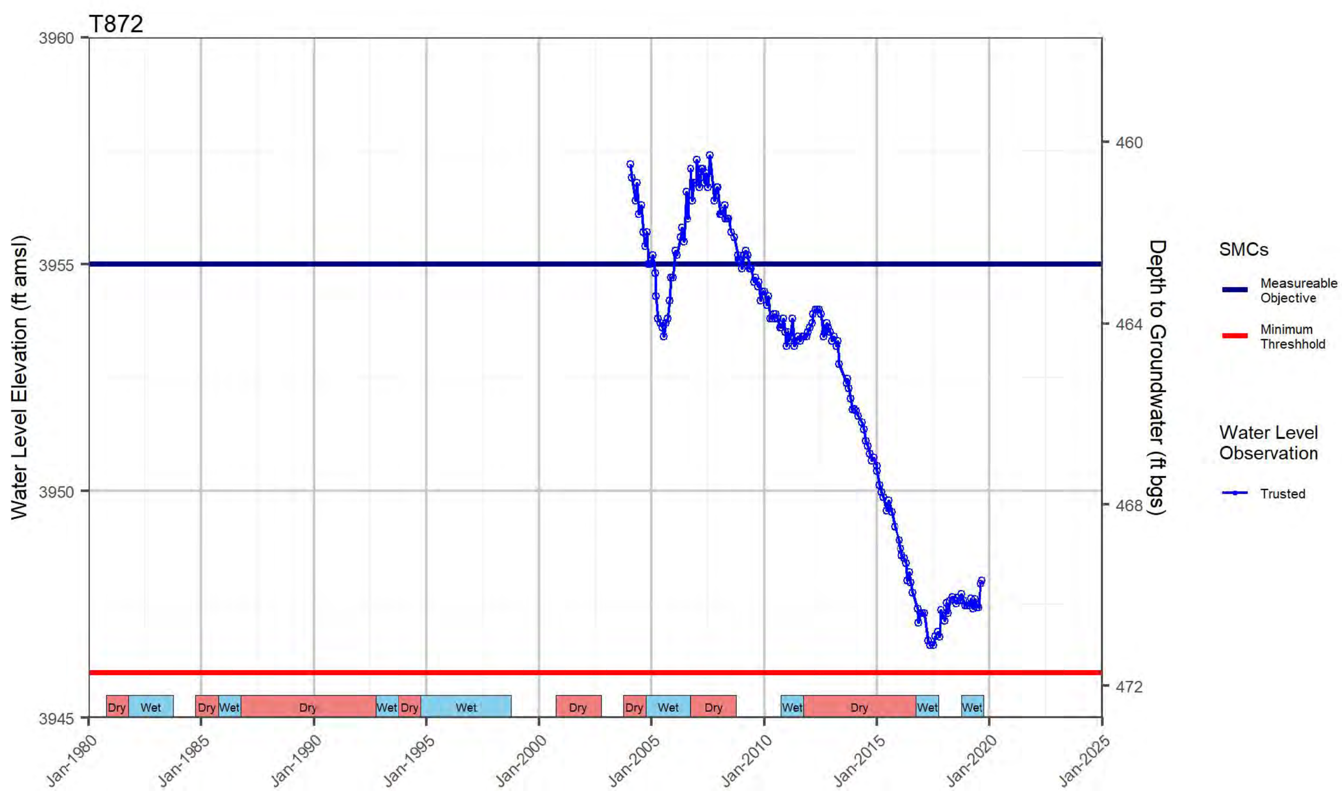
T808
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3855
3850
3845
3840
3835
3830
10
20
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted
Dry

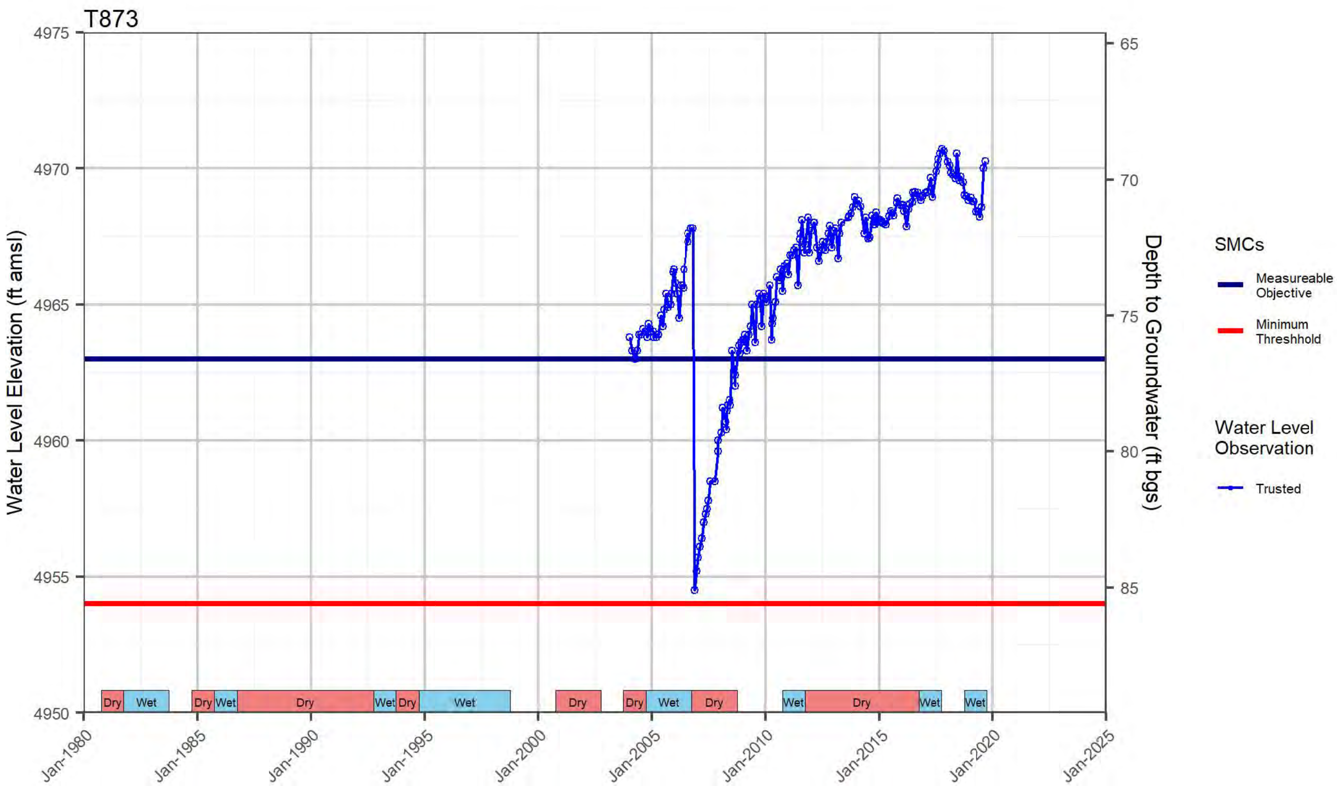
T809
3835
3830
3825
3820
3815
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
10
15
20
25
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


T869
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3992
3990
3988
3986
3984
3982
3980
279
282
285
288
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

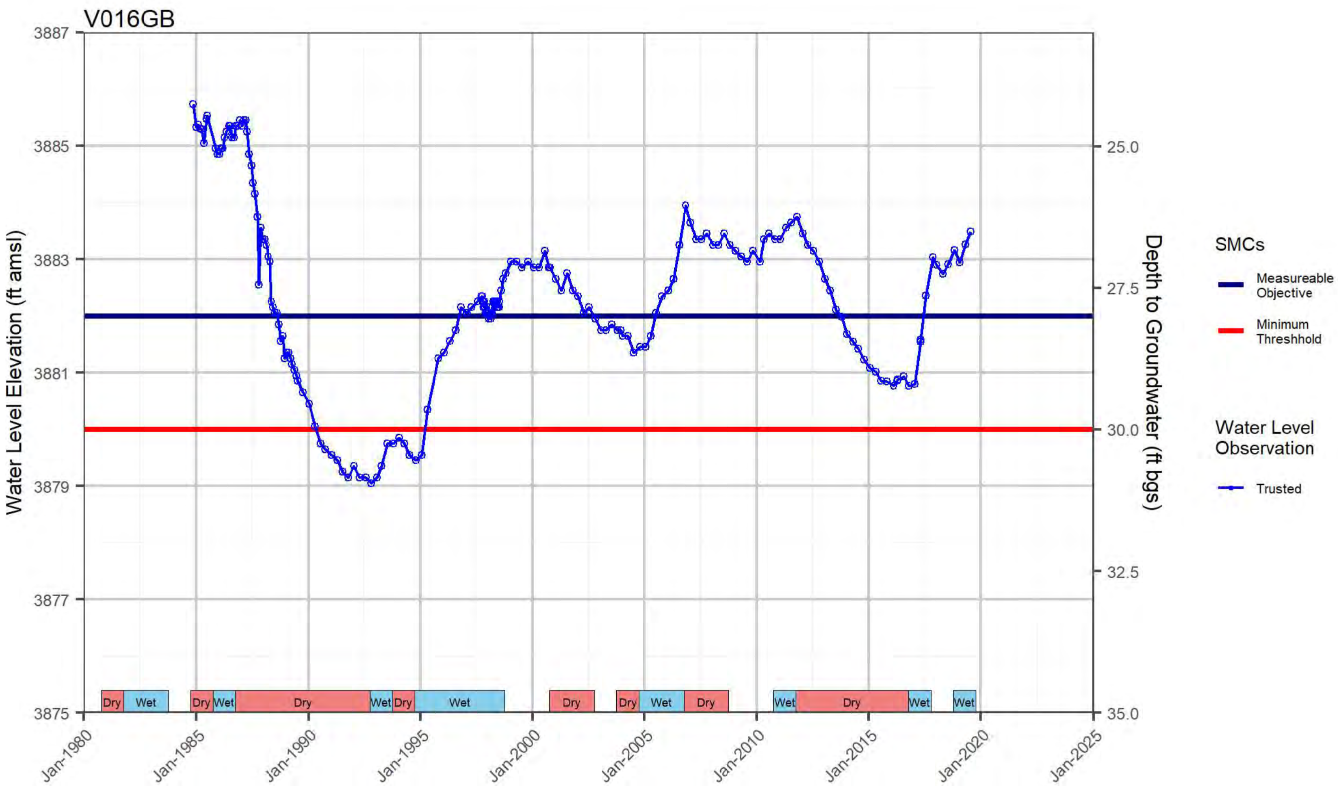


T871
Water Level Elevation (ft amsl)
3860
3857
3854
3851
3848
3845
Depth to Groundwater (ft bgs)
110
114
118
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

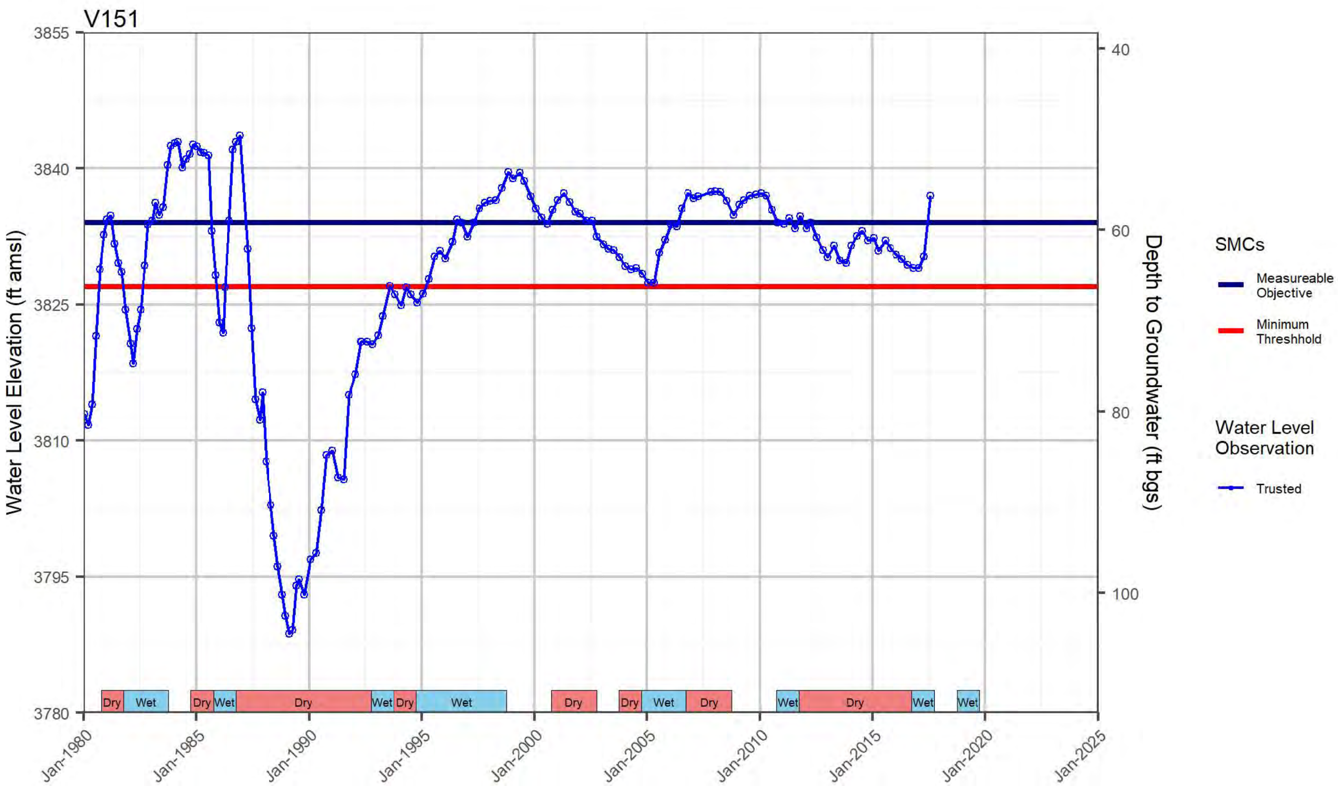

T872
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3960
3955
3950
3945
460
464
468
472
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

