INDIAN WELLS VALLEY GROUNDWATER BASIN

GSP Annual Report

Water Year 2020

(October 2019 to September 2020)

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Chapter 1 Executive Summary

The Indian Wells Valley Groundwater Authority (IWVGA) has prepared this Annual Report for the Indian Wells Valley Groundwater Basin (IWVGB or Basin), Basin 6-054, to be submitted to the California Department of Water Resources (DWR) in compliance with the Sustainable Groundwater Management Act (SGMA). This annual report presents required data for Water Year (WY) 2020 (October 2019-September 2020).

DWR has designated the IWVGB as a basin in critical overdraft. Overdraft in the IWVGB has been shown through several undesirable results, primarily the chronic lowering of groundwater levels, the degradation of water quality, and the reduction of groundwater in storage throughout the IWVGB. Consequently, the IWVGA must implement projects and management actions to mitigate and avoid undesirable results and reach sustainability by 2040.

The GSP for the IWVGB (Stetson, 2020) was adopted by the IWVGA Board of Directors on January 16, 2020 and was submitted to DWR on January 31, 2020. The sustainable yield is estimated to be 7,650 acre-feet per year (AFY). The GSP recommended projects and management actions to achieve Basin sustainability that will culminate in managing the IWVGB within the sustainable yield and the absence of undesirable and unsustainable groundwater conditions in the IWVGB. Sustainable management criteria were established for measuring progress towards groundwater sustainability.

During WY 2020, the IWVGA began developing the projects and management actions proposed in the GSP and began tracking sustainability using the proposed sustainable management criteria. Progress has been made toward the allocation of the sustainable yield, establishing replenishment fees for the acquisition of imported water supplies and funding shallow well mitigation, and developing a transient pool program to ultimately reduce overdraft conditions in the Basin.

In WY 2020, the IWVGA has continued its data collection to improve Basin understanding. The IWVGA received Proposition 1 funding from DWR to complete specific data collection tasks. During WY 2020, the Indian Wells Valley received approximately 5.6 inches of rain, classifying the year as Above Normal. In WY 2020, depth to groundwater (DTW) was measured at 143 wells in October 2019. Hydrographs have been developed for all wells in the monitoring program and are posted on the DMS website (www.iwvgsp.com). Groundwater levels have declined in many parts of the IWVGB during the last five years from Spring 2015 through Spring 2020. The estimated groundwater storage change in the main basin of the IWVGB during WY 2020 is a loss of 18,274 acre-feet (AF).

Groundwater production during WY 2020 is estimated to be 22,000 AF and recycled water use is estimated to be 1,330 AF. Therefore, total water use in the IWVGB in WY 2020 is estimated to be 23,330 AF.

This Annual Report provides an update on Basin conditions and Basin management activities organized into the following chapters:

- General information (including Basin location)
- Progress towards GSP implementation and sustainability
- Hydrologic conditions
- Groundwater elevation data (including contours and hydrographs)
- Groundwater storage data
- Water supply data (including groundwater extraction data)
- Other Data Collection

Chapter 2 General Information

The IWVGB is located in the northwestern part of the Mojave Desert in southern California, and underlies approximately 382,000 acres or approximately 600 square miles of land area in portions of the Counties of Kern, Inyo, and San Bernardino. The IWVGB is bordered on the west by the Sierra Nevada Mountain Range, on the north by the Coso Range, on the east by the Argus Range, and on the south by the El Paso Mountains. Surface water flow from the surrounding mountain ranges drains to China Lake, a large normally dry lake, or playa, located in the central north-east part of the Basin.

The land overlying the IWVGB encompasses portions of the Counties of Kern, Inyo, and San Bernardino, with the majority (approximately 73%) being in Kern County. A significant amount of land overlying the IWVGB comprises either the Naval Air Weapons Station China Lake (NAWS China Lake) or public lands managed by the United States Bureau of Land Management (BLM). The City of Ridgecrest (Ridgecrest or City) is the only incorporated community in the Indian Wells Valley and covers an area of approximately 20 square miles with a population of approximately 27,000 people. The Indian Wells Valley Water District (IWVWD) serves potable water to Ridgecrest and certain areas outside of Ridgecrest's jurisdiction Unincorporated communities in the Indian Wells Valley include the communities of Inyokern in Kern County and Pearsonville in Inyo County, along with other smaller communities.

Kern County, Inyo County, San Bernardino County, Ridgecrest, and the IWVWD entered into a joint exercise of powers agreement to form the IWVGA and serve as General Members on the IWVGA Board of Directors, which governs the IWVGA as a whole. The U.S. Navy and BLM serve as Associate Members (non-voting) on the IWVGA Board of Directors. Figure 2-1 provides the location of the IWVGB and the extents of the IWVGA boundaries.

In its 2016 Bulletin 118 interim update, DWR identified the IWVGB as a critically overdrafted basin of medium priority[1]. As such, in compliance with SGMA, the associated groundwater sustainability agency (GSA) was required to submit a GSP by January 31, 2020 to achieve local sustainable management of groundwater resources. The IWVGA Board of Directors adopted Resolution No. 02-16 on December 8, 2016, to establish the IWVGA as the exclusive GSA for the entirety of the IWVGB. . The GSP for the IWVGB

[1] The IWVGB has since been identified as a critically overdrafted basin of **high** priority as of the *Sustainable Groundwater Management Act 2018 Basin Prioritization: Process and Results*, published by DWR in January 2019.

(Stetson, 2020) was adopted by the IWVGA Board of Directors on January 16, 2020 and was submitted to DWR on January 31, 2020.

The IWVGB serves as the sole supply of potable water for the Indian Wells Valley. Residents of the Indian Wells Valley are served groundwater through private domestic wells, small cooperative groups sharing wells, small mutual water companies, the Inyokern Community Services District (Inyokern CSD), and the Water District. The U.S. Navy produces and distributes groundwater for the on-station water uses at the NAWS China Lake. Searles Valley Minerals Inc. produces groundwater from the IWVGB for use in its minerals recovery and processing operations in the Searles Valley (located east of the IWVGB) and for potable use in the small communities of Trona, Westend, Argus, and Pioneer Point in the Searles Valley. In addition, a number of farms located in the Indian Wells Valley rely on the IWVGB's water supplies for their agricultural operations. Overdraft conditions in the IWVGB have existed for since at least the 1960s (Dutcher and Moyle, 1973). The results of overdraft have manifested themselves through various undesirable results, primarily the chronic lowering of groundwater levels, the degradation of water quality, and the reduction of groundwater storage throughout the IWVGB.

Chapter 3 Progress Towards GSP Implementation and Sustainability

The IWVGB is characterized as a critically overdraft basin by DWR. The sustainable yield is estimated to be 7,650 AFY, while groundwater production is significantly higher. This classification accounts for the occurrence of undesirable results for the following sustainability indicators:

- Chronic lowering of groundwater levels
- Reduction of groundwater in storage
- Degraded water quality
- Potential for land subsidence

After extensive public outreach and collaboration, the IWVGA Board of Directors adopted the IWVG GSP on January 16, 2020. In compliance with SGMA, the GSP provides Basin management strategies that will culminate in managing the IWVGB within the sustainable yield and the absence of undesirable and unsustainable groundwater conditions in the IWVGB. The GSP recommends projects and management actions that are intended to achieve Basin sustainability while considering the unique geologic and hydrogeologic conditions of the IWVGB. Sustainable management criteria were established for measuring progress towards groundwater sustainability. The recommendations of the GSP will provide for long-term sustainable groundwater management in the IWVGB within 20 years (WY 2040) of GSP implementation.

During WY 2020, the IWVGA began developing the projects and management actions proposed in the GSP and began tracking sustainability using the proposed sustainable management criteria, discussed further in the subsections below. In addition, the IWVGA continued significant data collection efforts to fill data gaps. These data collection efforts are documented in Chapter 7.

3.1 Projects and Management Actions

The following subsections documents the progress made towards the implementation of the projects and management actions proposed in the GSP. Additional information regarding projects and management actions can be found in the GSP.

3.1.1 Management Action 1: Annual Pumping Allocation Plan, Transient Pool, and Fallowing Program

On July 16, 2020, the IWVGA Board of Directors adopted Resolution Number 06-20 to adopt a report documenting the sustainable yield of the IWVGB. The report concluded that the entire Basin sustainable yield is subject to a Federal Reserve Water Right Interest and is beyond the jurisdiction and regulation of the IWVGA, and therefore cannot be allocated to other groundwater users. As a result, all Basin pumpers – with the exception of de minimis extractors, federal extractors, and Transient Pool pumping—are pumping above the sustainable yield and are subject to costs for overdraft mitigation and augmentation projects, unless evidence of a quantifiable production right superior to the Navy's is provided.

On August 21, 2020, the IWVGA Board of Directors adopted Ordinance Number 03-20 to establish a volumetric Basin Replenishment Fee on all groundwater extractions in the IWVGB with the exception of federal and de minimis extractions. The purpose of the fee is to generate funds to develop and procure imported water supplies to meet water demands in the Indian Wells Valley (See Chapter 3.1.2 below). The report accompanying the ordinance assumes the U.S. Navy will provide its unused Federal Reserve Water Right interest to those that provide water to its workforce through agreements with those water providers. Those with permission to extract unused portions of the Navy's estimated Federal Reserve Water Right Interest shall not be subject to the Replenishment Fee. Despite the IWVGA not being able to establish an allocation plan due to the superiority of the U.S. Navy's groundwater rights, the Basin Replenishment Fee will provide an economic incentive to reduce groundwater pumping which will in turn significantly reduce groundwater extractions.

The IWVGA has developed a Transient Pool and Fallowing program to facilitate transitional reduced agricultural pumping to an interim acceptable level of basin overdraft until augmented supplies are available. On August 21, 2020, the IWVGA Board of Directors adopted Resolution Number 05-20 to adopt the Transient Pool and Fallowing program. Qualified agricultural users who voluntarily opt to participate in the program have been provided a finite Transient Pool allocation of groundwater supplies to manage independently as their operations permit. The Transient Pool allocations are not subject to the portion of the Basin Replenishment Fee intended for obtaining imported water supplies. Groundwater producers not in the Transient Pool program may continue to pump groundwater subject all applicable fees.

3.1.2 Project 1: Develop Imported Water Supply

Due to overdraft conditions in the Indian Wells Valley and water demands expected to continue to exceed the Basin sustainable yield in the future, securing imported water supplies is a priority for the Basin. The IWVGA has retained Capitol Core Group, Inc (Capitol Core) for the following general tasks:

- Identify and Procure Imported Water Supplies
- Develop and Secure Transfer Partners
- Identify and Secure Funding Sources

Significant work on these tasks occurred in WY 2020. The IWVGA Board considered options to procure specific single year, multiple year, and permanent transfers of water supplies; however, given the financial condition of the IWVGA during WY 2020, the IWVGA Board did not pursue the available imported water supplies. Capitol Core also began initial discussion with Los Angeles Department of Water and Power and Antelope Valley East Kern Water Agency to discuss interconnection opportunities. Lastly, Capitol Core met with several federal agencies regarding programmatic and potential funding sources, including requesting consideration of funding participation with the U.S. Navy for an interconnection project.

On August 21, 2020, the IWVGA Board of Directors adopted Ordinance Number 03-20 to establish a volumetric Basin Replenishment Fee on all groundwater extractions in the IWVGB with the exception of federal and de minimis extractions. The purpose of the fee is to generate funds to develop and procure imported water supplies to meet water demands in the Indian Wells Valley.

3.1.3 Project 2: Optimize Recycled Water

The IWVGA, in coordination with the City of Ridgecrest, began development of its recycled water program to optimize the use of recycled water from the City of Ridgecrest's wastewater treatment facility. The purpose of the program is increase local water supply, decrease dependence on imported water, and increase the sustainable yield of the IWVGB. During WY 2020, initial program development and coordination efforts between the IWVGA and the City of Ridgecrest took place.

3.1.4 Project 3: Conservation Efforts

Through Proposition 1 funding, the IWVGA began implementing a conservation program in WY 2020 targeting groundwater users located in severely disadvantaged communities (SDAC). The program consists of a rebate program for the installation of water conservation devices and a water audit, lead detection, and leak repair program in SDACs.

Indirectly, IWVGA extraction fees encourage and incentivize individual water saving and conservation practices. Additionally, the Water District has continued its conservations efforts for its customers, independent of the IWVGA.

3.1.5 Project 4: Shallow Well Mitigation Program

Shallow wells are anticipated to continue to be impacted due to overdraft conditions and areas in the Basin with poor and degraded water quality while the management actions and projects in the GSP are being developed and implemented. The IWVGA began development of the shallow well mitigation program in WY 2020.

On August 21, 2020, the IWVGA Board of Directors adopted Ordinance Number 03-20 to establish a volumetric Basin Replenishment Fee on all groundwater extractions in the IWVGB, with the exception of federal and de minimis extractions. The purpose of the fee is to generate funds to mitigate undesirable results impacting shallow wells caused by the lowering of groundwater levels and poor and degraded water quality.

3.1.6 Project 5: Dust Control Mitigation Program

Implementation of the fallowing program could potentially result in an increase in windblown dust and sand, due to the climate of the Indian Wells Valley which would require mitigation in order to eliminate undesirable results. The fallowing program has not been fully developed yet; consequently, no work on this project was completed in WY 2020.

3.1.7 Project 6: Pumping Optimization Project

Evaluation of the modeling results for the proposed groundwater management and project scenarios showed that some current groundwater pumping may need to be redistributed in the IWVGB to reduce concentrated pumping centers that would lead to continuing localized declining groundwater levels and corresponding continuing impacts to shallow domestic wells.

This project will need to be evaluated as other projects and management actions are implemented and the basin impacts of said projects are evaluated. Consequently, no work on this project was completed in WY 2020.

3.2 Sustainable Management Criteria

As discussed previously, the IWVGA has identified four sustainability indicators with documented historical and/or current undesirable results in the IWVGB:

- Chronic lowering of groundwater levels
- Reduction of groundwater in storage
- Degraded water quality
- Potential for land subsidence

As part of the GSP, the IWVGA developed minimum thresholds, measurable objectives, and interim milestones for the sustainability indicators in order to monitor progress towards sustainability and the elimination of undesirable results. The development of these criteria relied upon information about the IWVGB developed in the hydrogeologic conceptual model, current and historical groundwater conditions, and the water budget. Additional information regarding the development of the sustainable management criteria can be found in the GSP.

The IWVGA has selected representative monitoring sites to be used to specifically measure and monitor groundwater conditions caused by the sustainability indicators and to evaluate the efficacy of the proposed projects and management actions achieving sustainability. These sites were selected based on evaluation of the best available data. As more data becomes available through monitoring and data collection, the representative sites will be reevaluated for effectiveness at representing basin-wide conditions.

In general, the IWVGA anticipates continuing worsening conditions until projects and management actions are fully implemented and the basin has time to recover and respond to sustainable operations. The first interim milestones will be evaluated in 2025. As noted in Chapter 6, groundwater production in WY 2020 has reduced from WY 2019 showing progress towards operating within the IWVGB sustainable yield and eliminating undesirable results.

Sustainable management criteria established for the IWVGB can be monitored on the public data management system (DMS) at the following site: www.iwvgsp.com. A summary of the data is provided in the subsections below.

3.2.1 Chronic Lowering of Groundwater Levels

Ten representative sites throughout the IWVGB were initially selected to be the representative monitoring sites (key wells) to monitor for chronic lowering of groundwater levels. Sustainable management criteria have been established for each of the representative monitoring sites. The current status groundwater levels at the representative monitoring sites are as follows:

- Groundwater levels at four of the representative sites are above the measurable objectives;
- Groundwater levels at four representative sites are within the operating range between the measurable objective and the minimum threshold; and
- Two representative monitoring well sites do not have established sustainable management criteria and currently have limited data.

A key task for WY 2021 will be to evaluate the selected representative monitoring sites, particularly those with no or little data, to determine if revisions to the monitoring network are required. The WY 2020 data do not indicate concern that the first interim milestones will not be met in 2025. Groundwater elevation data are discussed more thoroughly in Chapter 5.

3.2.2 Reduction of Groundwater in Storage

Groundwater in storage will continue to reduce until the IWVGB is operated within the sustainable yield. The estimated change in groundwater storage is discussed in Chapter 5.3. The estimated change of groundwater in storage is a loss of approximately 18,274 acre-feet from the main IWVGB basin which has not exceeded the sustainable management criteria.

3.2.3 Degraded Water Quality

At the time the GSP was adopted, eleven representative sites throughout the IWVGB were initially selected to be the representative monitoring sites (key wells) to monitor for water quality degradation. The IWVGA has since encountered logistical and technical issues with certain representative monitoring sites and has consequently designated alternative sites as key wells for a total of ten representative monitoring sites. The current status of total dissolved solids (TDS) concentrations at the representative monitoring sites are as follows:

- TDS concentrations at five of the representative sites are below the measurable objectives;

- TDS concentrations at one representative site is within the operating range between the measurable objective and the minimum threshold; and
- Four representative monitoring well sites do not have established sustainable management criteria and currently have limited data.

A key task for WY 2021 will be to evaluate the selected representative monitoring sites, particularly those with no or little data, to determine if revisions to the monitoring network are required and to establish the sustainable management criteria for the newly designated representative monitoring site. The current data do not indicate concern that the first interim milestones will not be met in 2025. The data can be viewed on the DMS website (www.iwvgsp.com). Attachment A provides TDS data for the selected representative monitoring sites. Figure 3-1 provides the locations of these wells.

3.2.4 Land Subsidence

Due to implementation of projects and management actions that will result in stabilization of groundwater levels, the current rate of land subsidence is not anticipated to increase from the most recent available data period (2005-2010). Accordingly, the Measurable Objective and the interim milestones are set at the long-term historical rate of subsidence. No representative monitoring sites to measure land subsidence off of the Naval Air Weapon Station (NAWS) China Lake have been selected at this time. The IWVGA intends to periodically monitor land subsidence conditions throughout the IWVGB as datasets become available and as necessary to ensure no undesirable groundwater conditions are occurring. Periodically and at least every five years, the IWVGA will request any available land subsidence data from the U.S. Navy at their Supersonic Naval Ordinance Research Track (SNORT) alignment. No additional land subsidence data, beyond what is provided in the GSP, was available in WY 2020.

Chapter 4 Hydrologic Conditions

The California Code of Regulations (CCR) requires that GSP Annual Reports contain information on current and historical water year types (23 CCR § 356.2). DWR issues water year classifications for some areas of the state, including the Sacramento River and San Joaquin River basins. In January 2021, DWR prepared historical water type datasets for other areas of the state, including in the watersheds that overlie the IWVGB (DWR, 2021). The DWR historical data set covers the period from WY 1931 to 2018; classifications for WY 2019 and WY 2020 are not yet available.

GSAs have the option to (1) develop their own water year types based on best available information (23 CCR Section 354.18d), or (2) use the data recently developed by DWR for the water budget. The suitability of the DWR water year type index will be assessed for future reports; at this time, a classification for the most recent water year is not yet available from DWR. A water year type index (Attachment B), based on local precipitation data in the IWVGB, was developed previously for the baseline groundwater model (GSP Appendix 3-H, Stetson 2020a) and the WY 2019 GSP Annual Report (Stetson, 2020b). Use of that index is continued in this annual report.

The IWVGB water year type index is based on historical precipitation data from 1945-2020 at the China Lake NAF station and has five hydrologic categories. The categories are illustrated in the annual precipitation exceedance curve in Figure 4-1. The five types are Wet, Above Normal, Normal, Below Normal, and Dry. Table 4-1 shows the thresholds for determining water year type. The thresholds correspond to the vertical lines dividing the categories in Figure 4-1. WY 2020 was an Above Normal year, with 5.6 inches of rain at the index station. Table 4-2 and Attachment B lists the water year type since 2015 and the historical classifications of water year type since WY 1945, respectively.

Table 4-1: Percent Exceedance Ranges and Dividing Thresholds for Five Water Year Types

Year Type	Percent Exceedance Range (%)			Threshold Between Year Type (in/yr)	Number of Years in Historical Record (WY 1945-2019)
Wet	0%	-	10%	6.0	7
Above Normal	>10%	-	33%	4.0	18
Normal	>33%	-	67%	2.3	25
Below Normal	>67%	-	90%	1.3	17
Dry	>90%	-	100%	n/a	8
				Total years	***75***

Table 4-2: Water Year Types based on Precipitation at China Lake NAF Station (No. 041733)

WY	Annual Precipitation (in/yr)	Water Year Type
2015	3.67	N
2016	1.38	BN
2017	4.61	AN
2018	1.43	BN
2019	6.13	W
2020	5.57	AN

Notes: W = Wet, AN = Above Normal; N = Normal; BN = Below Normal; D = Dry.

Chapter 5 Groundwater Elevation Data

Since 1946, groundwater data have been collected in IWVGB for studies conducted by the Navy, U.S. Geological Survey, Department of Water Resources, the U.S. Bureau of Reclamation, and other agencies. In 1995, a groundwater monitoring program was established with Kern County Water Agency (KCWA) and the Navy collecting groundwater levels during the wet (spring) and dry (fall) seasons from approximately 140 to 190 wells throughout the IWVGB.

In WY 2020, depth to groundwater (DTW) was measured at 143 wells in October 2019 and 54 wells during the spring 2020. The abbreviated spring 2020 groundwater level measurements occurred from April to July 2020 by multiple methods and available personnel due to COVID-19 pandemic conditions and regional stay-at-home orders. Data were unable to be collected from domestic wells during spring 2020. Searles Valley Minerals (SVM) volunteered their staff to measure groundwater levels at a subset of monitoring wells located Bureau of Land Management (BLM) land (open space). The pandemic and stay-at-home orders also restricted NAWS China Lake personnel access to the naval base resulting in only a subset of Navy monitoring wells being measured.

Attachment C contains measured DTW data, Land Surface Datum (LSD) and resulting groundwater elevations (feet, mean sea level) for WY 2020. These data were filed on DWR's SGMA portal and appended to the IWVGSP.com (DMS) website. Groundwater elevation data were used to produce equipotential contour maps and hydrographs for this annual report.

5.1 Groundwater Elevation Contour Maps

KCWA[2] produced Fall 2019 and Spring 2020 groundwater elevation contours for this WY 2020 Annual Report. Figure 5-1 shows the Fall 2019 contours and Figure 5-2 shows the Spring 2020 contours with groundwater level monitoring wells, groundwater basin boundary, and watershed extents for Indian Wells Valley. CASGEM wells are noted by Spring 2020 contours have been dashed to show the uncertainty inherent when using limited data collected over a two-month period.

In general, the contour maps show groundwater flowing from Rose Valley in the northwest (about 2,250 feet, msl), the Sierra mountainfront fan deposits (about 2,190 feet, msl) along the west, the Argus Range

[2] Michelle Anderson, PG; Kern County Water Agency geologist.

mountainfront fan deposits from the east (about 2,180 feet, msl) and from El Paso Subarea (2,800 feet, msl) in the southwest towards the playa at the center of the basin. Pumping centers form depressions near discharge areas in the northwest (about 2,170 feet, msl), southwest (about 2,150 feet, msl), and southeast (about 2,120 feet, msl). There is a fault causing steep groundwater level contours from El Paso Subarea to the main IWVGB.

Fall 2019 and Spring 2020 groundwater elevation contours show few seasonal differences at the 10-foot contour level, however this could be due to the uncertainty introduced to the Spring 2020 contours due to limited data. The trends and changes in groundwater levels are better displayed on the hydrographs in the next section.

5.2 Hydrographs

Hydrographs have been developed for all wells in the IWV Groundwater Monitoring Program (GWMP) and are posted on the DMS website (www.iwvgsp.com). Hydrographs for 30 selected wells (Figure 5-3 and Attachment D), which include the designated key wells in the GSP used to track Basin management. The selected wells are located at 14 sites, and include seven nested multi-level piezometers, for a total of 30 wells. Groundwater level data collected by KCWA, the Navy, and other agencies were used to produce 14 hydrographs for these 30 wells (note: data for nested multi-level piezometers appear on the same hydrograph). Groundwater level data for the majority of the hydrographs begins in the late 1980s and early 1990s when the wells were installed, with the exception of the Inyo Well. The Inyo Well (27S/39E-07R01), located in the southwest of the IWV main basin has the longest period of record for groundwater level data in the basin dating back to 1946.

During monitoring and sampling conducted by Stetson during WY 2020, a discrepancy in measured groundwater levels was observed at USBR-03 between the shallow and mid-level piezometers. Casing heights in USBR-03 do not follow standard practices of installing shallow piezometers with higher stickup heights than deeper casings. Additionally, the top of casing elevations between the shallow and mid-level casing are relatively the same elevation. The origin of this error appears to have occurred immediately after well construction. The technical memorandum in Attachment E gives more detail on the issue and the steps taken to remedy the inconsistency.

The hydrographs in Attachment D show the historical changes of groundwater levels throughout the IWVGB. Due to COVID-19, all agencies that measure spring groundwater levels faced restrictions to well access. It is important to note that because of well access restrictions, spring groundwater levels were measured over a couple of months. The following bullets walk through the recent changes of groundwater levels from spring 2015 through spring 2020 (5 years) at the selected wells shown on Figure 5-3.

- USBR-10 nested piezometers (Attachment D Figure B1, upper graph) These nested wells are located in the northwest near the Ninemile Canyon Road. Recent 5-year groundwater level change was -5.1 feet (shallow, 640-660 feet depth), +0.8 feet (shallow-mid, 1,180-1,220 feet depth), and -3.4 feet (deep, 1,930-1,950 feet depth). Groundwater pressure in the shallow and deep piezometers track together in a downward trend (about 0.7 feet/year), whereas the shallow-mid piezometer is disconnected, showing about 0.2 feet/year rise in groundwater levels.

- USBR-6 nested piezometers (Attachment D Figure B1, lower graph) These nested wells are located in the northwest near the fan deposits from Sand Canyon. Groundwater level change (4 years) was -1.8 feet (shallow, 330-350 feet depth), -5.3 feet (mid, 1,190-1,210 feet depth), and 0.2 feet (deep, 1,640-1,660 feet deep). The shallow piezometer records seasonal signature of higher groundwater levels in the spring with reduced pumping and lower groundwater levels in the fall following the summer irrigation season. Groundwater levels at the shallow piezometer have stabilized (stopped having a downward trend) since about 2010. The deep piezometer shows about 20 feet of artesian groundwater pressure above groundwater levels in the shallow piezometer. Groundwater levels in the mid piezometer continues to decline from spring 2015 through spring 2020 at -1.06 feet/year. Although the deep piezometer showed a long-term decline in groundwater levels since the early 1990's, there was a significant increase (+8.0 feet) in groundwater elevation from Spring 2019 to Fall 2019.

- USBR-5 nested piezometers (Attachment D Figure B2, upper graph) These wells are located in the northwest at the base of Indian Wells Canyon (mountainfront recharge) and near the agricultural pumping center. There is a downward vertical gradient from shallow to mid to deep at this well. The recent 5-year groundwater level change was -5.3 feet (shallow, 850-870 feet depth), -2.5 feet (mid, 1,590-1,610 feet depth), and -0.1 feet (deep, 1,960-1,980 feet deep). Historically declining groundwater levels have been observed since construction of USBR-5 in 1993 in the shallow, mid and deep piezometers, but groundwater levels rose in the mid and deep piezometers during the wet WY 2019 and have dropped during above normal WY 2020, but not to historical levels. There is an overall decline in groundwater levels during the recent 5 years at -1.05 feet/year (shallow), -0.51 feet/year (mid), and -0.02 feet/year (deep).

- NR-2 nested piezometers (Attachment D Figure B2, lower graph) These wells are located in the northwest about one mile east of USBR-5 and near the agricultural pumping center. Due to COVID-19, groundwater levels were not able to be measured in Spring 2020. Two of the three piezometers (shallow and deep) were measured Fall 2020 (WY 2021). The Fall 2020 data are plotted in this hydrograph to aid in the interpretation of groundwater levels for WY 2020. The shallow piezometer is closer to larger pumping wells in the basin and shows declining groundwater levels (-0.88 feet/year) from spring 2015 to spring 2019. Groundwater levels in the mid and deep piezometers have similar declining trends.

- Sandquist Spa Well (Attachment D Figure B3, upper graph) This well is located between the pumping centers and the playa (discharge area). Groundwater levels have shown a steady decline since the well started to be monitored in 1995. The recent 5 years (spring 2015 through spring 2020) show a change of -3.8 feet in groundwater level, an average of -0.76 feet/year.

- Kerr McGee 17 (Attachment D Figure B3, lower graph) This well is located east of Highway 395 about 3 miles southeast of NR-2 just inside the Navy fence line. Measurements at this well show a seasonal signature. Groundwater levels have shown a steady decline since monitoring began in 1994. The Spring 2020 groundwater level was unable to be measured, however the groundwater levels rose in response to the recent wet WY 2019.