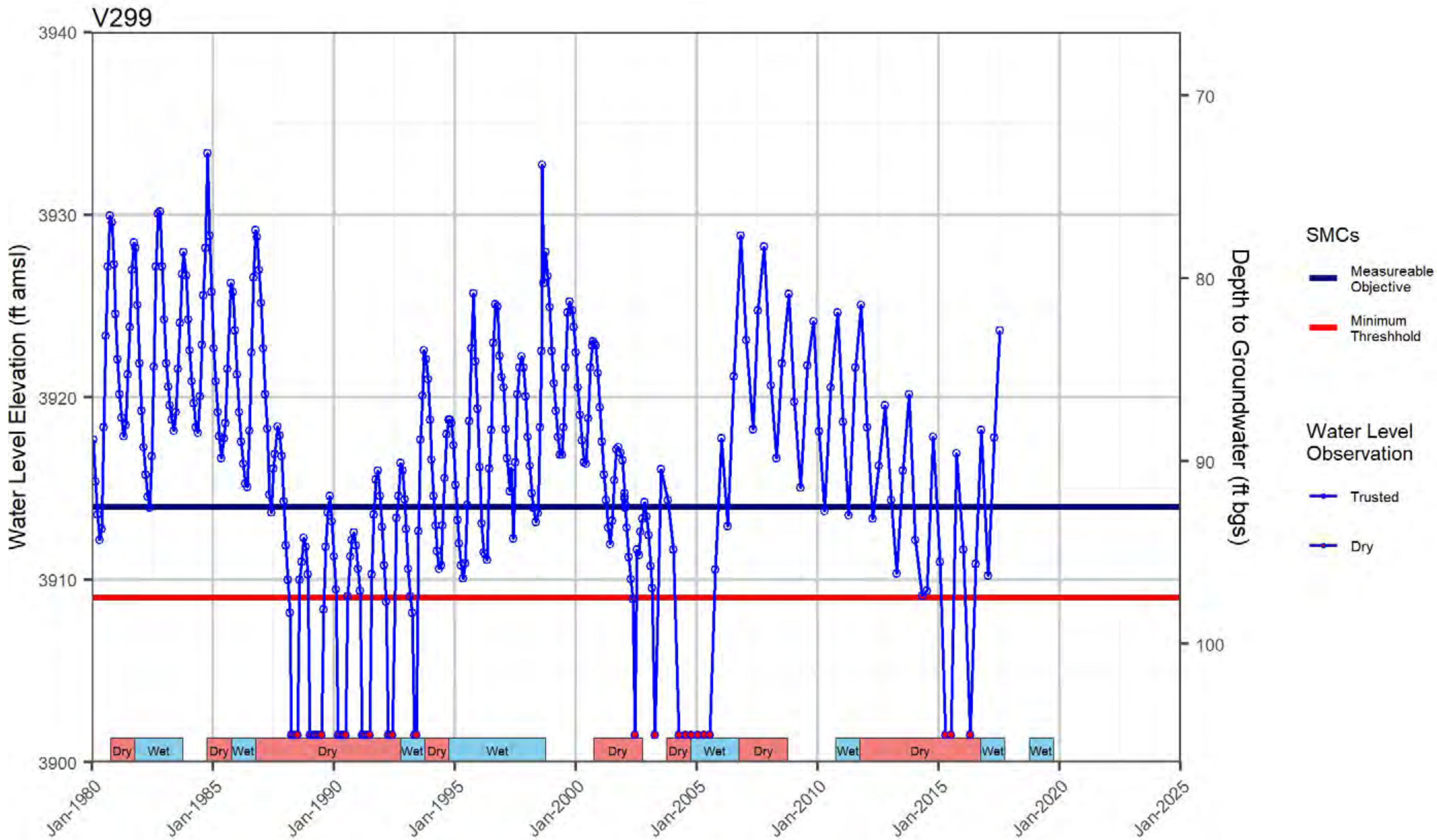


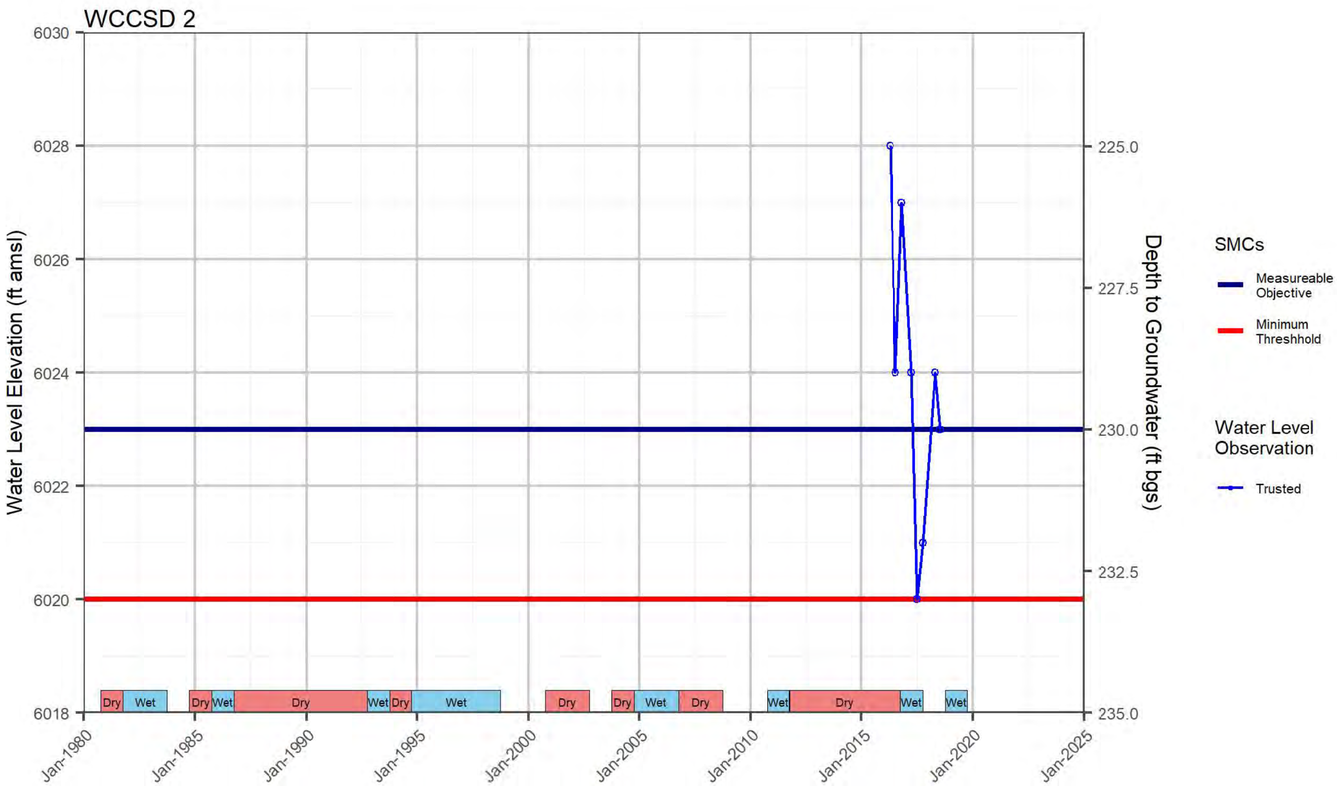
T873
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

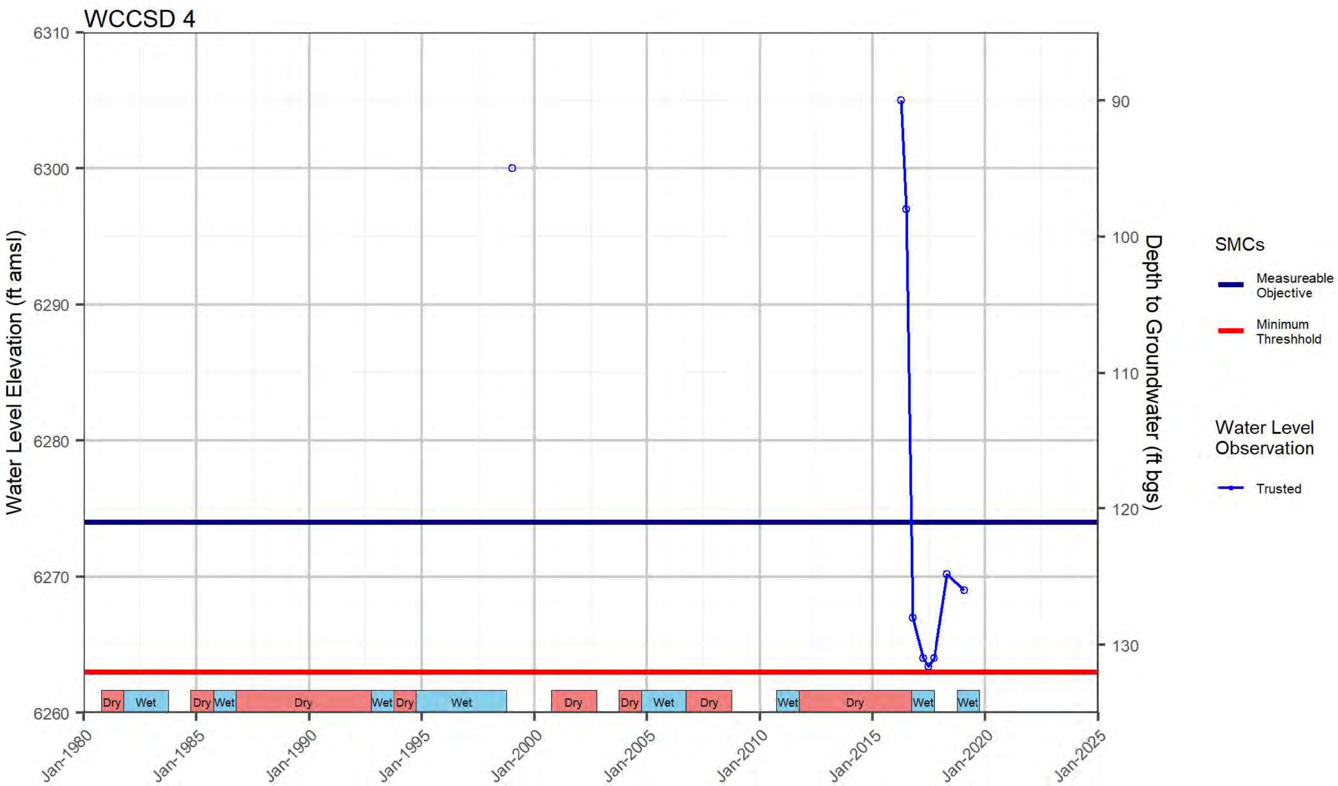


V016GB
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3887
3885
3883
3881
3879
3877
3875
25.0
27.5
30.0
32.5
35.0
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


V151
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3855
3840
3825
3810
3795
3780
40
60
80
100
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

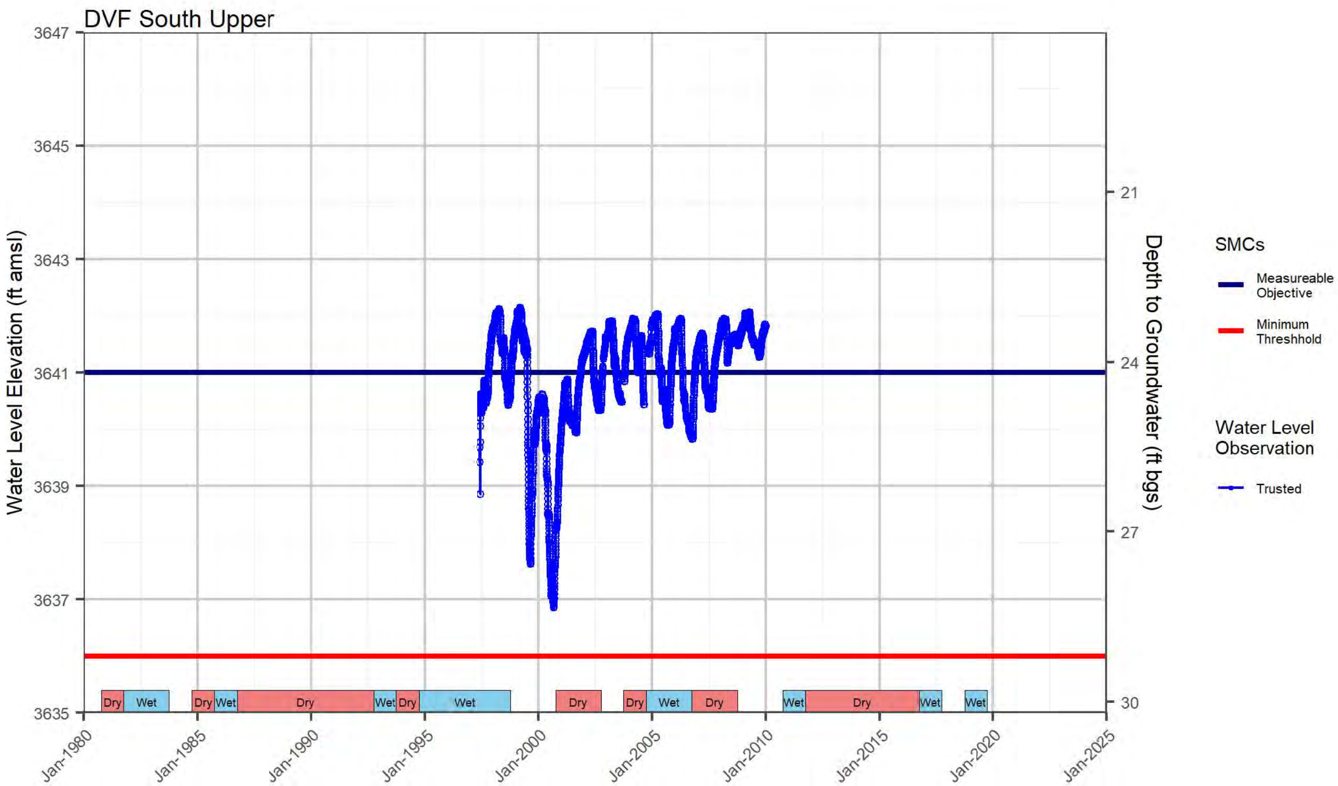

V299
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3940
3930
3920
3910
3900
70
80
90
100
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted
Dry


WCCSD 2
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
6030
6028
6026
6024
6022
6020
6018
225.0
227.5
230.0
232.5
235.0
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