- MW-32 nested wells (Attachment D Figure B4, upper graph) These wells are located along Business Highway 395 to the east of Inyokern, in the vicinity of pumping wells. Spring 2020 groundwater levels were unable to be measured at MW-32 due to COVID-19 restrictions. The recent 4 years (spring 2015 – spring 2019) showed groundwater level increases in the shallow-mid (880-900 feet depth) and mid-deep (1,240-1,260 feet depth) piezometers, but groundwater level declines in the deep (1,900-1,920 feet deep) piezometer. MW-32 shows artesian conditions (upward groundwater level gradient) at this location, with the highest pressure head measured from the deep piezometer. Groundwater levels observed in all of the piezometers show long term declining trends with seasonal fluxes from pumping stresses.

- USBR-4 well (Attachment D Figure B4, lower graph) This well is also located along Business Highway 395, about 2 miles west of MW-32 nested piezometers. The recent 5 years (spring 2015 through spring 2020) show a change of -2.9 feet in groundwater level (1,190-1,200 feet depth). The average annual change of -0.57 feet/year is within the seasonal flux of groundwater levels measured at this well.

- 26S/39E-32L1 (Attachment D Figure B5, upper graph) This well is located about 2 miles south of the junction of U.S. Highway 395 and California State Route 178. Groundwater levels have shown a steady decline since monitoring bean in 1995. A Spring 2020 groundwater level was unable to be measured at this well.

- George Air Corridor well (Attachment D Figure B5, lower graph) This well is located in the southeast area on Navy property. Groundwater levels have shown a steady decline since the well started to be monitored in 1989. The recent 5 years (spring 2015 through spring 2020) show a change of -1.1 feet in groundwater level, an average of -0.23 feet/year. The recent rate of decline is not as steep as historical rate of decline. This may be due to the moving of IWVWD pumping from the southeast to the southwest of the IWVGB.

- USBR-3 nested piezometers (Attachment D Figure B6, upper graph) These wells are located to the west of Ridgecrest and near the new Indian Wells Valley Water District (IWVWD) production wells. Groundwater level change (5 years) was -3.4 feet (shallow, 650-670 feet depth), -13.2 feet (mid, 1,320-1,340 feet depth), and -12.9 feet (deep, 1,850-1,870 feet deep). Groundwater levels shows artesian conditions at this location. Declining groundwater levels have been observed since construction of USBR-3 in 1993 in the shallow, mid and deep piezometers and continue to decline from spring 2015 through spring 2019 at -0.68 feet/year, -2.64 feet/year, and -2.58 feet/year, respectively.

- Inyo well (Attachment D Figure B6, lower graph) This well has the longest period of monitoring data, since 1946, and is located in the southwest area of the IWVWD new production wells. This well was deepened once, and was dry during the spring 2020 groundwater level measurement (425 feet depth). Groundwater levels have shown a steady decline since about 1953. The recent 5 years (spring 2015 through spring 2020) show a change of -12.1 feet in groundwater level, an average of -2.42 feet/year.

- AB303-05 well (Attachment D Figure B7, upper graph) This well is located in the El Paso subarea to the southwest of the main IWV groundwater basin. Steady, flat groundwater levels have been observed at this well with a slight rise in recent years. The recent 5 years (spring 2015 through spring 2020) show a change of +3.4 feet in groundwater level, an average of +0.67 feet/year. (Note: very little groundwater production occurs in the El Paso subarea.)

- USBR-1 nested piezometers (Attachment D Figure B7, lower graph) These wells are also located in the El Paso subarea, southwest of a fault that separates this subarea from the main IWV groundwater basin. Steady groundwater levels have been observed at all four piezometers since about 1995, with a slight rise in recent years. Only the shallow and shallow-mid piezometers were measured in both spring 2015 and spring 2020 for a 5-year comparison, showing groundwater level changes +0.7 and +0.8 feet, respectively (shallow, 615-635 feet depth; and shallow-mid, 1,040-1,060 feet depth). These groundwater level changes correspond to average annual changes of approximately +0.15 feet/year. (Note: very little groundwater production occurs in the El Paso subarea.)

5.3 Estimated Change in Groundwater Storage from Spring 2015 to Spring 2020

Groundwater levels have declined in many parts of the IWVGB during the last five years from Spring 2015 through Spring 2020. There are some areas that show little change, or even a rise in groundwater levels, especially in the El Paso subarea. Two different methods were used to evaluate the changes in groundwater levels from Spring 2015 through Spring 2020: (1) map color flood comparison of measured groundwater level change, and (2) Thiessen polygon method using 41 monitoring wells distributed throughout the basin to estimate storage changes.

5.3.1 Groundwater Level Change from Spring 2015 to Spring 2020

Groundwater levels were measured at 47 wells during both Spring 2015 and Spring 2020 (limited due to COVID-19 restrictions). These groundwater data were compared to evaluate the average annual groundwater level change across the basin. Figure 5-4 shows the average annual groundwater elevation change from 2015 to 2020 displayed as gradational colors for the 47 monitoring wells with data for both Spring 2015 and Spring of 2020. The highest levels of groundwater elevation change observed (orange dots) appear to correlate with pumping and discharge areas. The largest decline in groundwater levels were observed at USBR-3, located near the south/southwest pumping center. These wells can be seen as the orange dots (< -1.5 feet/year) on Figure 5-4. The average change in the 47 measured groundwater levels was -0.70 feet/year and the median change in measured groundwater levels was -2.20 feet/year between 2015 and 2020.

Stable groundwater levels (no loss of groundwater storage) are observed in the wells shown as blue dots in Figure 5-4. This condition occurs mostly in El Paso Subarea where there is very limited pumping; and in the southeast near Ridgecrest where pumping was reduced when IWVWD moved its production further to the west.

5.3.2 Thiessen Polygon Method

The Thiessen Polygon Method (Dunne and Leopold, 1978) was used to estimate annual groundwater storage change within the IWVGB based on observed spring water levels at 41 wells from WY 2016 through WY 2020. The wells were chosen based on their period of record and distributed location throughout the basin to form the Thiessen Polygons. This method provides a weighted average of changes in groundwater storage based on annual observed groundwater levels.

As stated above, access to wells was limited due to the COVID-19 pandemic and regional stay-at-home orders. Due to the limited access, depth to water (DTW) at 11 of the 41 wells used for the annual groundwater storage calculation were unable to be measured. DTW at five of the 11 wells were able to be estimated from a hydrograph based on Fall 2020 DTW measurements. The remaining six of 11 wells did not have Fall 2020 groundwater level measurements to estimate DTW levels from a hydrograph. To remedy this DTW change was taken from an alternate well in each polygon. Table 5-1 shows the alternate wells and DTW change used in the WY 2020 groundwater storage calculation.

Table 5-1: DTW Change in Alternate Wells for WY 2020 Groundwater Storage Change, Thiessen Polygon Method

Thiessen Polygon ID	Basin Area	Original Well	Alternate Well	Spring 2019 DTW (ft)	Spring 2020 DTW (ft)	2019 to 2020 Change in DTW (ft)
TP-5	NW	25S/38E-14Q01	25S/38E-14A	229.37	231.71	-2.34
TP-8	NW	26S/38E-02R01	MS Well[1]	171.83	172.29	-0.46
TP-10	NW	26S/39E-20C02	SZ Well[1]	225.99	226.59	-0.60
TP-11	SW	26S/38E-22B	West Well[1]	365.17	363.94	1.23
TP-36	SE	26S/39E-34C01	GH Well[1]	308.68	309.40	-0.72
TP-38	SE	27S/40E-06F01	Well #2[1]	218.84	218.00	0.84

1 Well with WellIntel sonic water level meters installed and sending data using Wi-Fi. Locations shown of Figure 5-5.

Figure 5-5 displays the Thiessen polygons formed by the 41 wells. Each polygon was developed using geographical information system (GIS) to calculate perpendicular bisectors[3] and areas. The 41 polygons are summarized in Attachment F and represent a total of 304,726 acres. These polygons range in size from 2,662 acres (polygon TP-34) near Ridgecrest where there are many wells to 36,916 acres (polygon TP-22) in the northeast region of the IWVGB where there are few wells.

The change in groundwater storage for each polygon was calculated from the change in groundwater levels and the aquifer's specific yield (Sy) using the following equation:

Change of Groundwater in Storage (ft^3) = [area (ft^2)] x [Sy (unitless)] x [change in DTW (ft)]

Where: area acreage of polygon (1 acre = 43,560 square feet)
Sy from calibrated groundwater model (GSP, Appendix 3-H)[4]
DTW from KCWA/Navy Groundwater Monitoring Program

Attachment F tabulates the data used to calculate storage change at each of the 41 polygons for five years: WY 2016 through WY 2020. Table 5-2 summarizes these results for the IWV main groundwater basin and

[3] The edges of the polygons are equidistant to two measuring points. Each edge is setup by (1) drawing a line connecting two adjacent points; (2) locating the bisector, and then (3) constructing a second line perpendicular to the first intersecting at the bisector. This second line is the edge of the Thiessen-weighted average polygon. This is done between all points in the basin until the entire two-dimensional plane within the specified boundaries is subdivided into multiple polygons.
[4] Stetson Engineers Inc, 2020a.

the El Paso subarea. Based on measured groundwater levels, the Thiessen polygon method estimates an annual decrease in groundwater storage within the IWV main basin for WY 2016 through WY 2020. Figure 5-6 provides a plot of the estimated groundwater storage change from WY 2015 to WY 2020 along with the recent estimated groundwater pumping. See Chapter 6.1 for the discussion of groundwater pumping. This method estimates an overall increase in groundwater storage in the El Paso subarea where there is very limited domestic pumping (and limited groundwater level data).

The largest calculated groundwater storage change in WY 2020 occurred in the northwest (-11,155 acre-feet) with monitoring wells recording about one-foot declines from spring 2019 to spring 2020. Storage change in the southeast showed an increase of 3,689 acre-feet with groundwater levels averaging a 0.3-foot rise.

Table 5-2: WY 2016 to WY 20120 Estimated Groundwater Storage Change, Thiessen Polygon Method

	Thiessen Area (acres)	**WY 2016** (AF)	**WY 2017** (AF)	**WY 2018** (AF)	**WY 2019** (AF)	**WY 2020** (AF)	**5-Year Cumulative Change** (AF)
Northwest	45,359	774	-7,309	-4,951	-8,732	-11,155	-31,373
Southwest	26,549	-601	-2,530	-1,124	2,516	-93	-1,833
Southeast	37,365	-1,448	-1,220	-3,176	-2,221	3,689	-4,375
Navy	128,815	-2,041	5,132	-10,131	-2,021	-10,715	-19,777
IWV Main Basin	238,088	-3,316	-5,927	-19,382	-10,459	-18,274	-57,358
El Paso Subarea	66,638	4,702	4,432	-2,554	10,326	1,767	18,673
Total	304,726	1,387	-1,495	-21,936	-133	-16,508	-38,685
Hydrologic Condition		*BN*	*AN*	*BN*	*W*	*AN*	

The largest single-well groundwater level drop used for the Thiessen polygons occurred at well 25S/39E-28P01 (-10.8 feet) in the west-central part of the Navy base. Groundwater levels in this well rose 4.4 feet between October 2014 and November 2016, remained higher through spring 2019, and dropped in fall 2019. The cumulative change in storage near this well is estimated to be -3,998 acre-feet over the recent five years (Attachment F). Groundwater levels in this area may be responding to seismic activity more than pumping within the basin.

Chapter 6 Water Supply Data

6.1 Groundwater Extraction Data

Groundwater from the IWVGB is the sole source of potable water in the Indian Wells Valley. Groundwater is produced from approximately 930 wells. Figure 6-1 provides the location of the production wells in the IWVGB[5]. Since 2018, the IWVGA has been actively engaged in efforts to determine annual groundwater production in the IWVGB.

For the purpose of developing the numerical flow model, historical groundwater extractions were evaluated for establishing future baseline pumping conditions. The most recent available pumping data were compiled from known and cooperative individual groundwater producers. Through stakeholder outreach efforts, major pumpers provided estimates to use for future conditions that reflected their projected water demands. Prior studies were used to estimate pumping for groundwater producers where little data were available nor provided by stakeholder outreach. Through these efforts to establish baseline groundwater conditions in the IWVGB, an estimate of groundwater extractions to be modeled in WY 2019 was determined. These groundwater production volumes are provided in Table 6-1. The Baseline (No Action) estimate of total groundwater extractions was greater than actual groundwater produced (and reported) in the IWVGB during WY 2020.

In mid-2018, the IWVGA began a well registration and well reporting effort for the purpose of collecting volumetric pumping fees. Non-*de minimis* users, other than federal entities, are required to register their groundwater production wells and report monthly groundwater production as of September 2018 (note: pumping fees also do not apply to federal entities). Currently, there are some non-compliant groundwater producers in the IWVGB. The methods that groundwater producers use to report their production include the following:

- Water meters
- Electrical meters
- Estimates based on land use
- Estimates based on population served by groundwater production well

[5] There is insufficient data by well to display the volume of each production well on Figure 6-1; however, the figure shows the location of wells by well use category.

These groundwater production data that were reported to the IWVGA during WY 2020 for the purposes of the volumetric pumping fee are provided in Table 6-1. This estimate of total groundwater extractions is less than actual groundwater produced in the IWVGB during WY 2020 due to inaccuracies of self-reporting, non-compliant groundwater producers, and groundwater producers present in the IWVGB that are not subject to reporting.

Additionally, in early 2020, the IWVGA requested historical pumping records from all non-*de minimis* pumpers (excluding federal entities) for the purpose of allocating the sustainable yield of the IWVGB. As with the required reported production for the pump fee, not all groundwater pumpers fully complied with the request. This self-reported data from groundwater pumpers was used to estimate the total IWVGB production during WY 2020.

In March 2020, the IWVGA adopted an Ordinance 01-20 requiring the installation and testing of IWVGA-approved flow and hour metering equipment on all non-de minimis and non-federal wells in the Basin. This ordinance was adopted to ensure accurate measurement, reporting, and monitoring of groundwater extractions from the Basin.

As discussed in Chapter 3.1.1, the IWVGA has developed a Transient Pool program in WY 2020 to facilitate transitional reduced agricultural pumping to an interim acceptable level of basin overdraft until augmented supplies are available. Self-reported groundwater production data from these qualified groundwater pumpers have been used to estimate the total IWVGB production during WY 2020.

The best engineering estimate of WY 2020 pumping is derived from the combination of all pumping records and sources available to the IWVGA and is presented in the final column in Table 6-1, below. Attachment G provides a more detailed breakdown of pumping categories and the data source for each value. Data collection efforts in WY 2020 have improved as compared to WY 2019 and provide a more accurate estimate of total pumping in the IWVGB. The IWVGA is continually working to improve its estimate of groundwater production in the IWVGB because these data are critical components of the water budget and essential for managing sustainability.

Table 6-1: IWVGB Groundwater Production Estimates

Water Use Sector	Estimated No Action Projections (AF)	WY 2020 Reported Pumping (incomplete) [3]	WY 2020 Total Estimated Pumping (AF) [6]
Urban	6,940	6,510	6,510
Industrial	2,910	2,820	2,820
Agriculture	21,630[2]	9,470	9,850
Other – Federal [1]	2,040	-- [4]	1,410
Other – Domestic/ Mutuals/Co-Ops	1,380	550 [5]	1,410
TOTAL	**34,900**	(incomplete)	**22,000**

1 Federal groundwater use is for NAWS China Lake. Estimates were provided by the U.S. Navy.

2 This value likely overestimates actual agricultural groundwater production in WY 2020 because some agriculture groundwater producers self-reported future planned water demands.

3 These values underestimate actual groundwater production in WY 2020 because not all non-de minimis groundwater producers submit data regularly to the IWVGA and because some groundwater producers were not required to report their groundwater production during WY 2020.

4 Federal entities are not required to report monthly production to the IWVGA for the purpose of the fee.

5 De minimis users (those that produce less than 2 acre-feet per year (AFY) or those that have four or fewer connections) are not required to report monthly production to the IWVGA for the purpose of the fee.

6 See Attachment G for a more detailed table.

6.2 Surface Water Supply

Natural surface waters are not used as a drinking water supply source in the IWVGB. Approximately 2,450 acre-feet of recycled water was produced at the City of Ridgecrest's wastewater treatment plant during WY 2020 and was used for the following:

- Landscape irrigation
- Agricultural irrigation
- Partial maintenance of the Mojave Tui Chub habitat
- Discharge to evaporation/percolation ponds

Table 6-2 below provides the estimated breakdown of beneficial recycled water use in WY 2019.

Table 6-2: WY 2020 Recycled Water Use.

Recycled Water Use Sector	WY 2020 Estimated Use[1] (AF)
Urban[2]	480
Agriculture[3]	110
Other[4]	740
TOTAL	**1,330**

1 Data provided in email by the City of Ridgecrest to Joseph Montoya on February 16, 2021.
2 Used for irrigation of golf course on NAWS China Lake.
3 Used for irrigation of alfalfa fields for beneficial re-use.
4 Recycled water not used for urban and agricultural irrigation is disposed of in evaporation/percolation ponds. Approximately 1,860 AF was discharged to the ponds in WY 2020. It is estimated approximately 60 percent of the recycled water discharged to the ponds evaporates, with the remaining percolating to the groundwater (Provost and Pritchard Consulting Group, 2015). In addition, these ponds partially support the Mojave Tui Chub habitat on NAWS China Lake.

6.3 Total Water Use

Total water use in the IWVGB during WY 2020 is comprised of groundwater supplies and recycled water supplies. See Chapters 6.1 and 6.2 above for additional detail on these supplies.

Table 6-3: WY 2020 Estimated Total Water Use in the IWVGB.

Use Category	WY 2020 Estimated Total Water Use (AF)
Groundwater Production	22,000
Recycled Water	1,330
TOTAL	**23,330**

Chapter 7 Other Data Collection

In WY 2020, the IWVGA has continued its data collection efforts to improve Basin understanding and monitor groundwater sustainability. DWR Proposition 1 funding was used to complete specific data collection tasks. Each of these tasks were summarized in technical memoranda or reports and submitted to DWR. Technical memoranda and reports are also posted on the IWV DMS website www.iwvgsp.com. Summaries of these tasks are provided below.

- Water quality sampling was completed at 14 wells, 5 streams and 3 springs within the IWVGB during fall 2019. The purpose of this sampling was to provide baseline water quality data, augment data in the existing water quality database, and address some data gaps for sustainable management of the IWV basin. Results from this sampling will be used to refine the existing IWV groundwater basin monitoring network (GSP § 354.34), validate the hydrogeologic conceptual model (HCM) (GSP § 354.14), and update the numerical groundwater model (GSP § 354.16).

  DMS Technical Memorandum Reference:

  Stetson Engineers Inc, 2020b. *Indian Wells Valley Groundwater Authority;* Water Quality Sampling and Results Summary, Proposition 1 Funding Agreement Number 4600012716 SGWP Grant.

- Isotope sampling was completed at 7 wells and 3 streams within the IWVGB during fall 2019. The purpose of this sampling was to validate the hydrogeologic conceptual model (HCM) (GSP § 354.14), and determine sources of groundwater recharge, flow paths and ages of groundwater in the IWVGB. Groundwater throughout the valley is a result of both recent (3,000 to 6,000 years) and Pleistocene recharge (12,000 to 30,000 years). Groundwater samples indicate groundwater from the intermediate and deep groundwater groups demonstrate characteristics analogous with Pleistocene-aged recharge, while shallow groundwater shows signatures consistent with modern recharge from surrounding highlands. Pleistocene-aged groundwater has been shown to occur more frequently in the southeastern area of IWV.

  DMS Report Reference:

  Chapman & Thomas, 2020. *Desert Research Institute;* Isotopic Evaluation of Groundwater Recharge and Flow in Indian Wells Valley, Proposition 1 Funding Agreement Number 4600012716 SGWP Grant.

- Two precipitation stations (Walker Past East and Chimney Peak) were installed in the IWVGB to fill meteorological data gaps, refine the existing IWV groundwater basin monitoring network (GSP § 354.34), validate the hydrogeologic conceptual model (HCM) (GSP § 354.14), and provide data for future model updates (GSP § 354.16). Data collected from these stations is posted on the DMS website under the map view.

  DMS Technical Memorandum References:

  Stetson Engineers Inc, 2020. *Indian Wells Valley Groundwater Authority;* Walker Pass (East) Precipitation Stationing – Installation and Testing, Proposition 1 Funding Agreement Number 4600012716 SGWP Grant.

Stetson Engineers Inc, 2020. *Indian Wells Valley Groundwater Authority;* Chimney Peak Precipitation Engineers Stationing – Installation, Proposition 1 Funding Agreement Number 4600012716 SGWP Grant.

- Two existing stream gages (Sand and Grapevine Canyons) were retrofitted with transducer and transmitter assemblies. These hydrological data refine the existing IWV groundwater basin monitoring network (GSP § 354.34) and provide data for future model updates (GSP § 354.16). Data collected from these stations is posted on the DMS website under map interface.

  DMS Technical Memorandum Reference:

  Stetson Engineers Inc, 2020. *Indian Wells Valley Groundwater Authority;* Sand Canyon Stream Gaging Stationing – Installation and Testing, Proposition 1 Funding Agreement Number 4600012716 SGWP Grant.

  Stetson Engineers Inc, 2020. *Indian Wells Valley Groundwater Authority;* Grapevine Canyon Stream Gaging Stationing – Planning and Design, Proposition 1 Funding Agreement Number 4600012716 SGWP Grant.

- Aquifer testing was performed by Desert Research Institute (DRI). A constant rate pumping test was performed at IWVWD Well 10 during July 2020 with an average discharge rate of 1,109 gpm, followed by groundwater level recovery. Two aquifer tests were completed at the Quist Farms ag wells in November 2020: (1) 21-hour constant rate pumping test of 285gpm at well 26S/39E-35G01; and (2) 48-hour constant rate pumping test of 285 gpm at well 26S/39E-35G02. Both tests were followed by groundwater level recovery measurements for analysis.

  DMS Technical Memorandum Reference:

  Heintz, 2020. *Desert Research Institute;* Indian Wells Valley Multi-well Aquifer Test Analysis: IWVWD Well 10 and Quist Ranch 21-hour and 48-hour Tests, Ridgecrest, Ca, Proposition 1 Funding Agreement Number 4600012716 SGWP Grant.

- To facilitate the retrieval of groundwater level data for hosting on the DMS, Stetson implemented remote monitoring and telemetry equipment at 7 of the planned 11 key groundwater well locations. Data for those wells can be found on the DMS under either (1) map interface (telemetry sites) or (2) GSP dashboard. The remaining five wells are located on Navy property, awaiting permitting. A Technical Memorandum will be written once installation of equipment at all 11 wells is complete.
- In February 2020, Searles Valley Minerals performed in-kind services by providing staff and equipment to video log four GWMP monitoring wells [26S/40E-17Q01 (South Hanger), 26S/39E-11E01 (Sandquist Spa), 26S/39E-05L01, and 26S/39E-05K01] on NAWS China Lake. Wells were video logged using Aries Industries BT9600 and WC1750 water well inspection cameras provided by SVM.

Chapter 8 References

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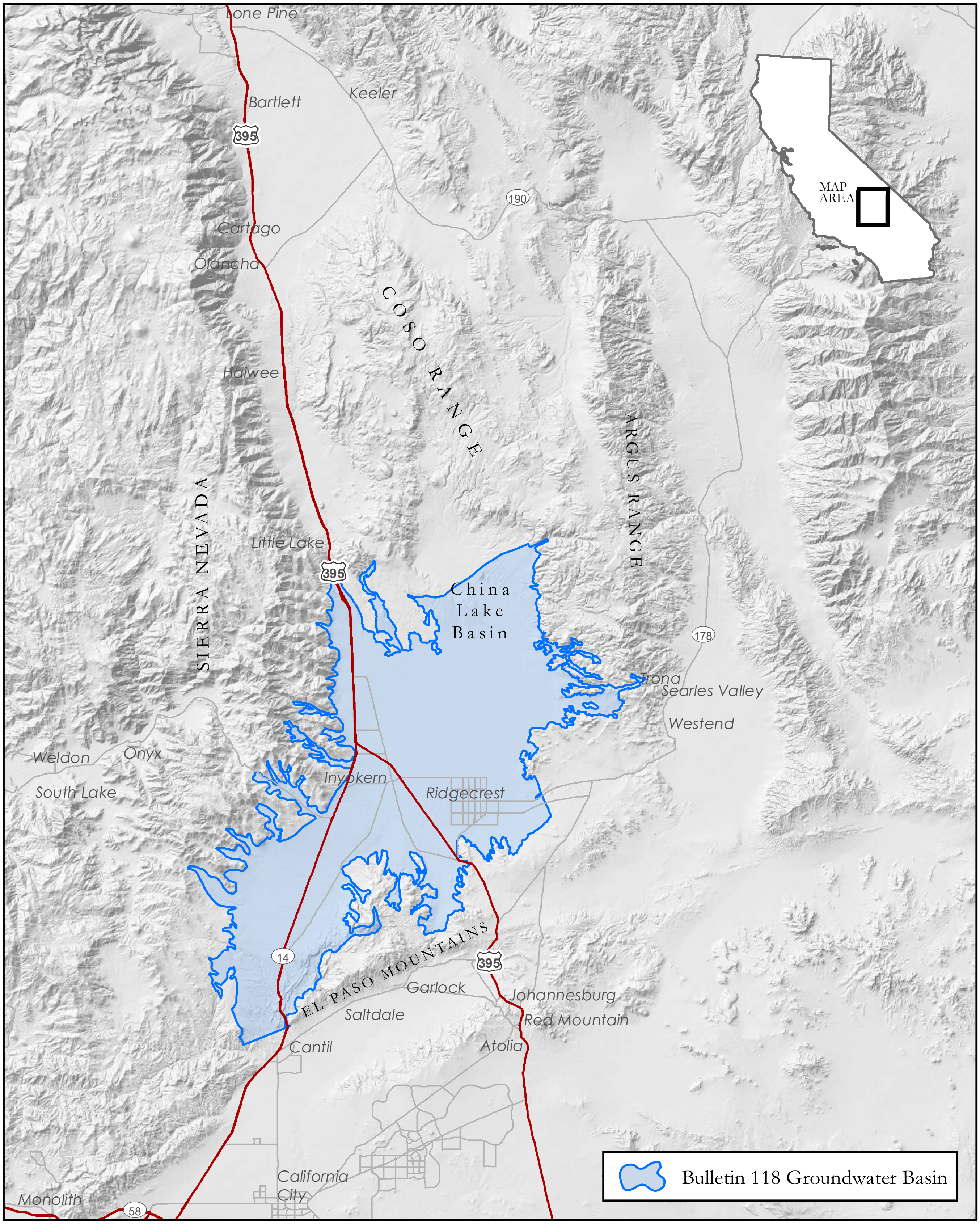

STETSON ENGINEERS INC.