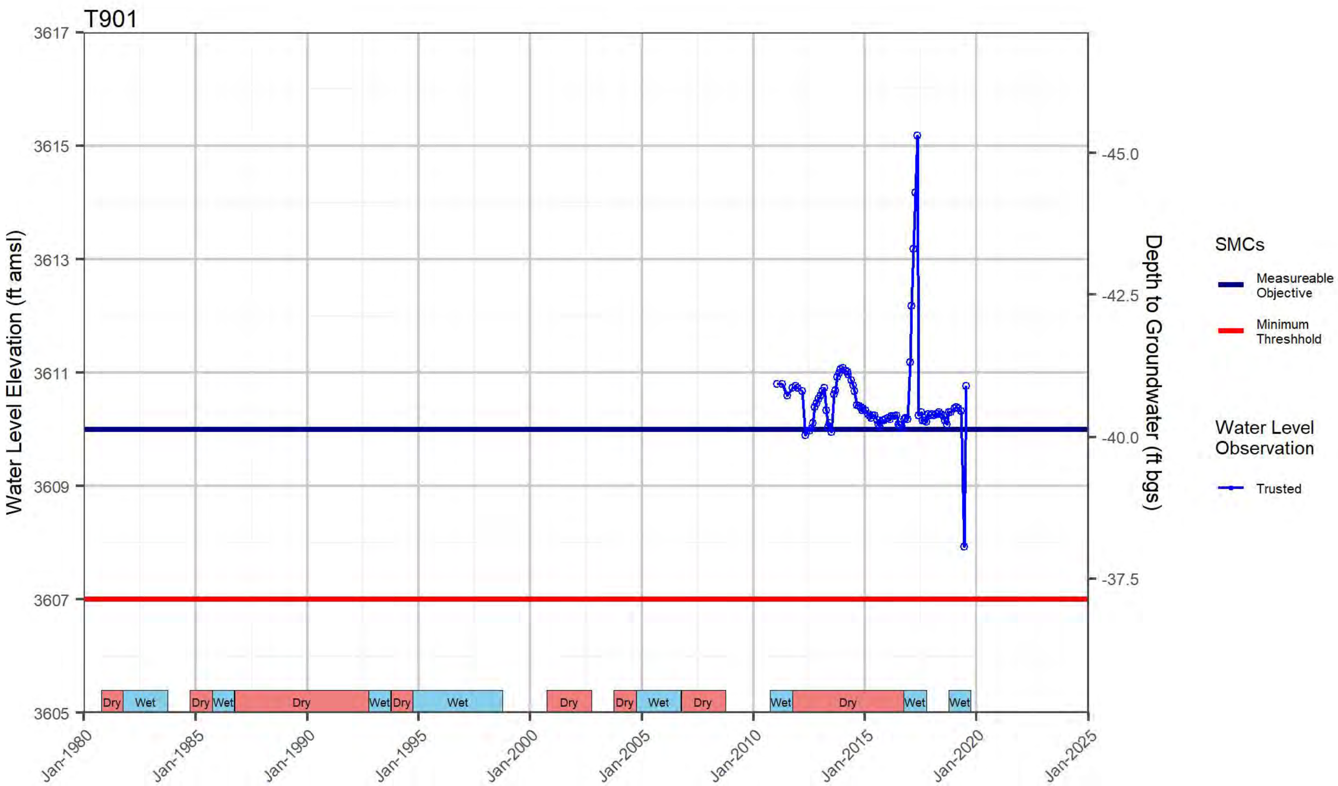


WCCSD 4
6310
6300
6290
6280
6270
6260
Water Level Elevation (ft amsl)
90
100
110
120
130
Depth to Groundwater (ft bgs)
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

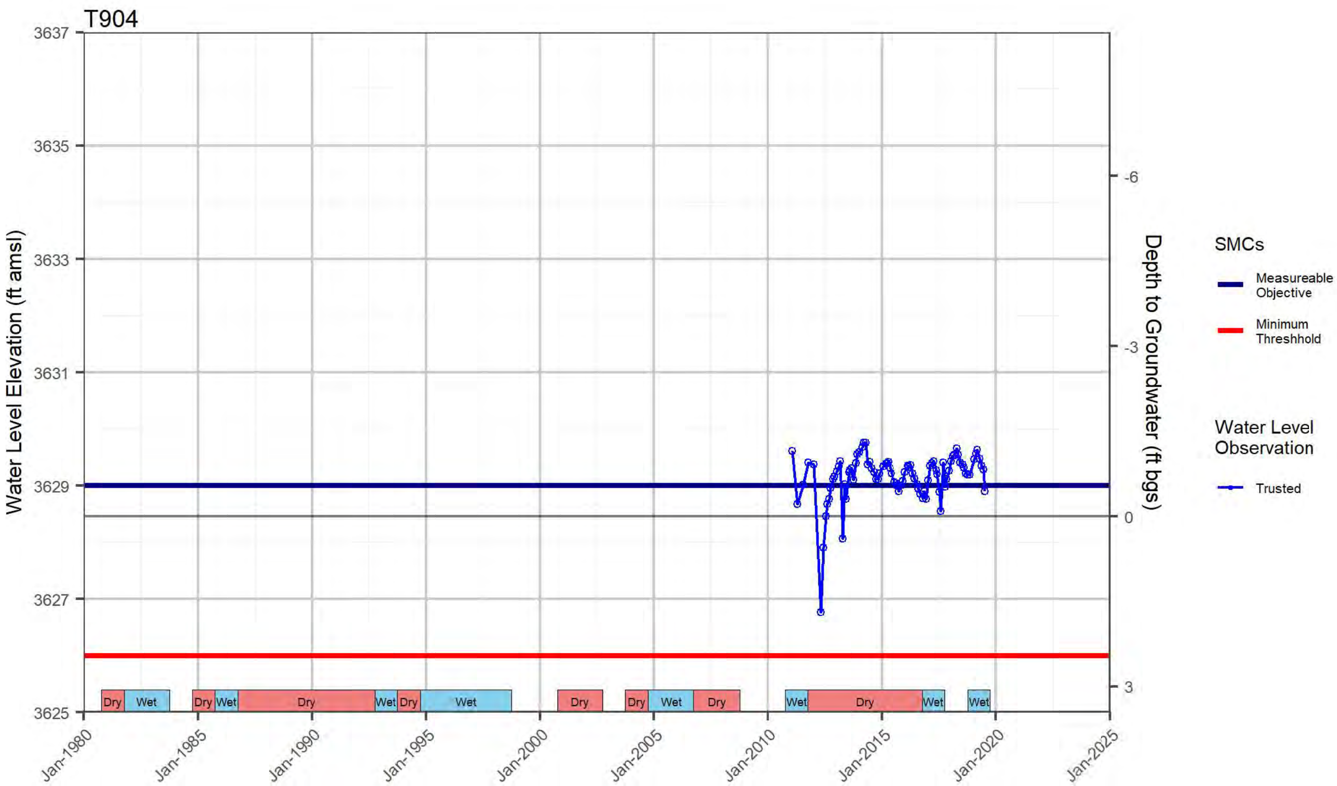
Owens Lake Management Area



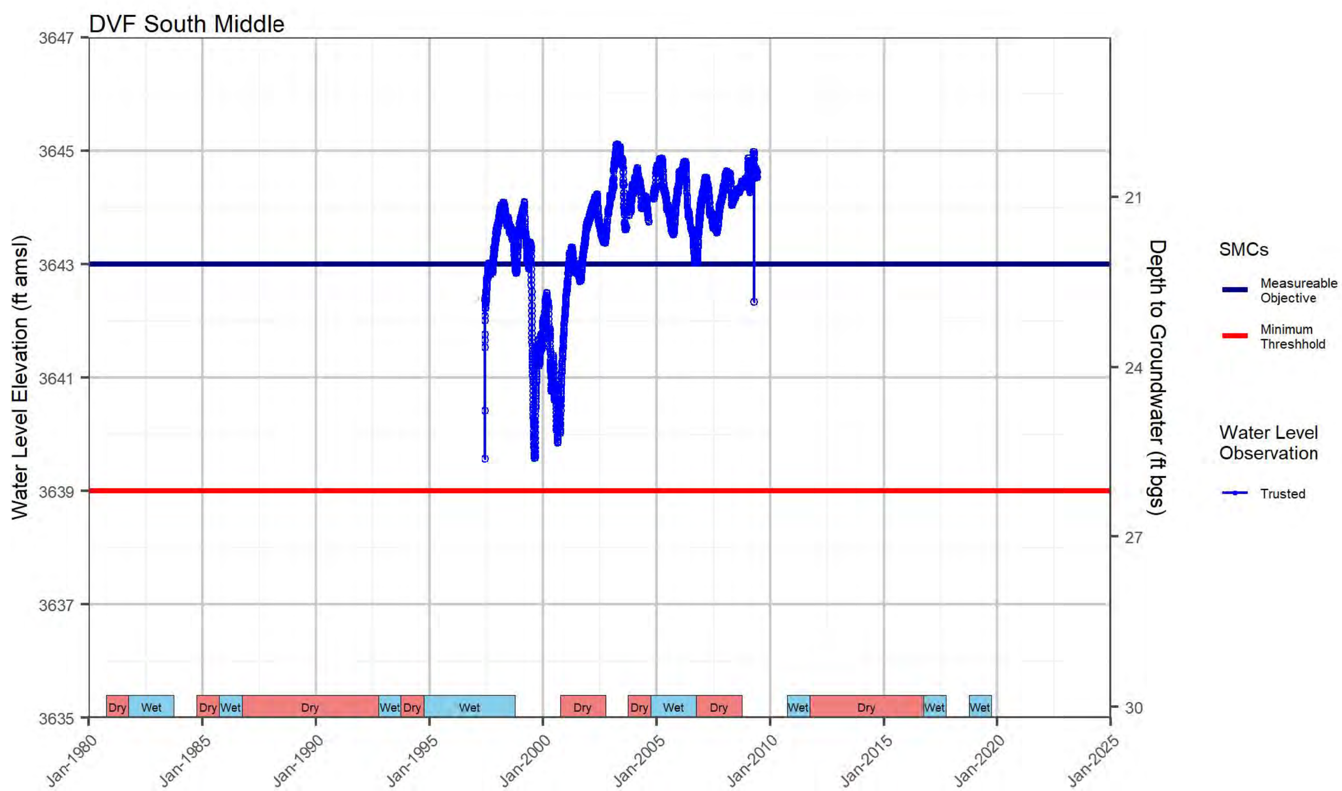
DVF South Upper
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3647
3645
3643
3641
3639
3637
3635
21
24
27
30
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

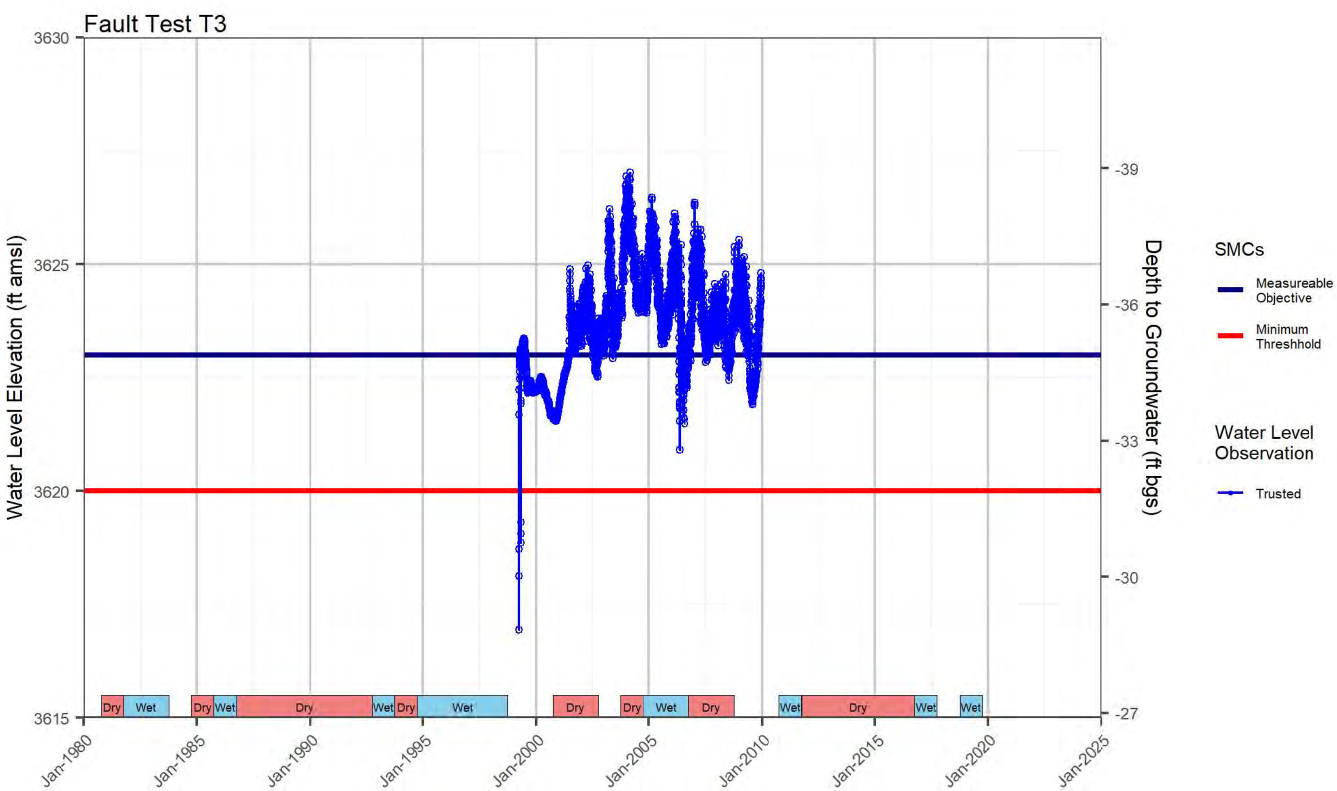


T901
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3617
3615
3613
3611
3609
3607
3605
-45.0
-42.5
-40.0
-37.5
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