INDIAN WELLS VALLEY GROUNDWATER BASIN AND INDIAN WELLS VALLEY GROUNDWATER AUTHORITY BOUNDARIES

(DWR BULLETIN 118 BASIN NO. 6-054)

N

0 5 10 Miles

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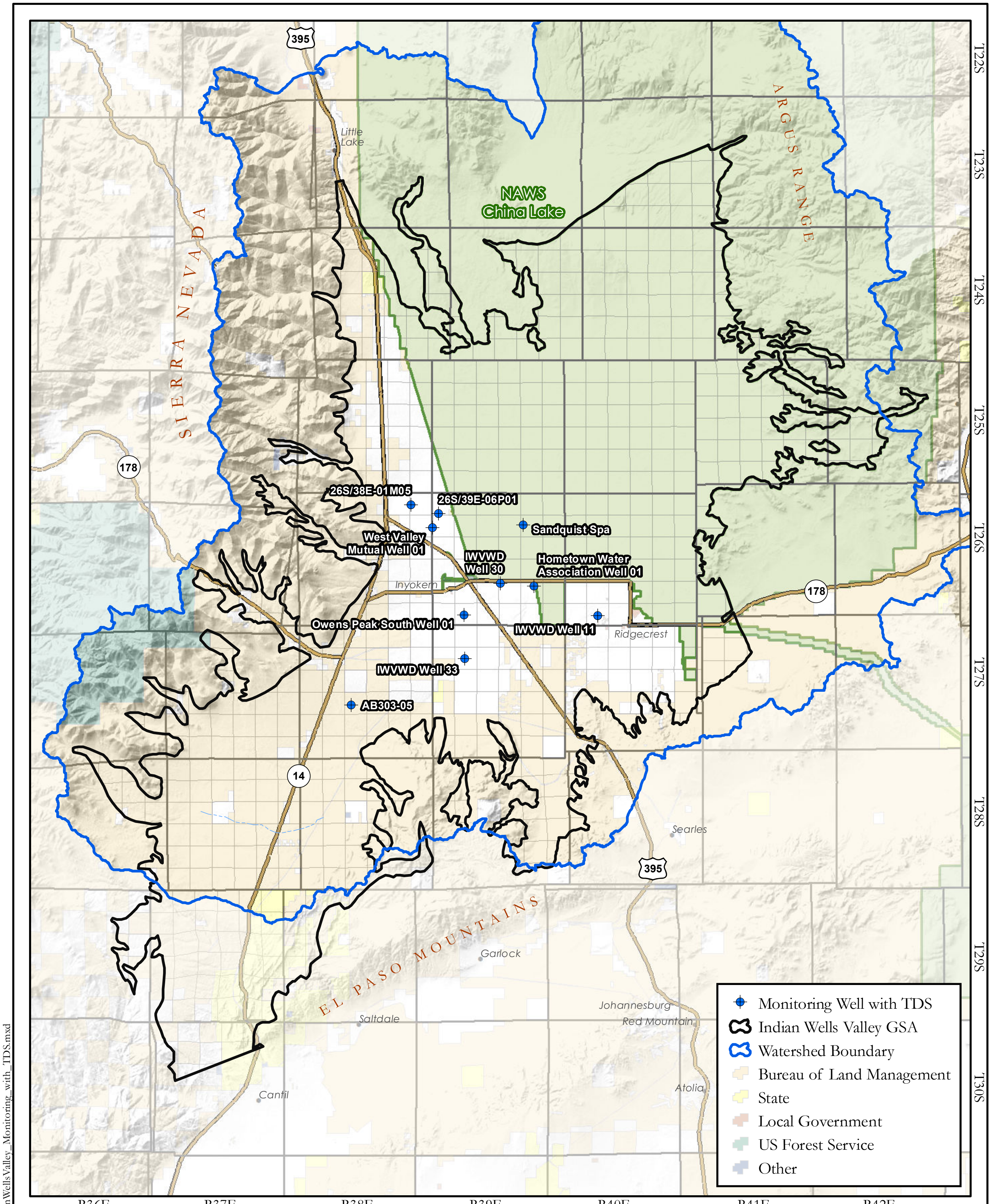
FIGURE 3-1



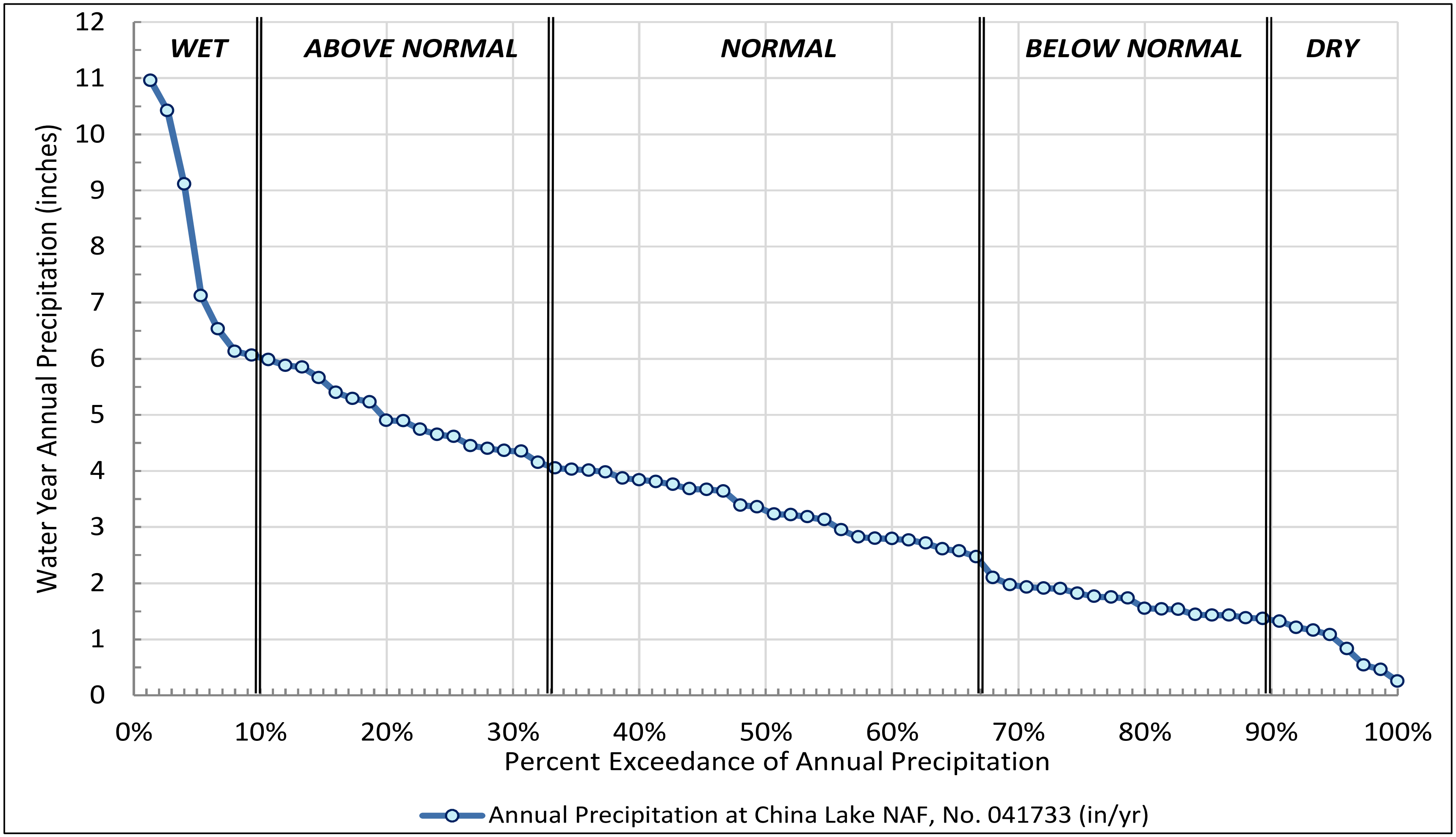
STETSON ENGINEERS INC.

MONITORING WELLS WITH TDS DATA IN ATTACHMENT A
INDIAN WELLS VALLEY
DRAFT 3/30/2021

0 3 6 Miles

N

Document Path: I:\in2652\IndianWellsValley_Monitoring_with_TDS.mxd

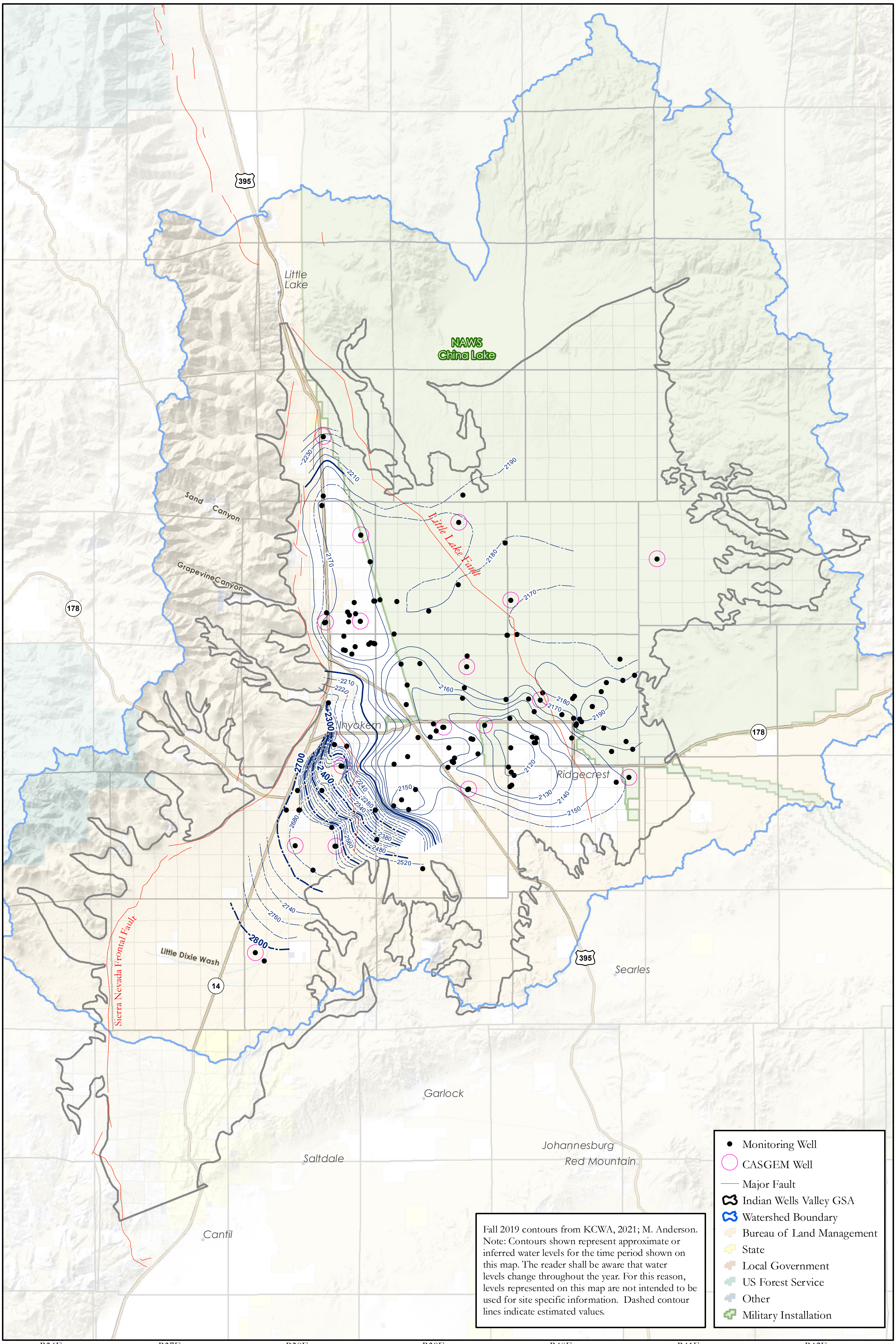


STETSON
ENGINEERS INC.

PERCENT EXCEEDANCE OF ANNUAL PRECIPITATION AT INDEX STATION CHINA LAKE NAF
WATER YEAR 1945 - 2020

FIGURE 4-1

Document Path: J:\jn2652\IndianWellsValley_GWContour_Fall2019.mxd



STETSON ENGINEERS INC.