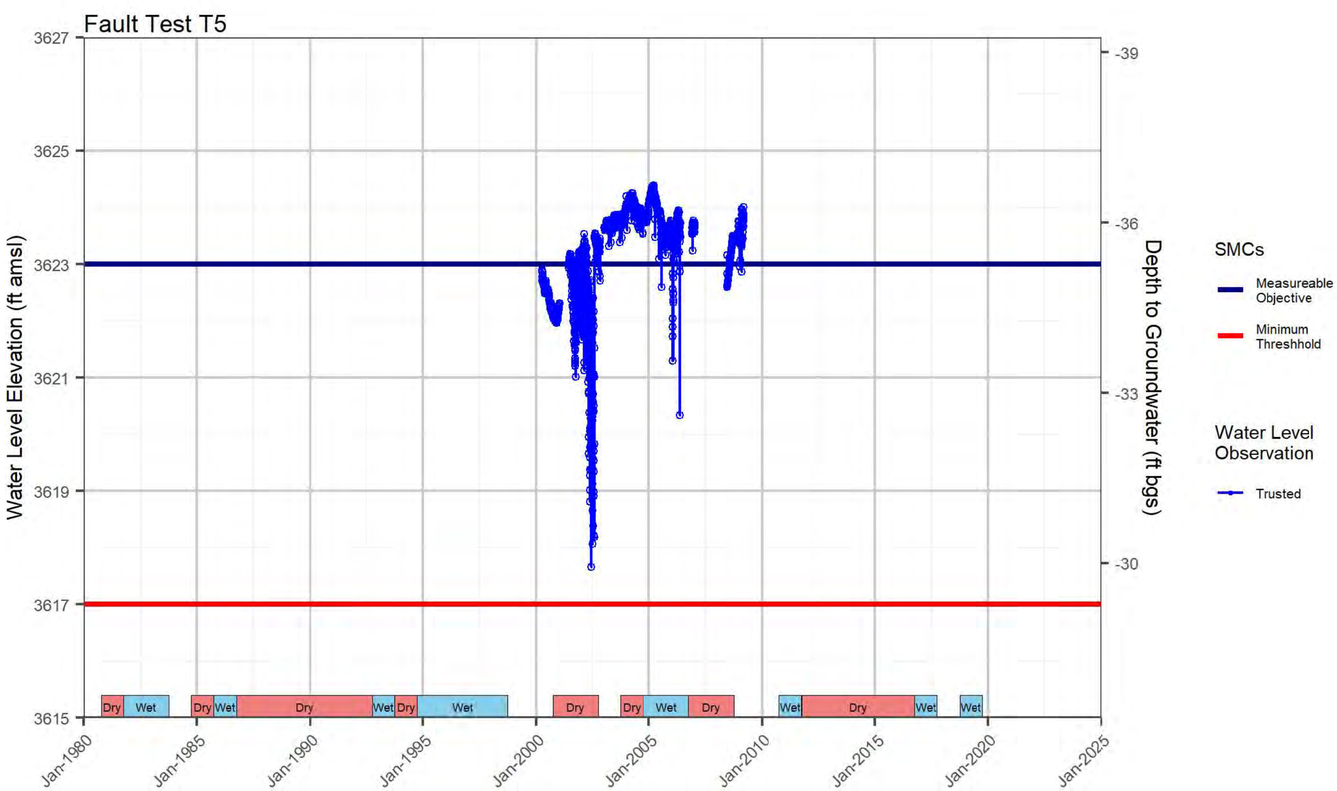

T904
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3637
3635
3633
3631
3629
3627
3625
-6
-3
0
3
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

T910
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3617
3615
3613
3611
3609
3607
3605
-36
-33
-30
-27
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

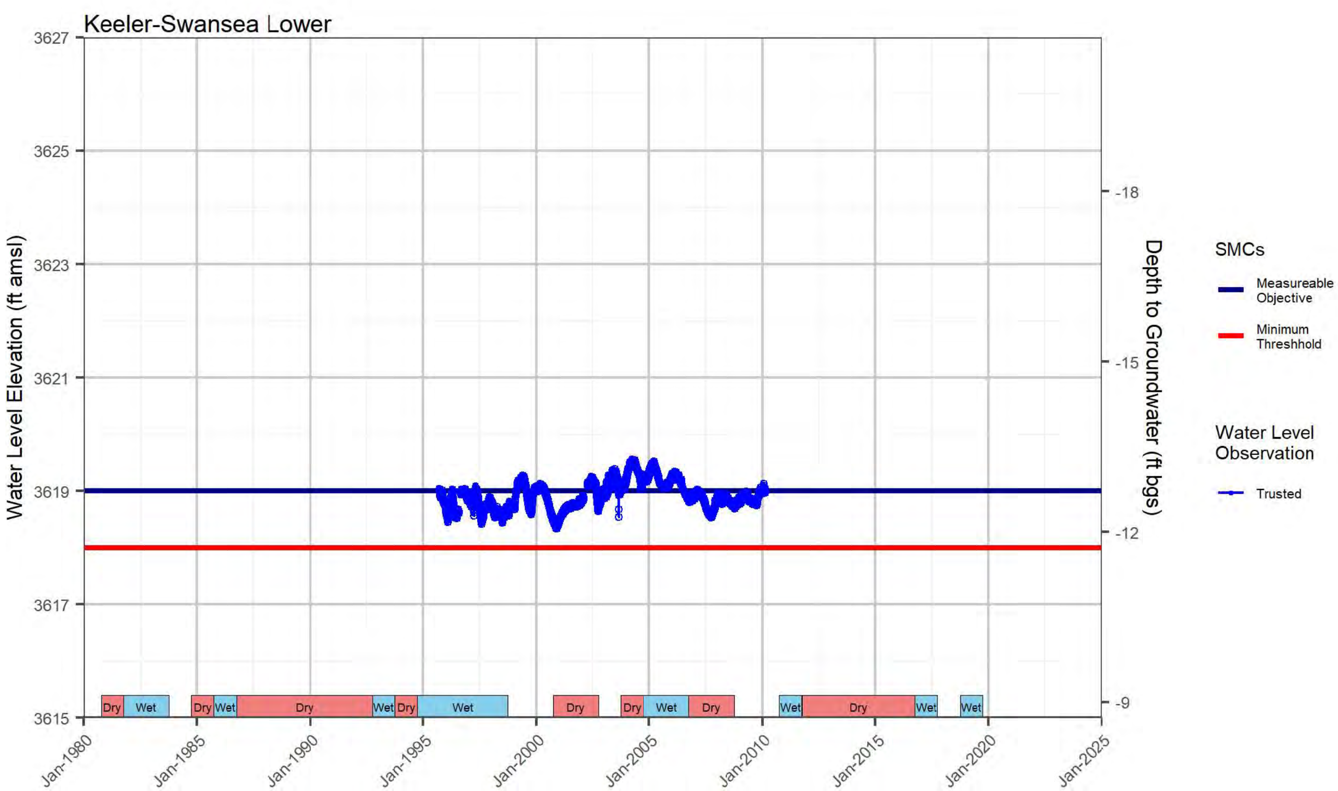

DVF South Middle
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3647
3645
3643
3641
3639
3637
3635
21
24
27
30
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

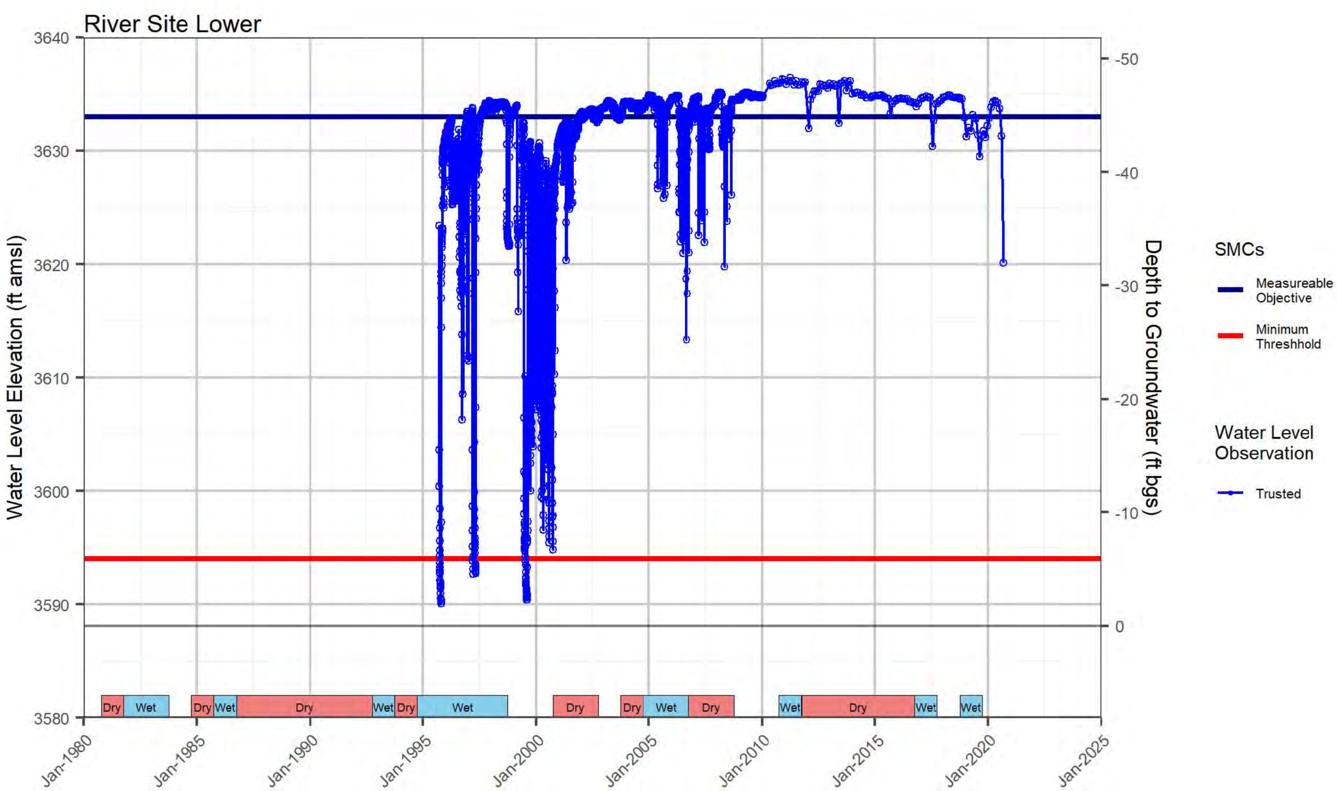


Fault Test T3
3630
3625
3620
3615
Water Level Elevation (ft amsl)
-39
-36
-33
-30
-27
Depth to Groundwater (ft bgs)
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

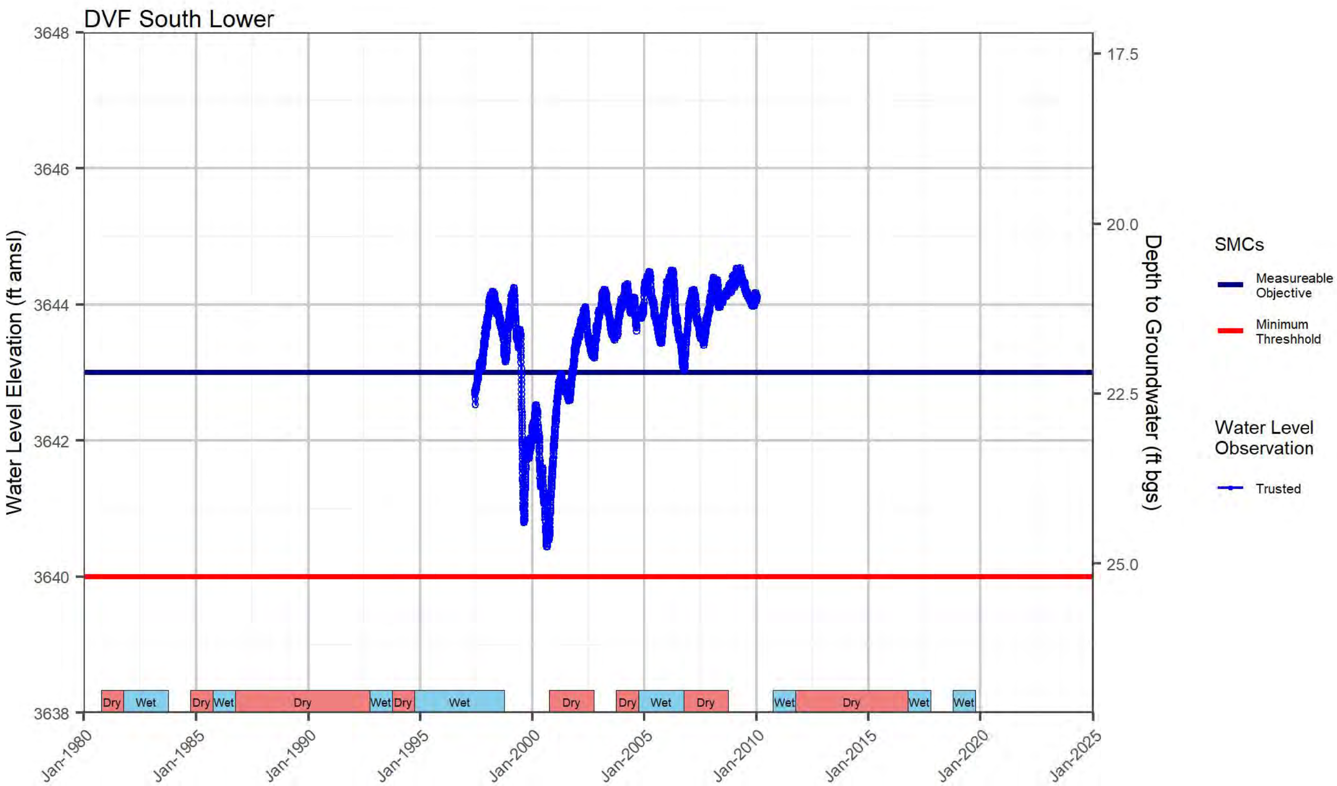


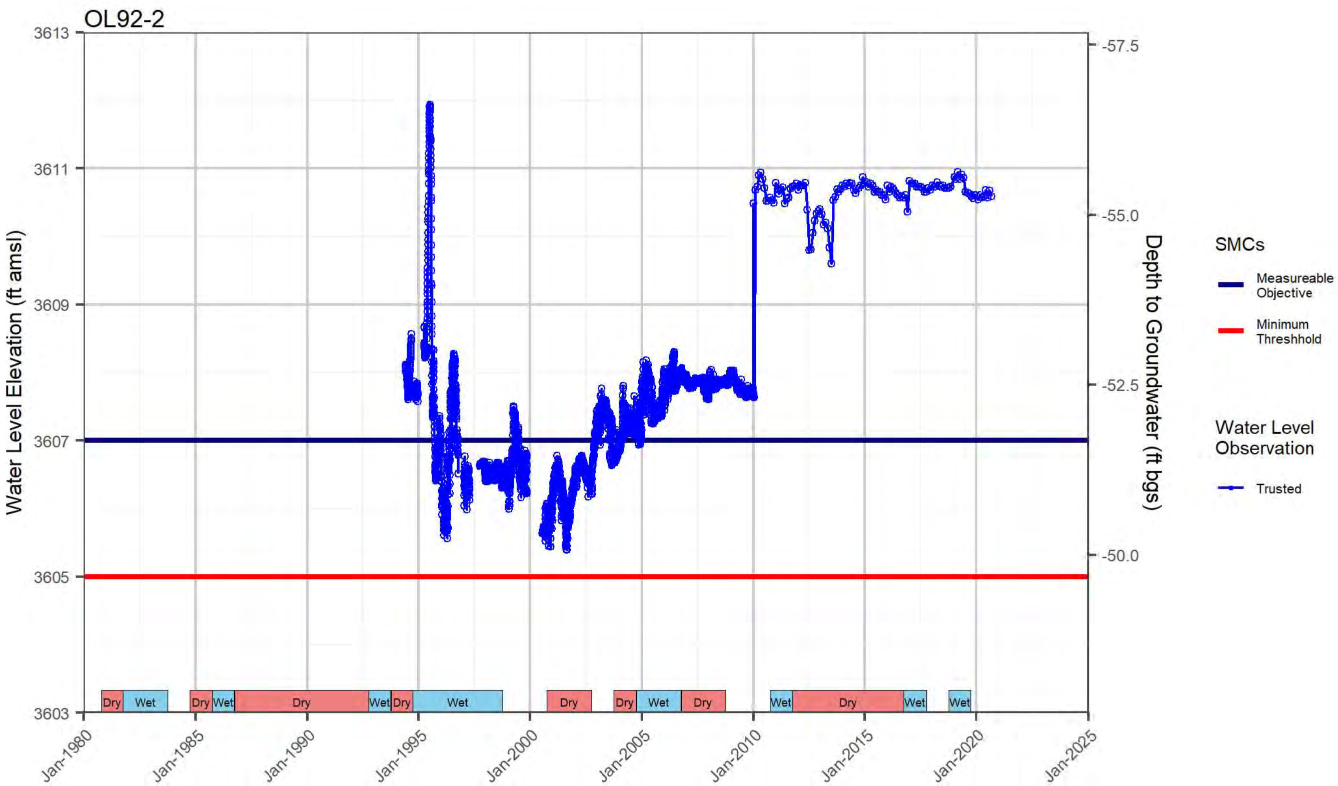
Fault Test T5
3627
3625
3623
3621
3619
3617
3615
Water Level Elevation (ft amsl)
-39
-36
-33
-30
Depth to Groundwater (ft bgs)
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

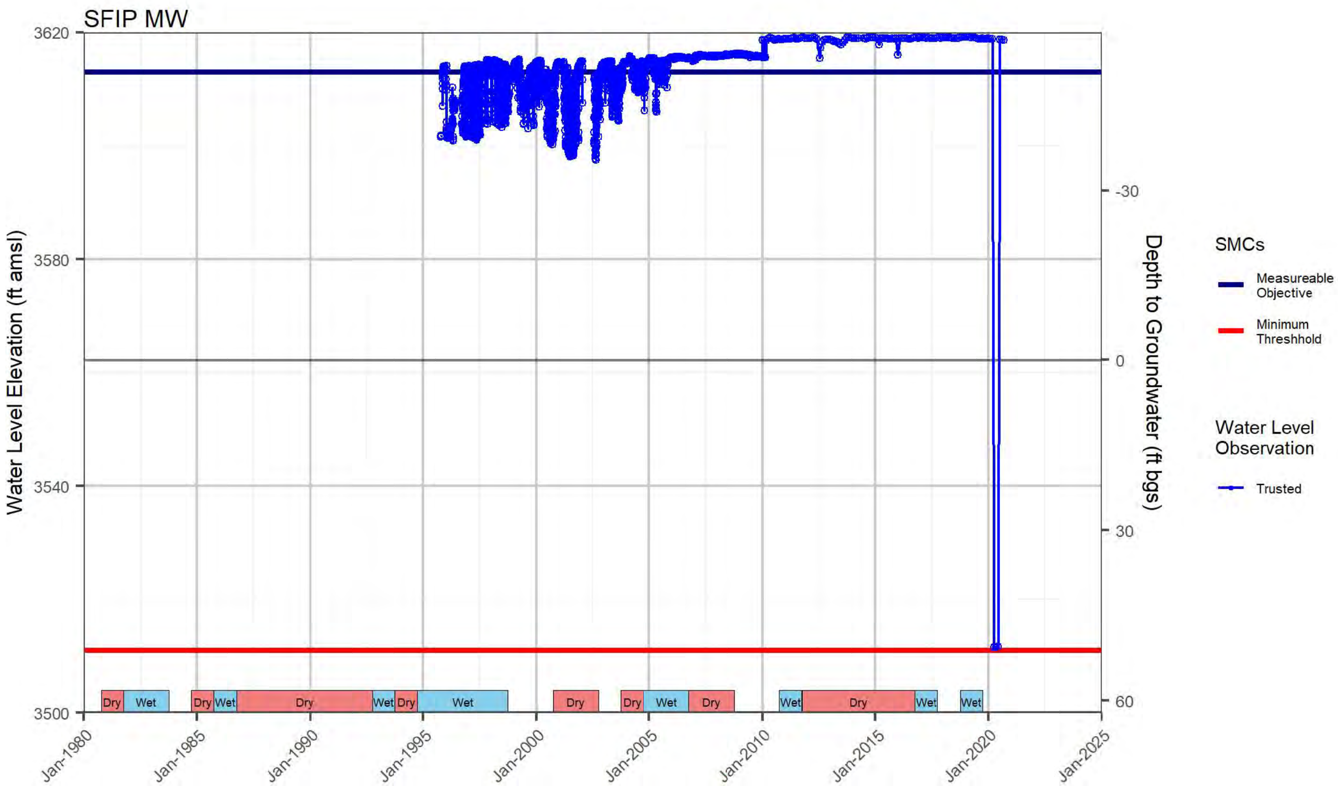

Keeler-Swansea Lower
3627
3625
3623
3621
3619
3617
3615
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
-18
-15
-12
-9
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

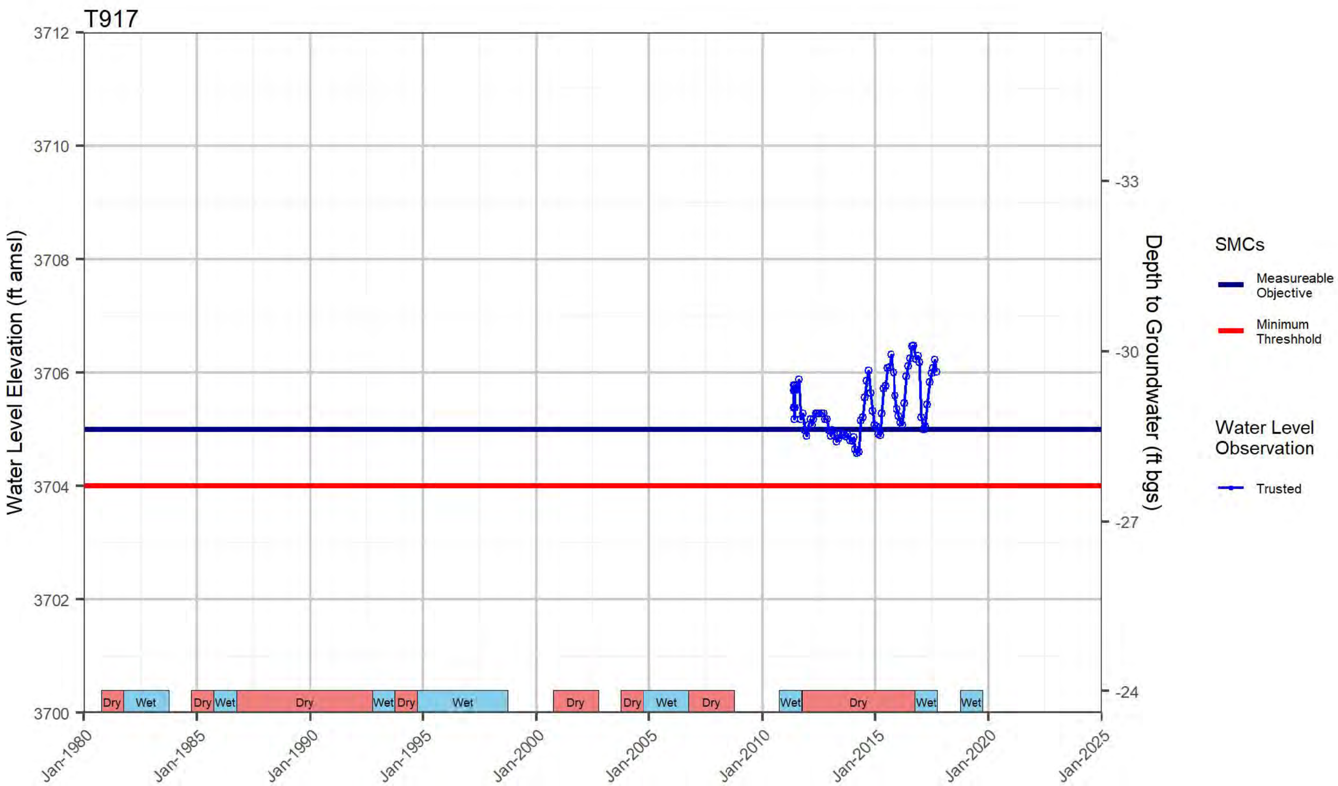


River Site Lower
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3640
3630
3620
3610
3600
3590
3580
-50
-40
-30
-20
-10
0
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

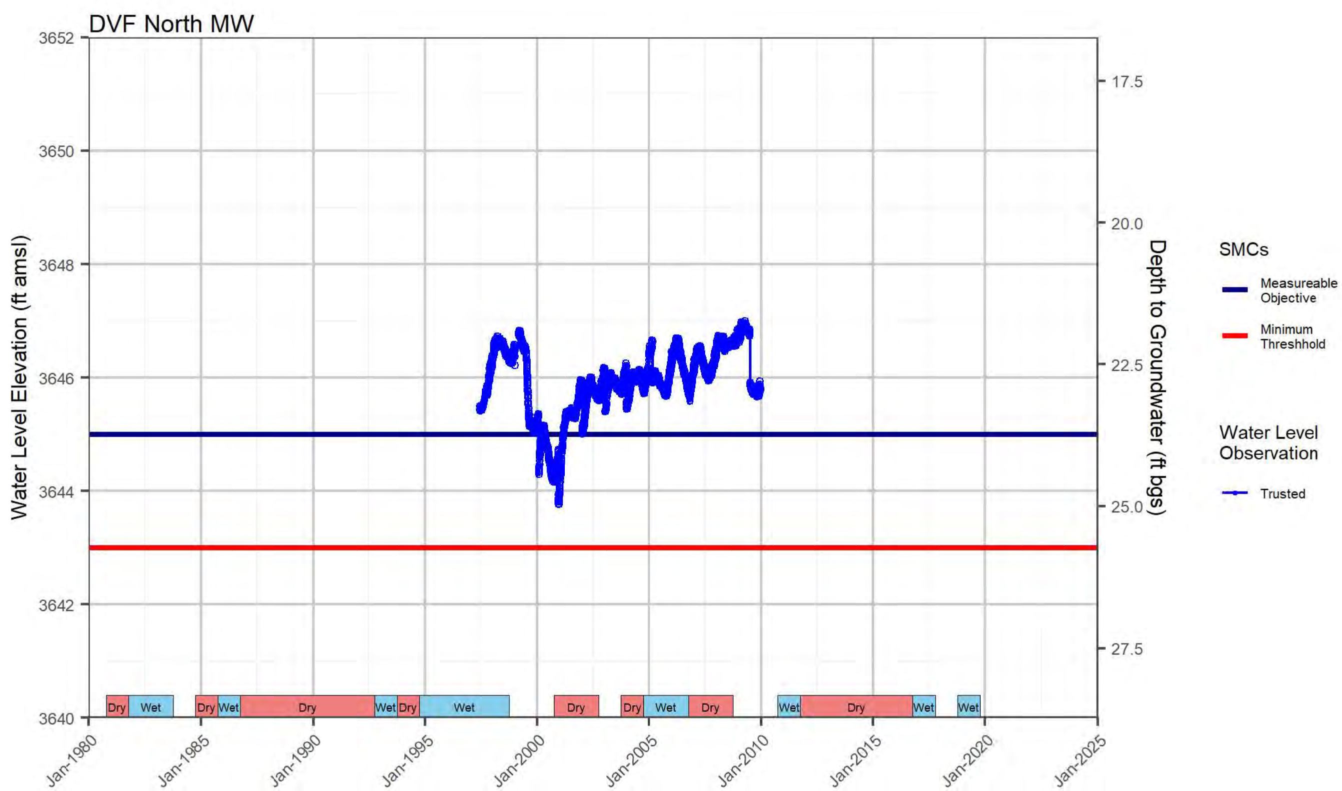

DVF South Lower
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3648
3646
3644
3642
3640
3638
17.5
20.0
22.5
25.0
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


OL92-2
Water Level Elevation (ft amsl)
3613
3611
3609
3607
3605
3603
Depth to Groundwater (ft bgs)
-57.5
-55.0
-52.5
-50.0
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


SFIP MW
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3620
3580
3540
3500
-30
0
30
60
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