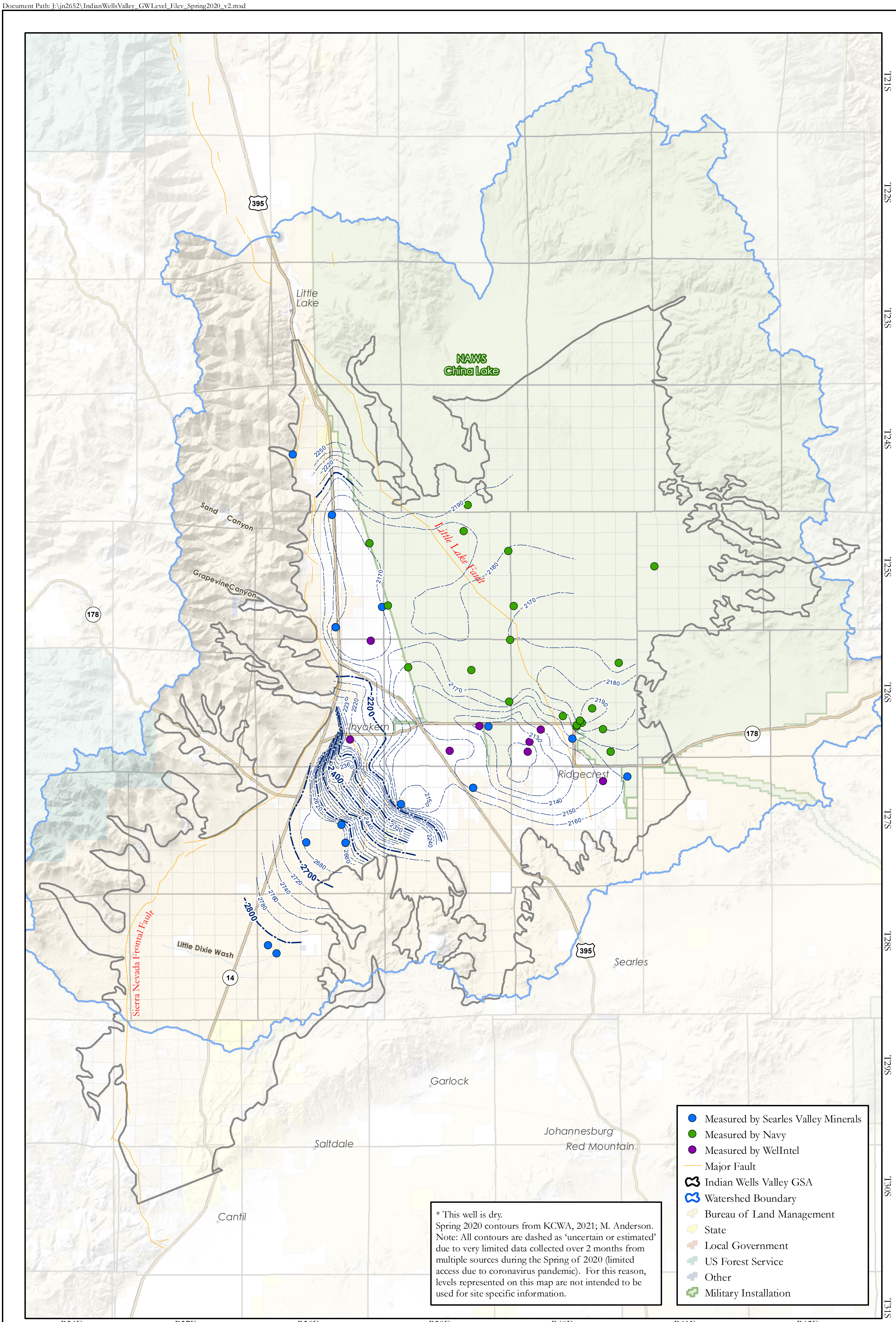
FALL 2019
GROUNDWATER ELEVATION CONTOURS
INDIAN WELLS VALLEY
DRAFT 3/9/2021

0 2 4 Miles

N

FIGURE 5-1

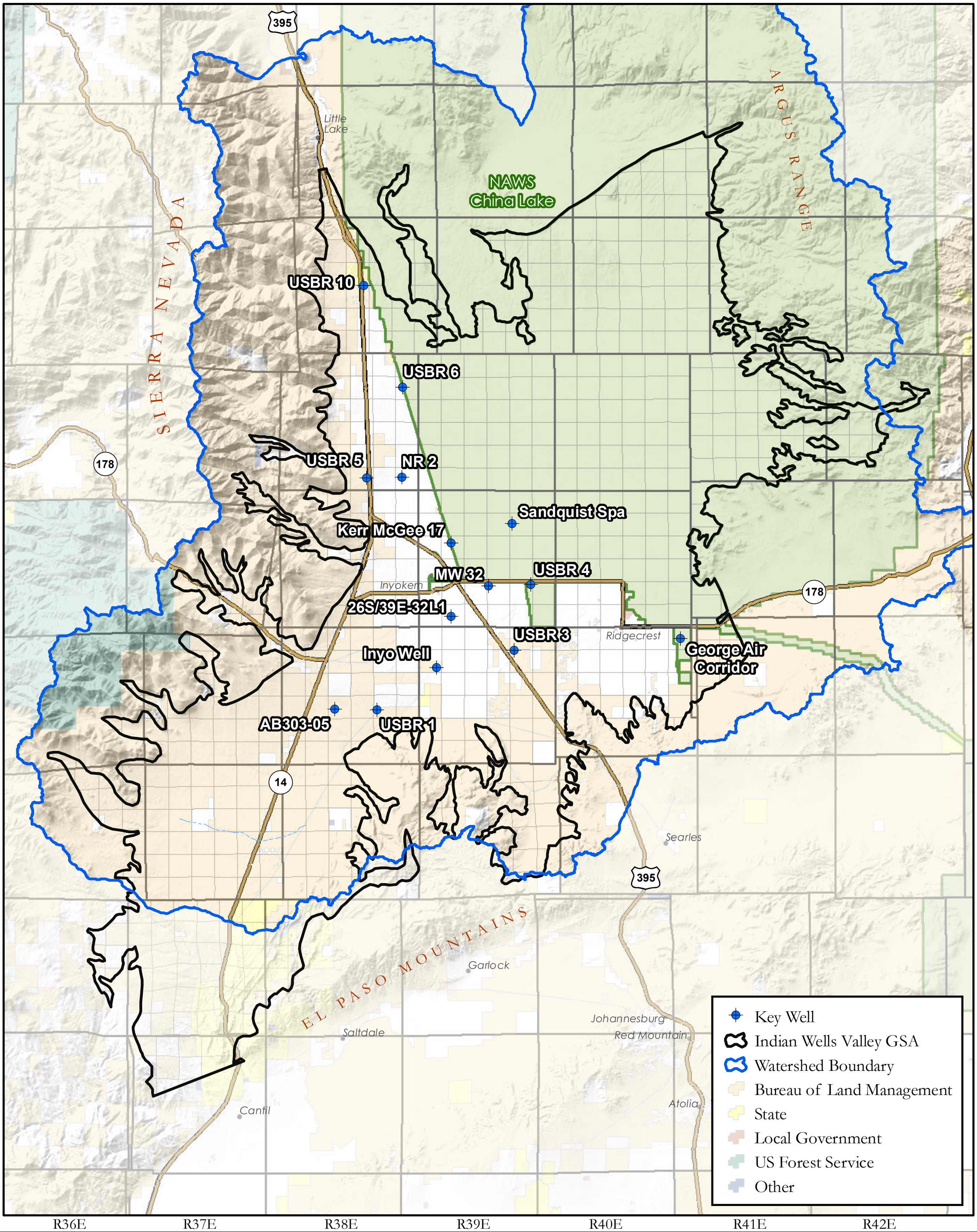
Document Path: J:\jn2652\IndianWellsValley_GWLevel_Elev_Spring2020_v2.mxd



STETSON ENGINEERS INC.

ESTIMATED SPRING 2020
GROUNDWATER ELEVATION CONTOURS
INDIAN WELLS VALLEY
DRAFT 3/23/2021

FIGURE 5-2



STETSON ENGINEERS INC.

MONITORING WELLS WITH HYDROGRAPHS IN ATTACHMENT D
INDIAN WELLS VALLEY

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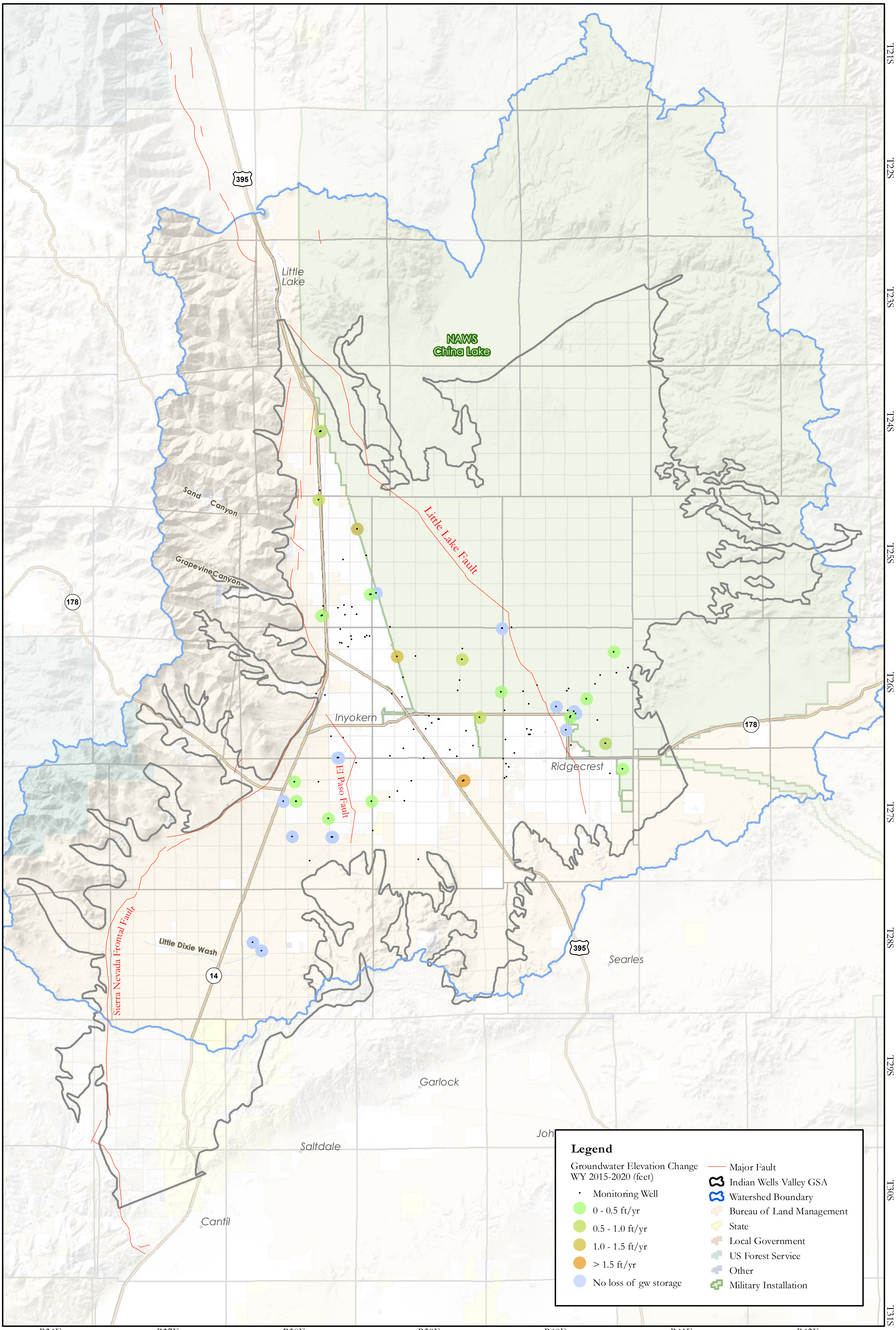

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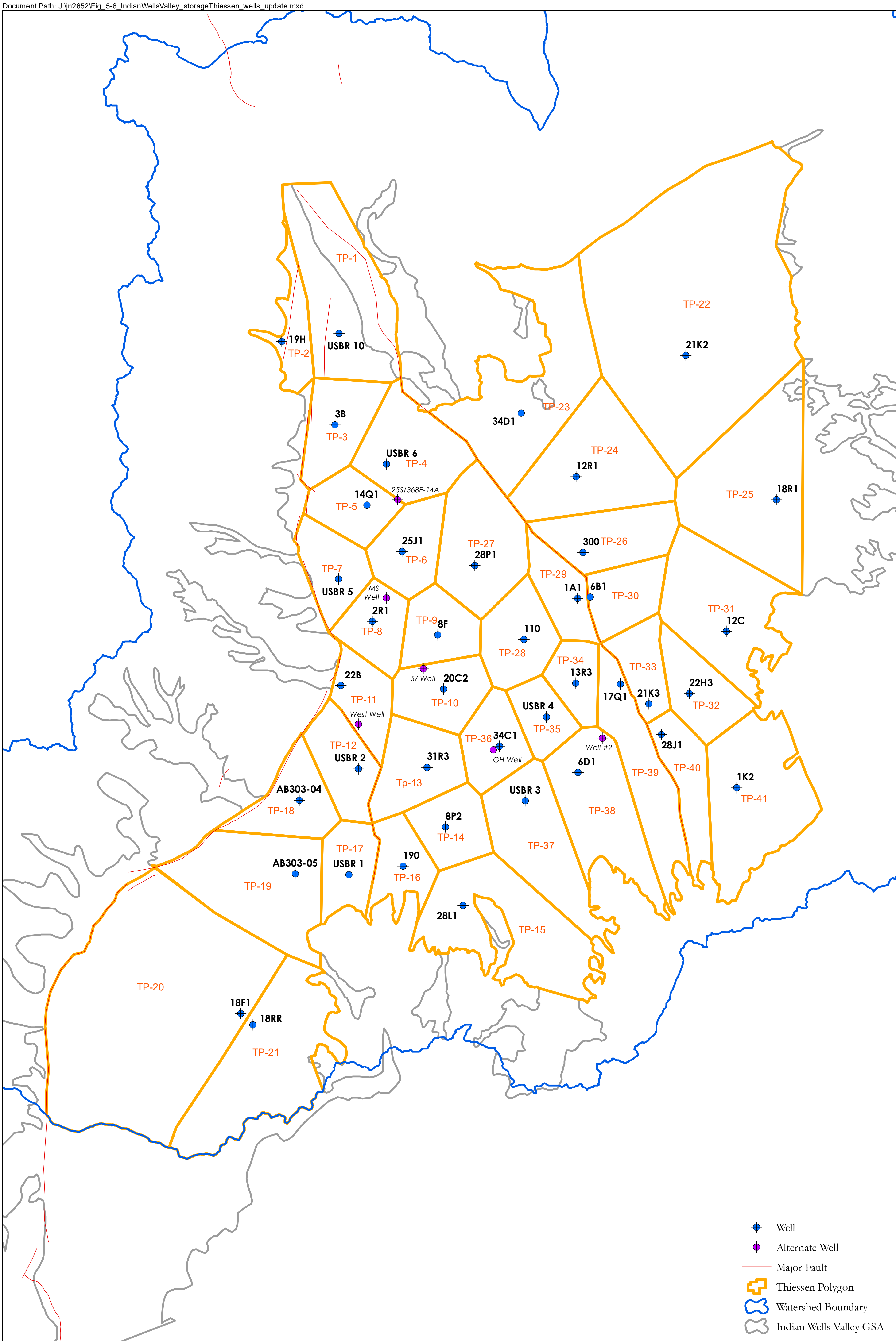
AVERAGE ANNUAL GROUNDWATER LEVEL CHANGE
WY 2015 to 2020
INDIAN WELLS VALLEY

0 2 4 Miles

N

FIGURE 5-4

Document Path: J:\jn2652\Fig_5-6_IndianWellsValley_storageThiessen_wells_update.mxd



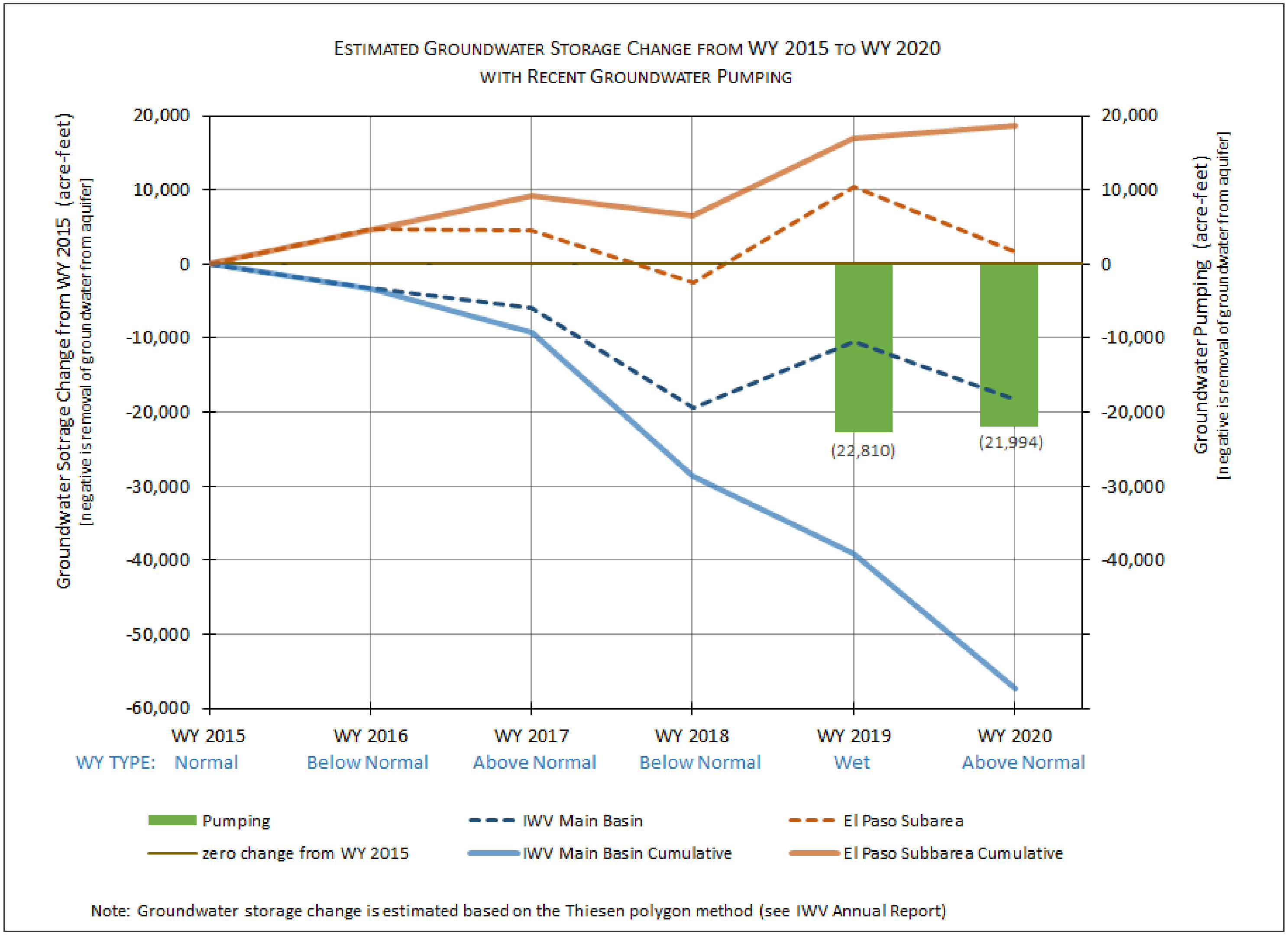
STETSON ENGINEERS INC.