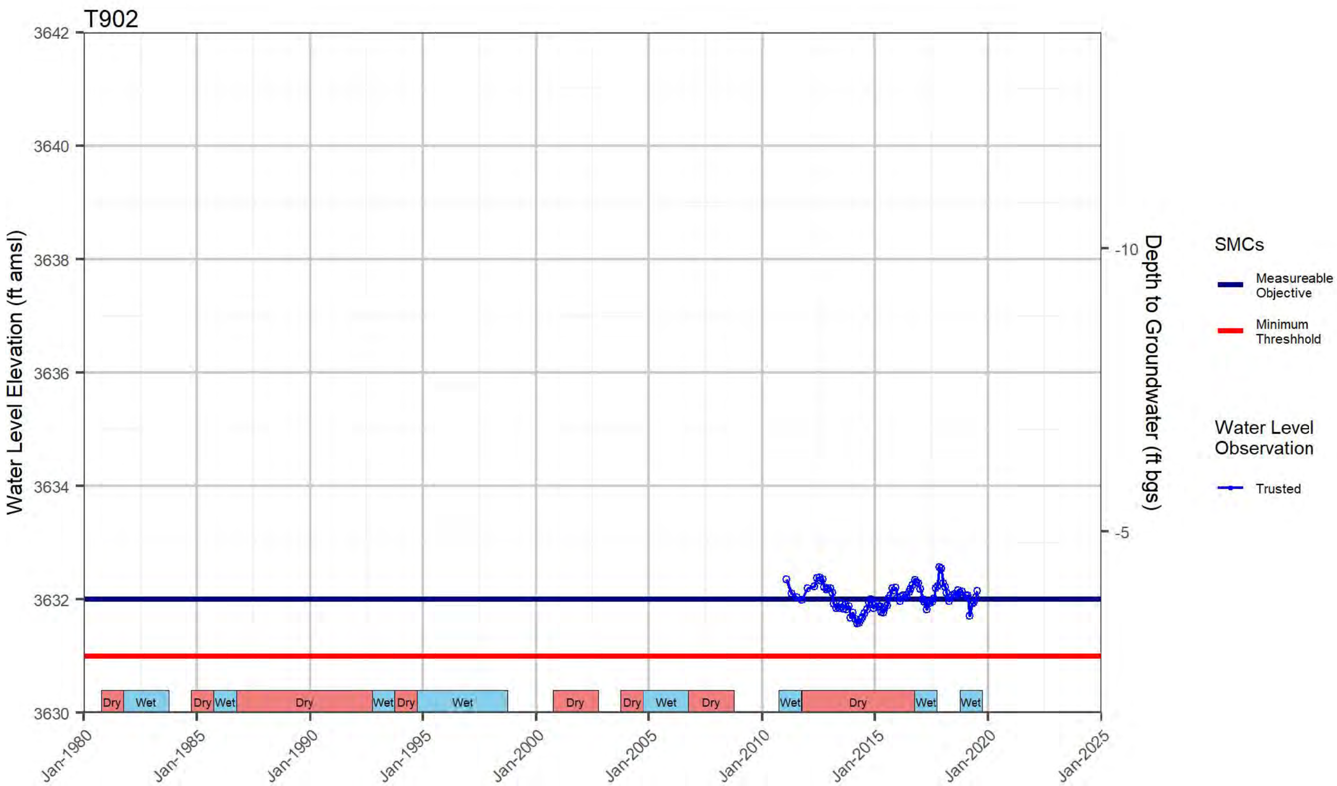


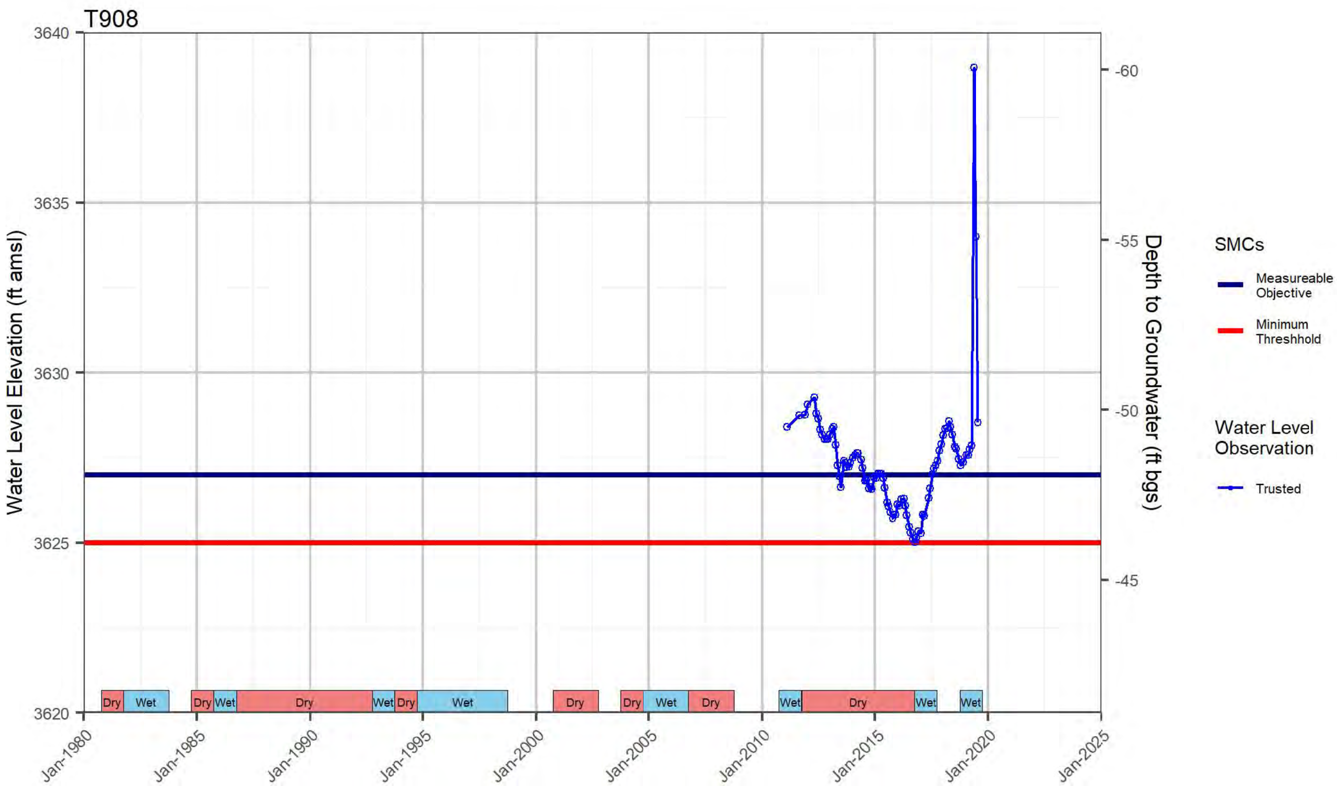
T917
3712
3710
3708
3706
3704
3702
3700
Water Level Elevation (ft amsl)
-33
-30
-27
-24
Depth to Groundwater (ft bgs)
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

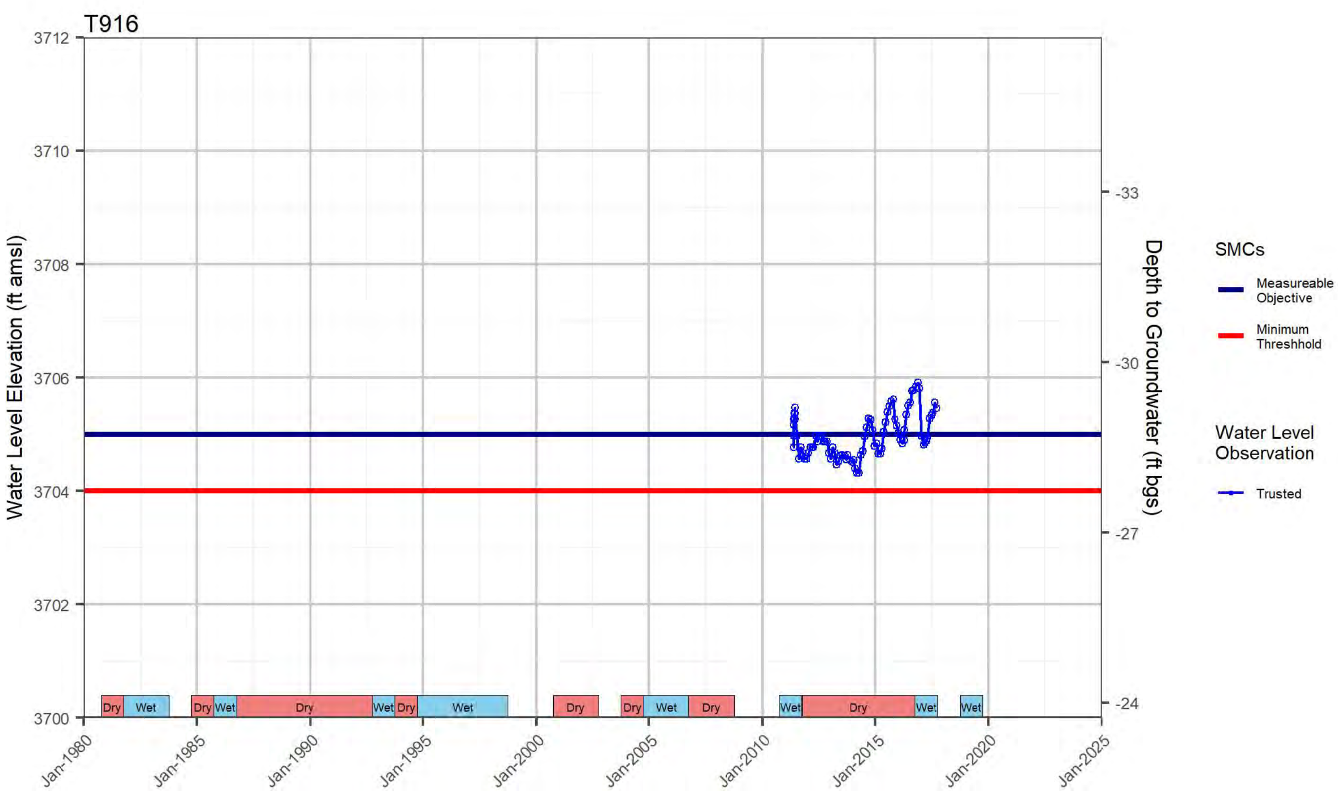


DVF North MW
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3652
3650
3648
3646
3644
3642
3640
17.5
20.0
22.5
25.0
27.5
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

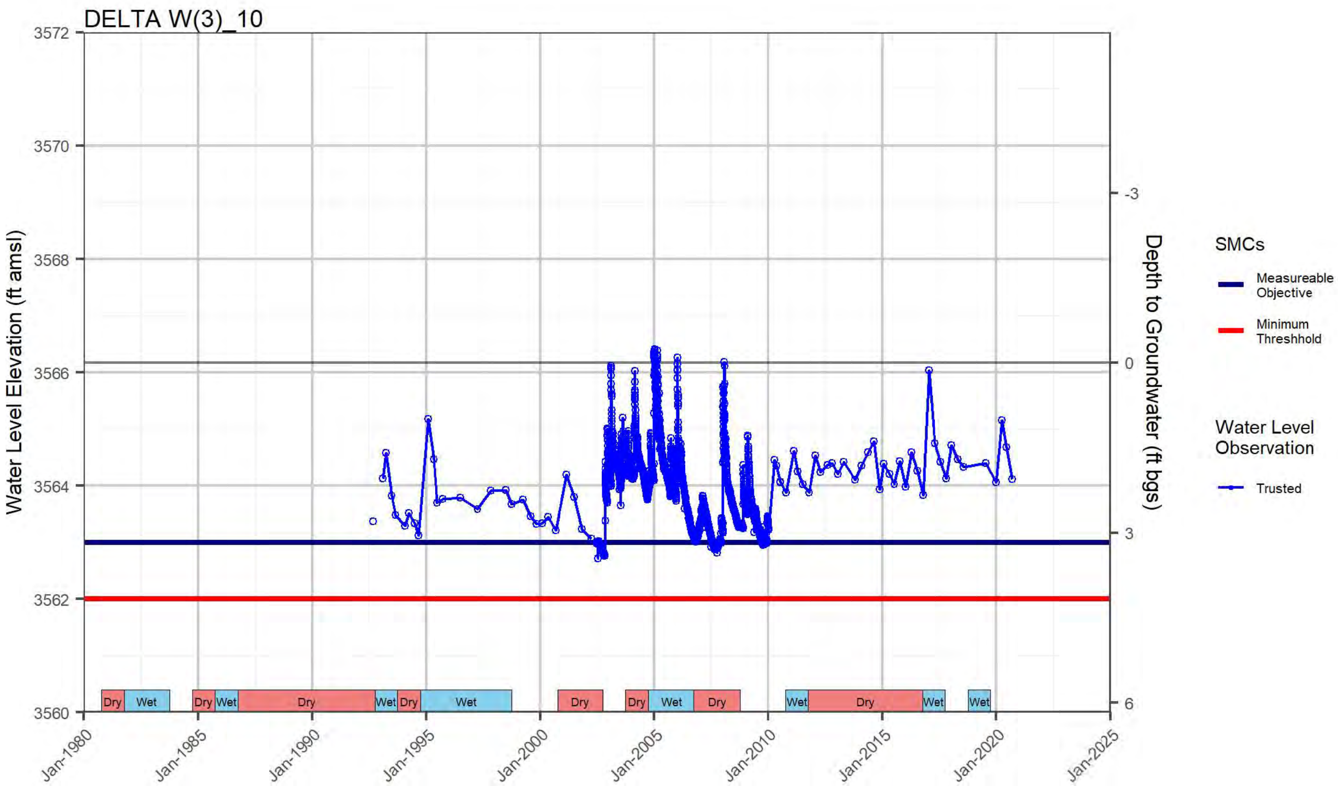
T899
3627
3625
3623
3621
3619
3617
3615
Water Level Elevation (ft amsl)
-57
-54
-51
-48
Depth to Groundwater (ft bgs)
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


T902
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3642
3640
3638
3636
3634
3632
3630
-10
-5
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

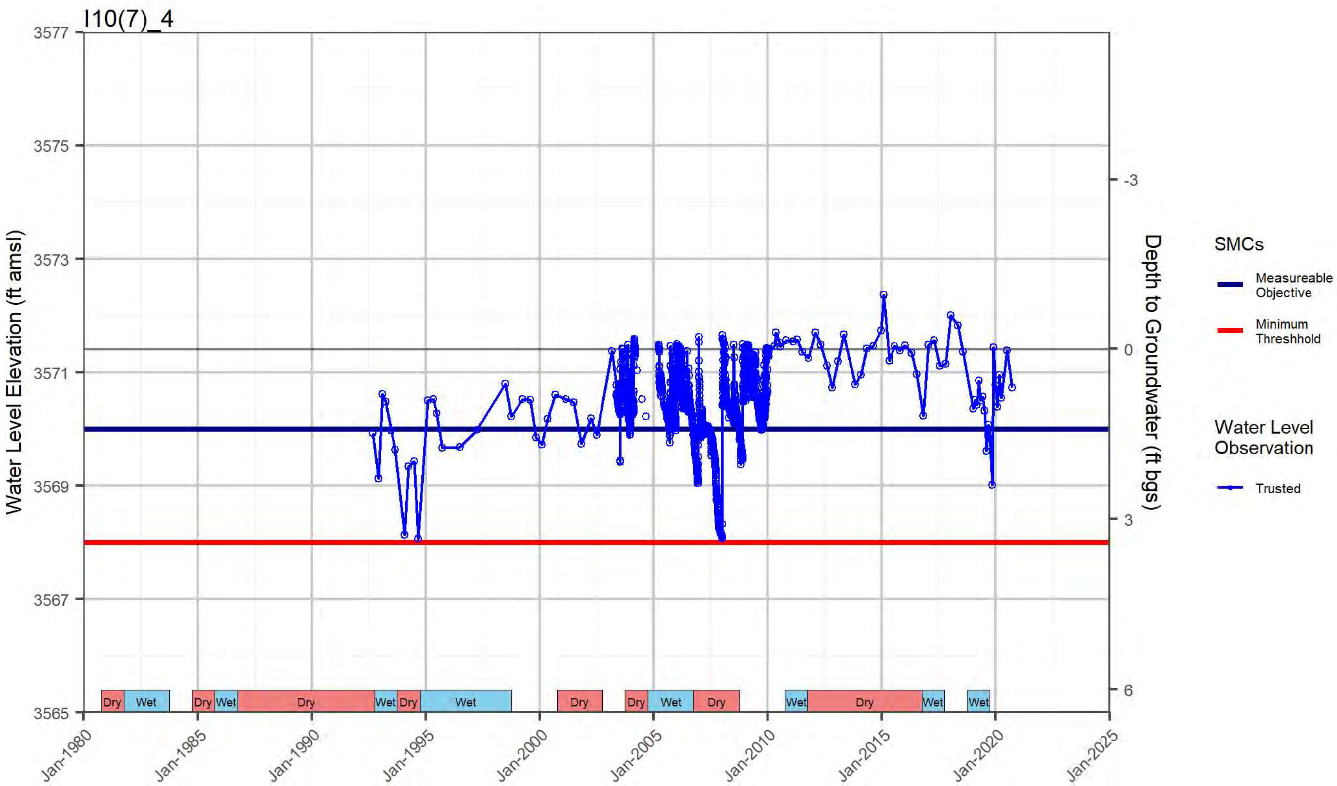

T908
Water Level Elevation (ft amsl)
3640
3635
3630
3625
3620
Depth to Groundwater (ft bgs)
-60
-55
-50
-45
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



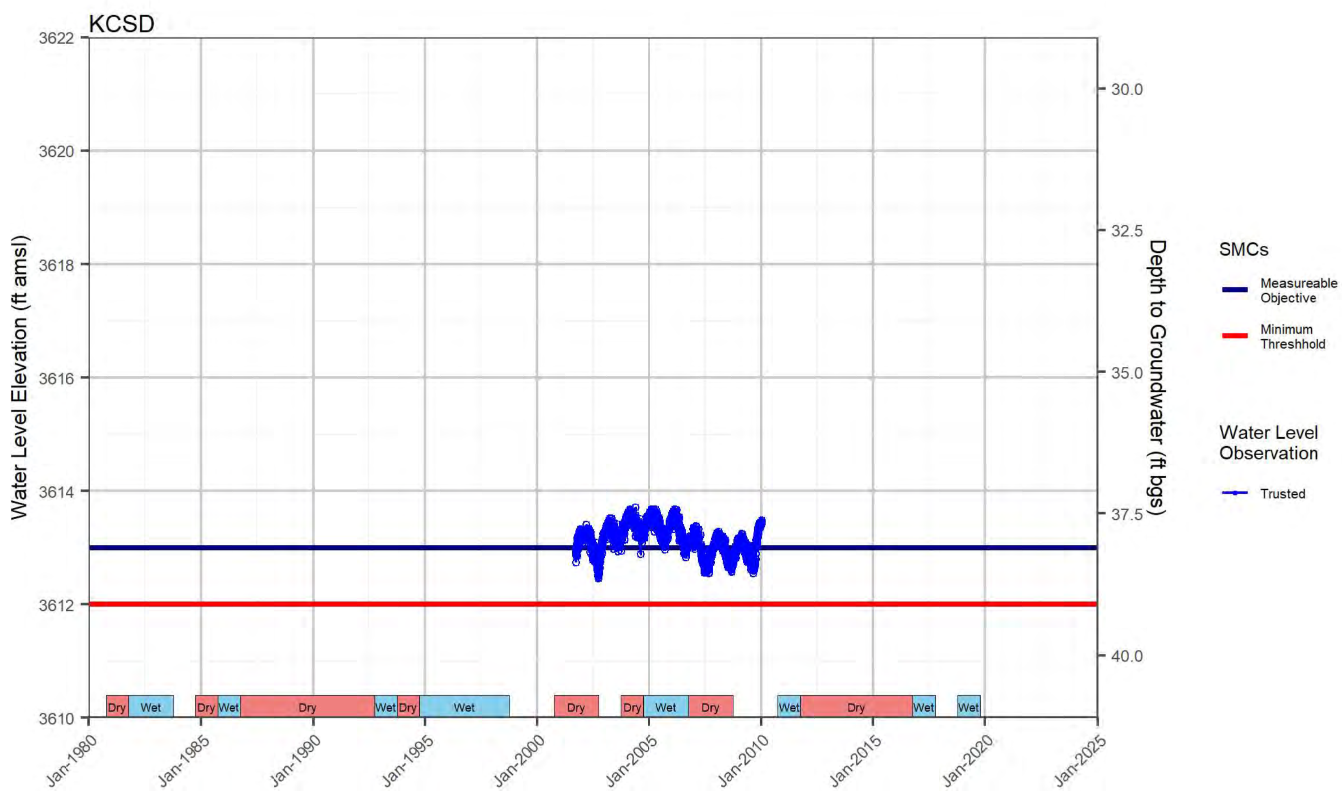
T916
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3712
3710
3708
3706
3704
3702
3700
-33
-30
-27
-24
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



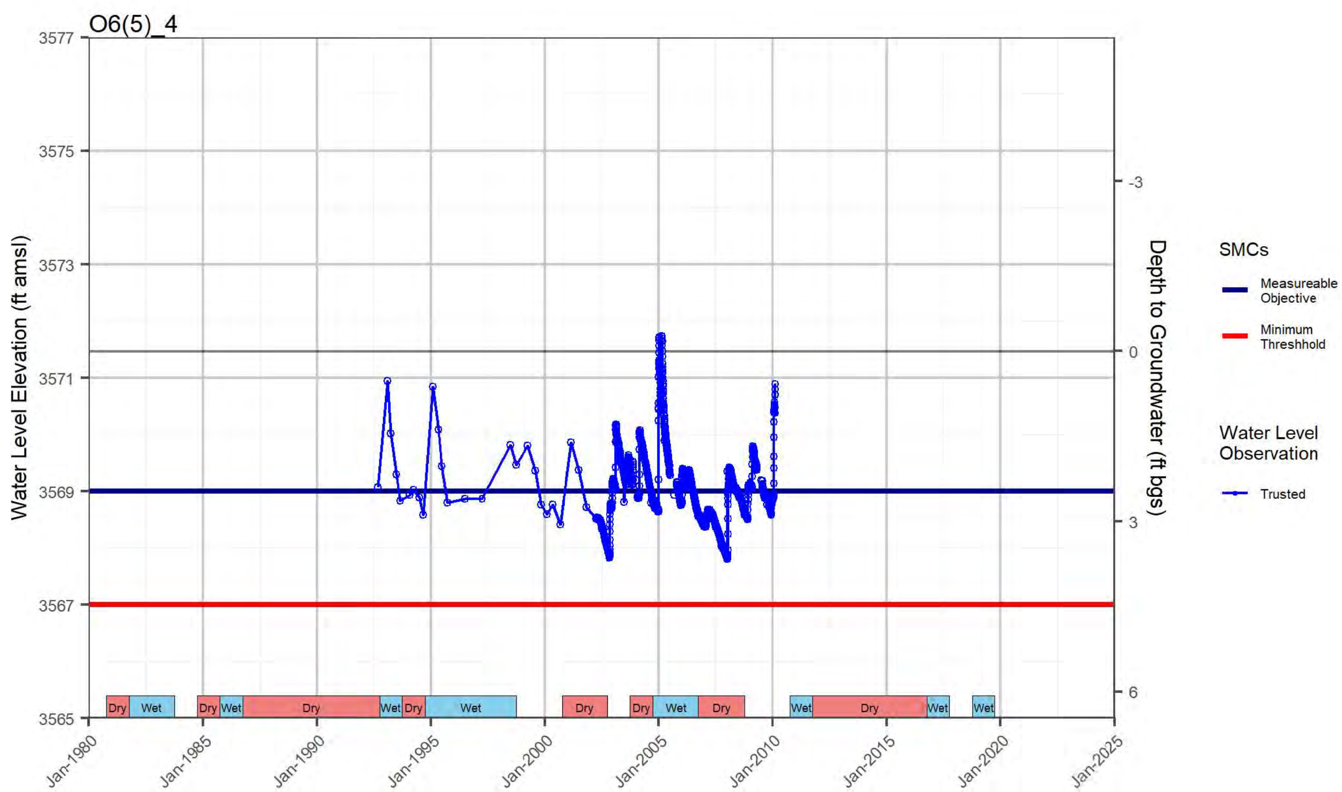
DELTA W(3)_10
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3572
3570
3568
3566
3564
3562
3560
-3
0
3
6
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



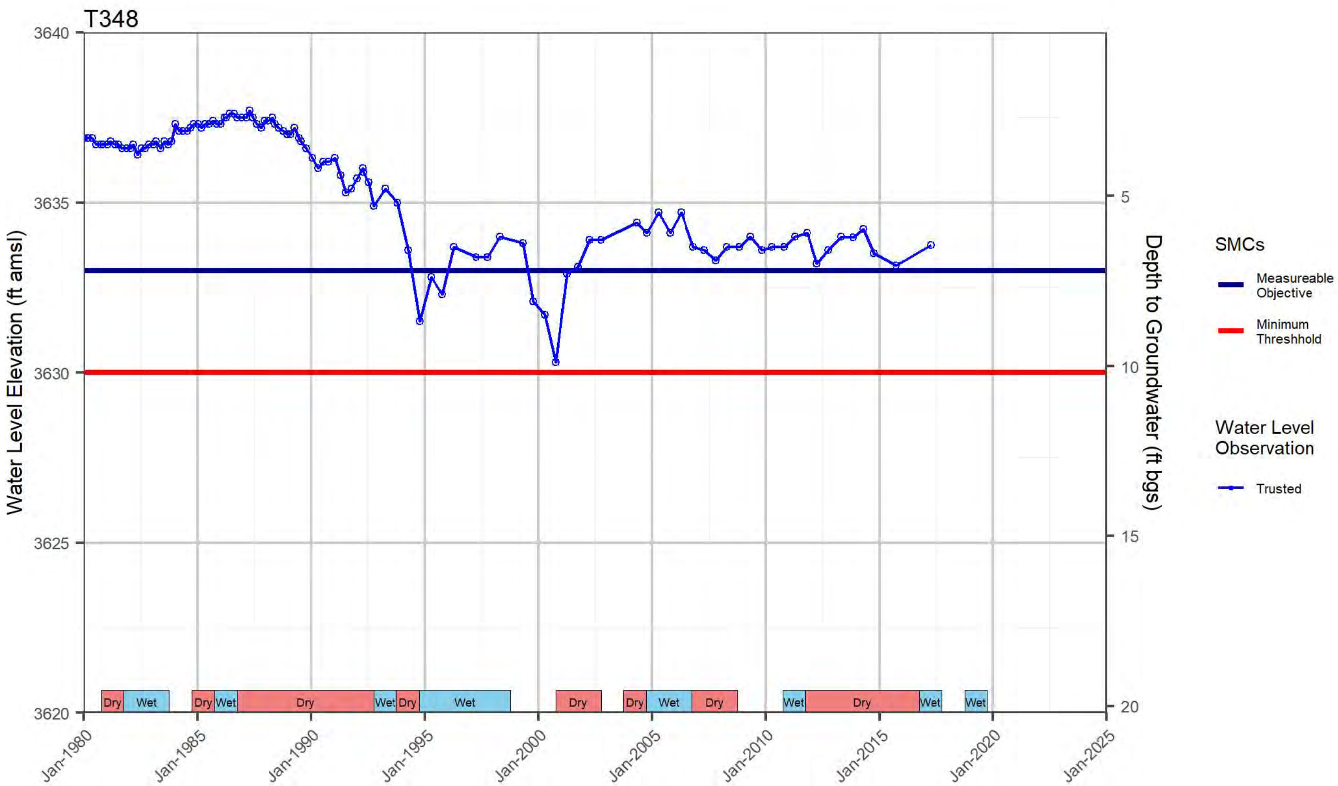
I10(7)_4
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3577
3575
3573
3571
3569
3567
3565
-3
0
3
6
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



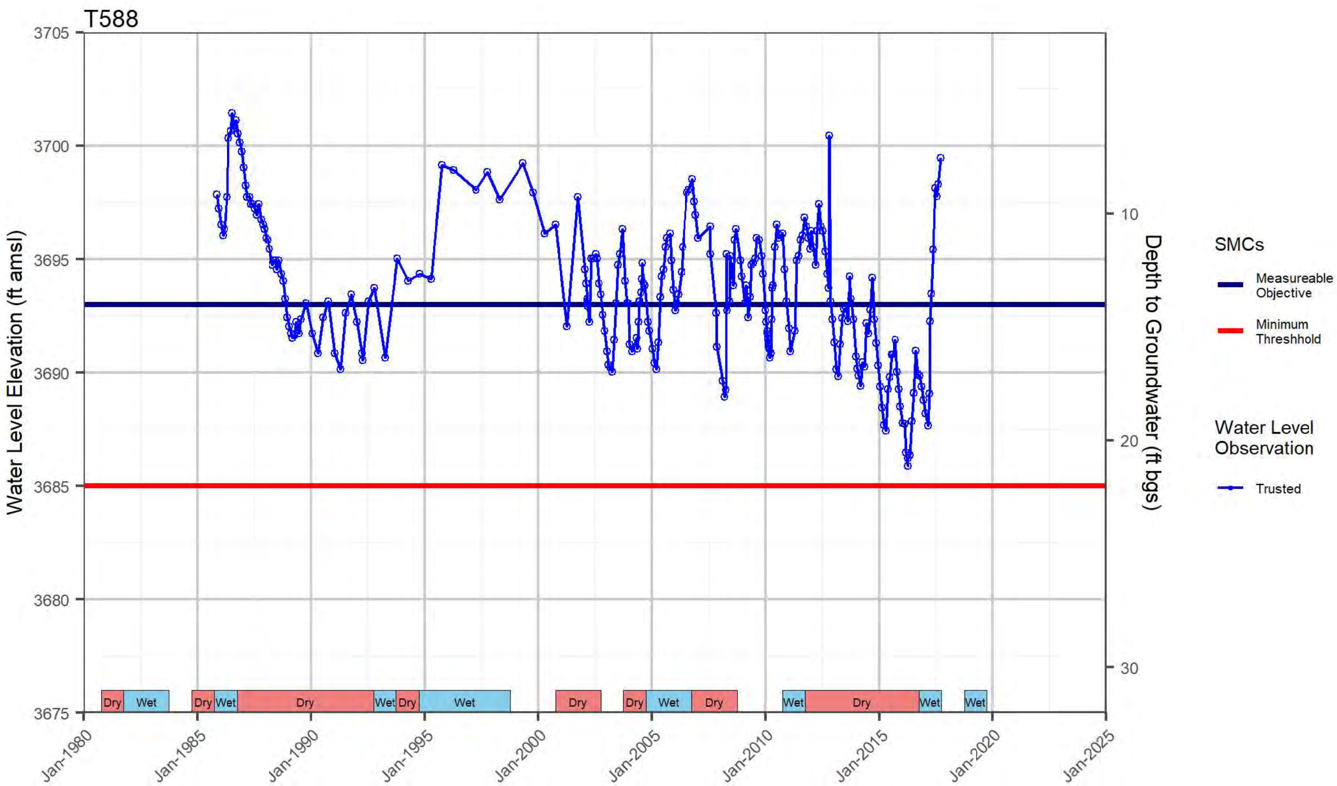
KCSD
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3622
3620
3618
3616
3614
3612
3610
30.0
32.5
35.0
37.5
40.0
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Dry
Wet
Dry
Wet
Dry
Wet
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