THIESSEN POLYGONS
INDIAN WELLS VALLEY
DRAFT 2/25/2021

0 1.5 3 Miles

N

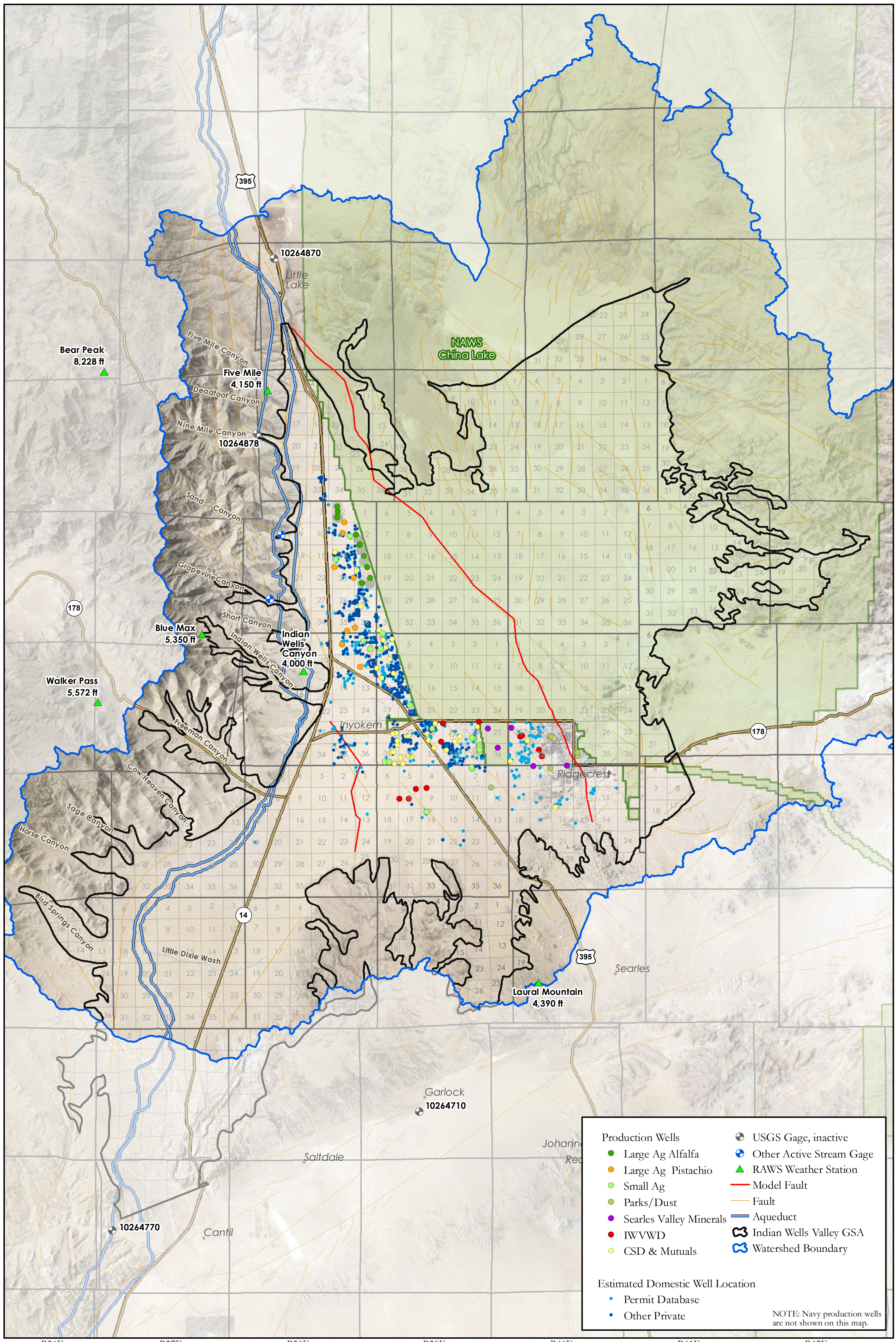
FIGURE 5-5



STETSON ENGINEERS INC.

ESTIMATED GROUNDWATER STORAGE CHANGE
WY 2016 TO 2020

FIGURE 5-6



STETSON ENGINEERS INC.

PUMPING WELL LOCATION MAP
INDIAN WELLS VALLEY

0 2 4 Miles

N

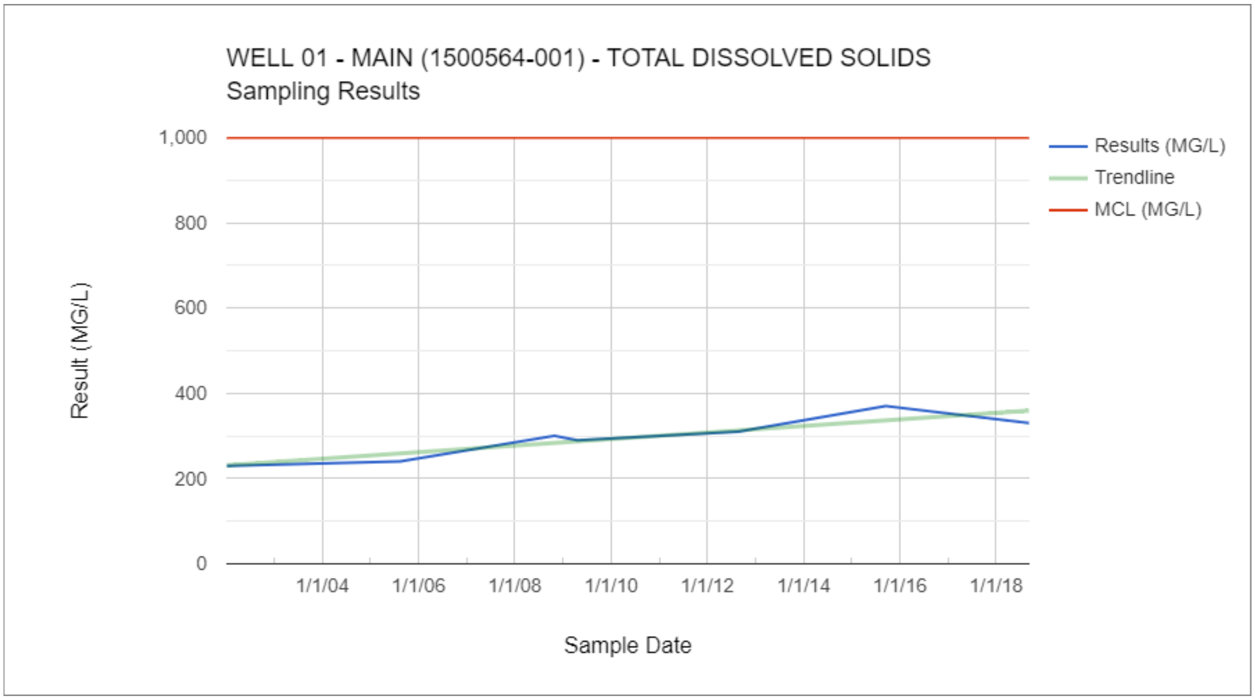
FIGURE 6-1

Attachment A

Total Dissolved Solids Concentrations for Select Monitoring Wells

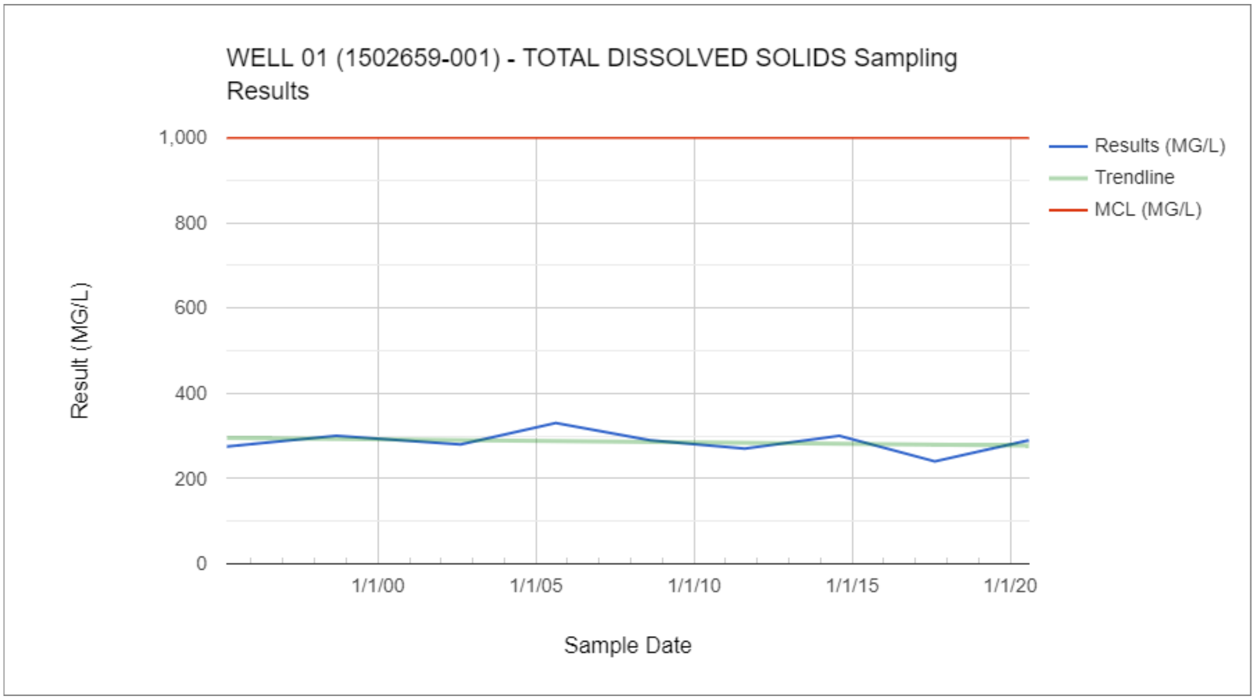
Total Dissolved Solids (TDS) Concentrations

Hometown Water Association Well 01 (26S/39E-26B1)



Source: Safe Drinking Water Information System.

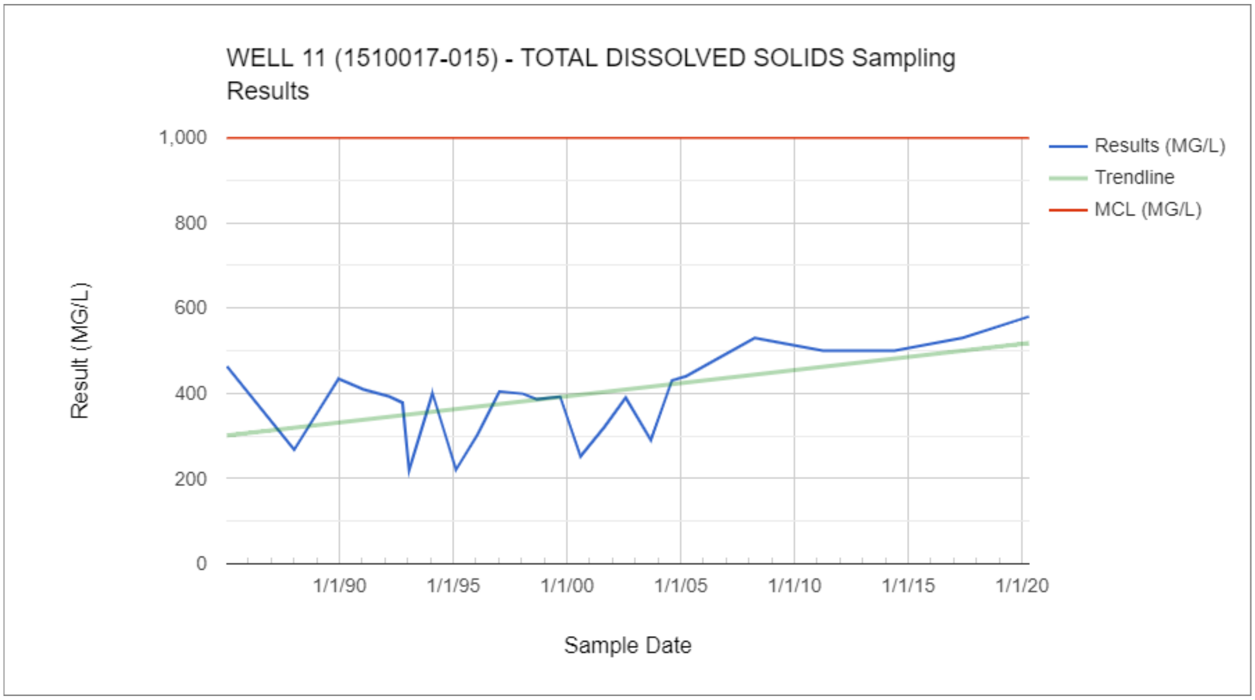
Owens Peak South Well 01 (26S/39E-32L01)



Source: Safe Drinking Water Information System.