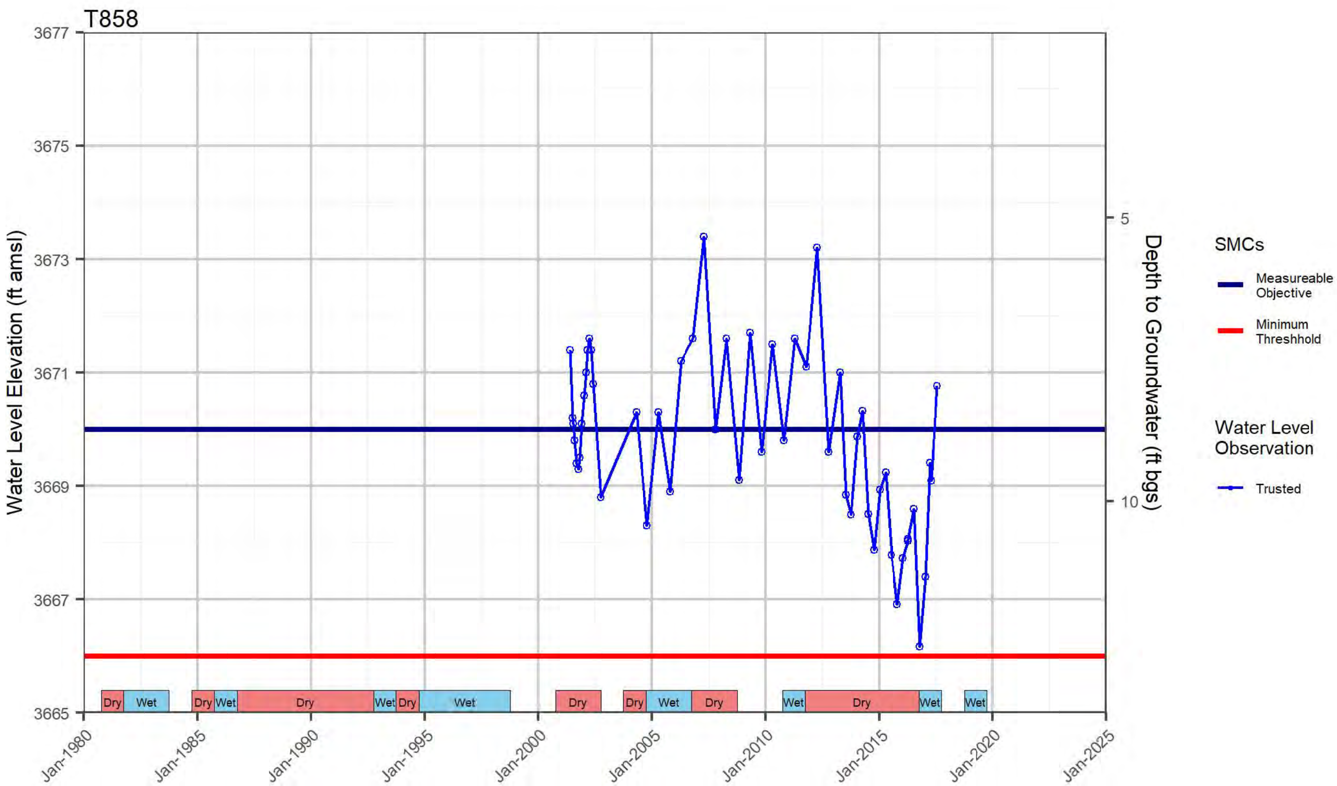
O6(5)_4
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3577
3575
3573
3571
3569
3567
3565
-3
0
3
6
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

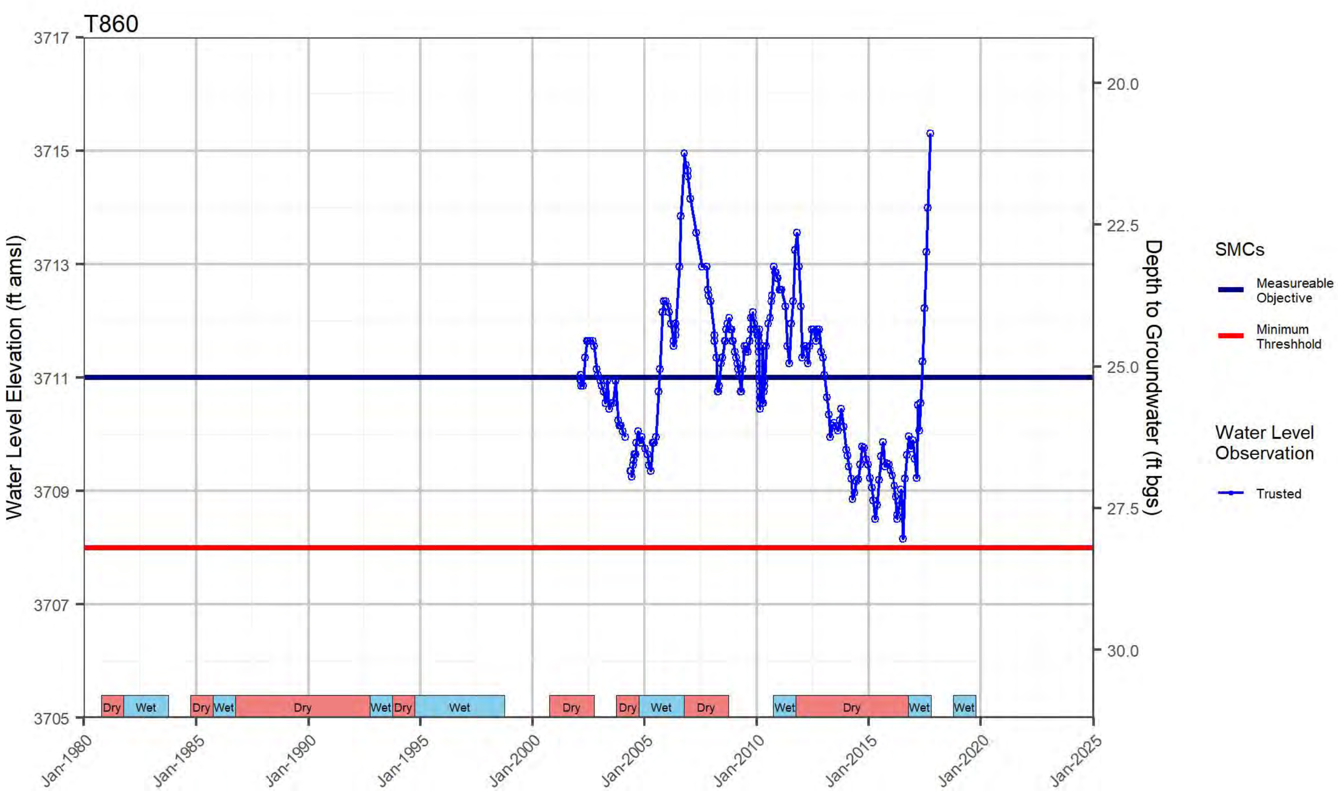


T348
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3640
3635
3630
3625
3620
5
10
15
20
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted

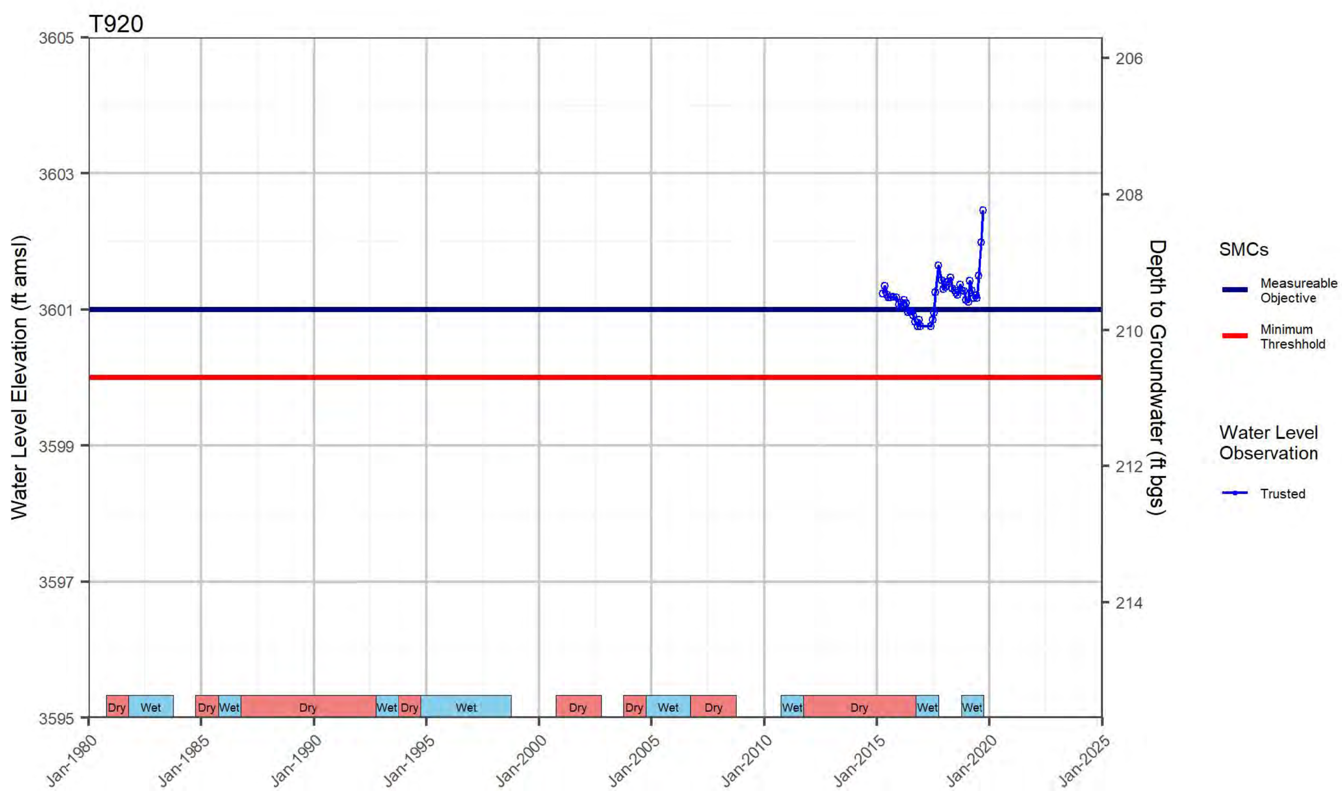


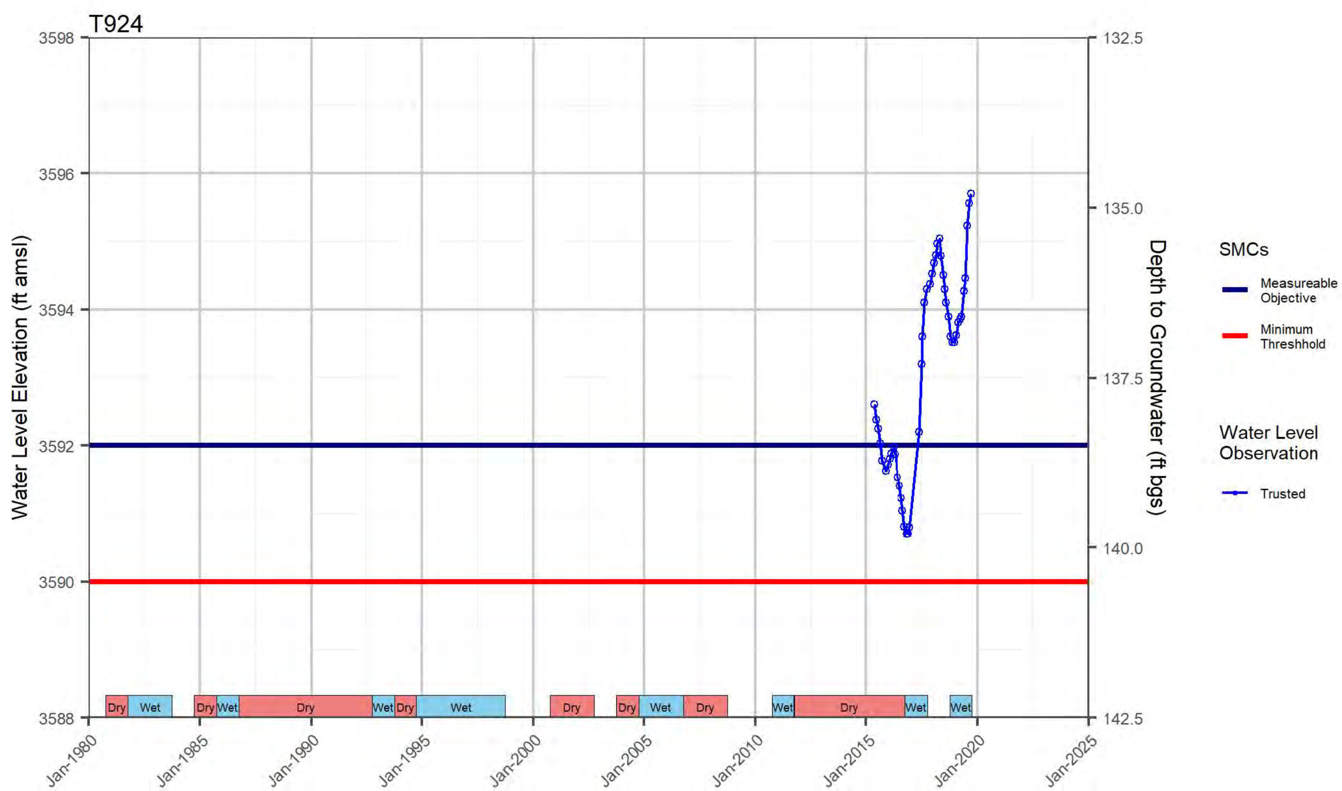
T588
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3705
3700
3695
3690
3685
3680
3675
10
20
30
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


T858
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3677
3675
3673
3671
3669
3667
3665
5
10
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted



T860
Water Level Elevation (ft amsl)
3717
3715
3713
3711
3709
3707
3705
Depth to Groundwater (ft bgs)
20.0
22.5
25.0
27.5
30.0
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


T920
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3605
3603
3601
3599
3597
3595
206
208
210
212
214
Dry
Wet
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted


T924
Water Level Elevation (ft amsl)
Depth to Groundwater (ft bgs)
3598
3596
3594
3592
3590
3588
132.5
135.0
137.5
140.0
142.5
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Dry
Wet
SMCs
Measureable Objective
Minimum Threshhold
Water Level Observation
Trusted