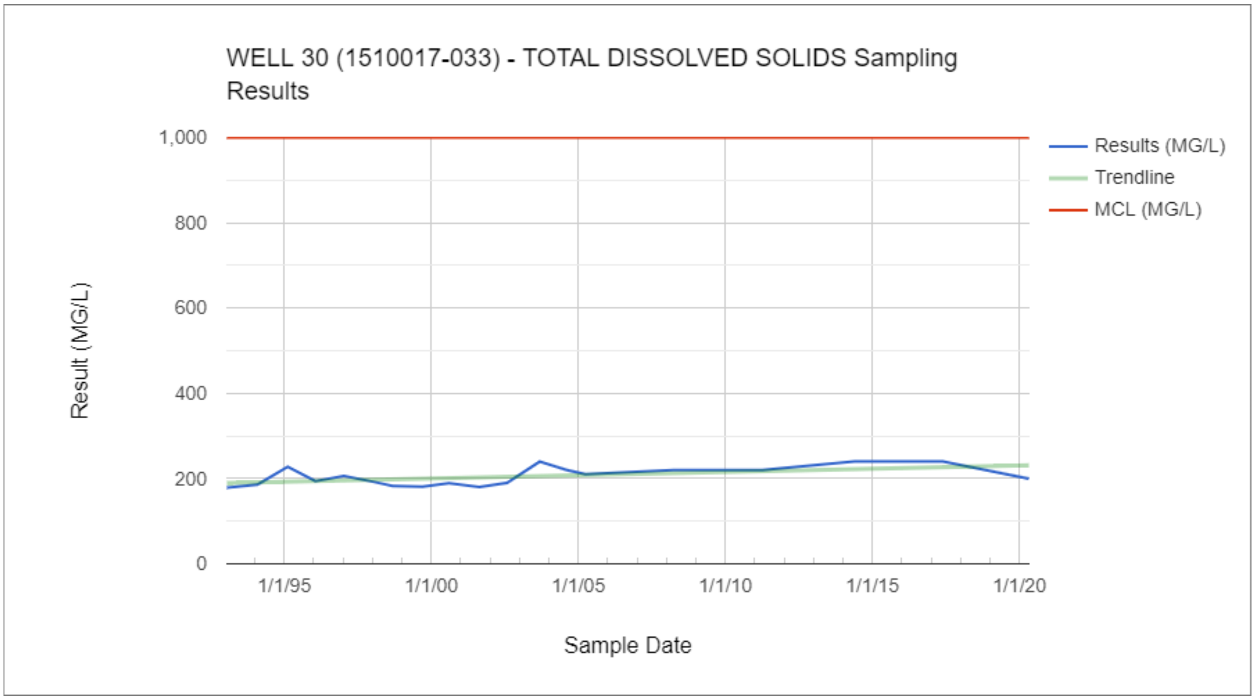
Total Dissolved Solids (TDS) Concentrations

Indian Wells Valley Water District Well 11 (26S/40E-32K01)



Source: Safe Drinking Water Information System.

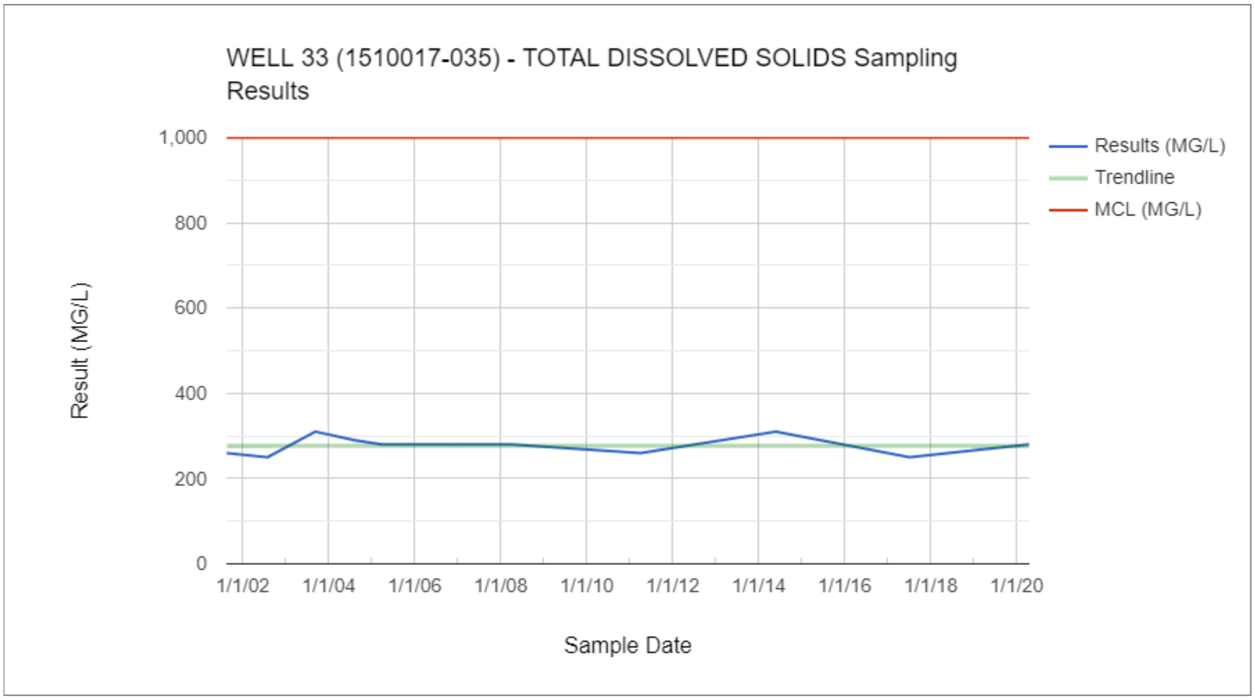
Indian Wells Valley Water District Well 30 (26S/39E-27D01)



Source: Safe Drinking Water Information System.

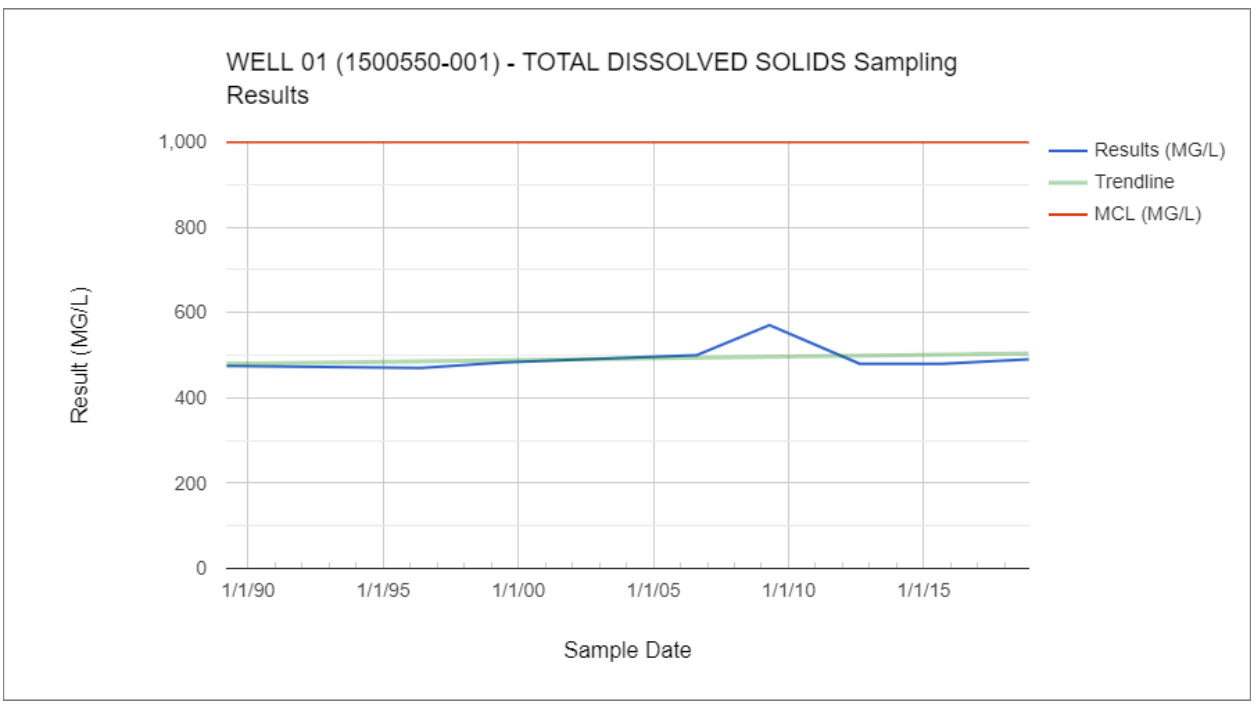
Total Dissolved Solids (TDS) Concentrations

Indian Wells Valley Water District Well 33 (27S/39E-08L01)



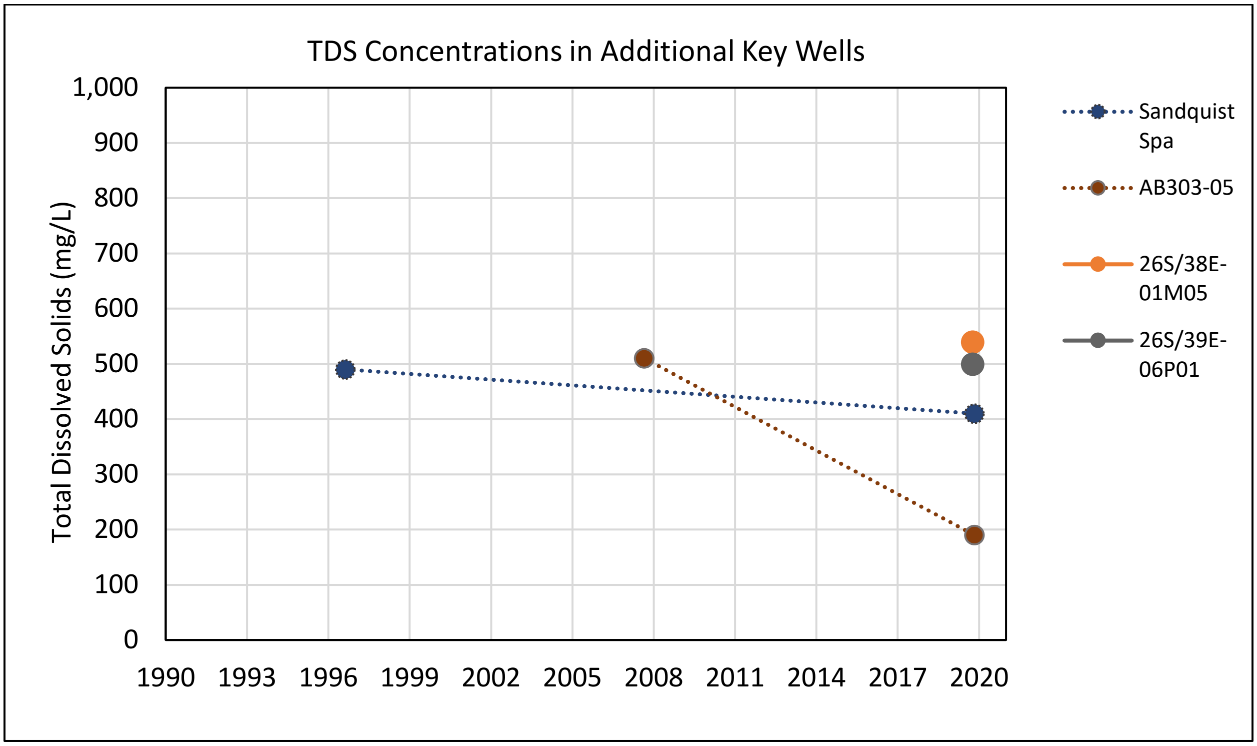
Source: Safe Drinking Water Information System.

West Valley Mutual Well 01 (26S/39E-07M1)



Source: Safe Drinking Water Information System.

Total Dissolved Solids (TDS) Concentrations



Attachment B

Historical Water Year Type

Based on Precipitation at China Lake NAF Station (No. 041733)

Historical Water Year Types

Based on Precipitation at China Lake NAF Station (No. 041733)

Water Year	Annual Precipitation (in/yr)	Water Year Type	Water Year	Annual Precipitation (in/yr)	Water Year Type
1945	4.90	AN	1985	2.79	N
1946	2.77	N	1986	4.15	AN
1947	3.81	N	1987	2.82	N
1948	1.97	BN	1988	5.4	AN
1949	1.21	D	1989	1.37	BN
1950	1.90	BN	1990	1.43	BN
1951	0.25	D	1991	3.84	N
1952	4.89	AN	1992	9.11	W
1953	1.75	BN	1993	7.12	W
1954	2.80	N	1994	1.08	D
1955	1.93	BN	1995	5.23	AN
1956	1.73	BN	1996	1.91	BN
1957	2.10	BN	1997	2.71	N
1958	4.45	AN	1998	6.06	W
1959	2.47	N	1999	1.53	BN
1960	3.13	N	2000	1.76	BN
1961	1.82	BN	2001	4.36	AN
1962	3.87	N	2002	0.54	D
1963	4.03	N	2003	4.35	AN
1964	1.54	BN	2004	3.22	N
1965	4.74	AN	2005	5.88	AN
1966	5.85	AN	2006	2.61	N
1967	2.57	N	2007	0.46	D
1968	4.65	AN	2008	3.18	N
1969	5.29	AN	2009	1.16	D
1970	3.68	N	2010	3.36	N
1971	2.95	N	2011	3.98	N
1972	1.55	BN	2012	1.32	D
1973	3.76	N	2013	0.83	D
1974	5.98	AN	2014	1.44	BN
1975	3.39	N	2015	3.67	N
1976	3.64	N	2016	1.38	BN
1977	4.01	N	2017	4.61	AN
1978	10.96	W	2018	1.43	BN
1979	6.53	W	2019	6.13	W
1980	5.66	AN	2020	5.57	AN
1981	3.23	N			
1982	4.40	AN			
1983	10.42	W			
1984	4.05	AN			

Note: *W = Wet; AN = Above Normal; N = Normal; BN = Below Normal; D = Dry*

Attachment C

Groundwater Level Data: Fall 2019 and Spring 2020

Grounwater Level Data

Fall 2019 & Spring 2020

						Fall 2019			Spring 2020			
State ID	DBID	CASGEM	Alternate Well Name	Latitude	Longitude	Date	DTW (ft, bgs)	GW Elev (ft, msL)	Date	DTW (ft, bgs)	GW Elev (ft, msL)	Change in DTW WY 2020
24S/38E-19H	247			35.83719	-117.90704				4/23/2020	7.92	2,963	-7.92
24S/38E-21A01	202	✔	USBR-10-S	35.84143	-117.87176	10/7/2019	318.18	2241.21	6/30/2020	319.57	2,240	-1.39
24S/38E-21A02	203	✔	USBR-10-SM	35.84134	-117.87258	10/7/2019	320.39	2,239	6/30/2020	319.50	2,240	0.89
24S/38E-21A04	205	✔	USBR-10-D	35.84134	-117.87258	10/7/2019	316.96	2,242	6/30/2020	318.37	2,241	-1.41
24S/39E-34D01	199			35.80213	-117.75901	10/7/2019	46.69	2,180	5/4/2020	46.90	2,180	-0.21
24S/40E-24K02	244			35.83168	-117.65779				5/4/2020	52.00		
25S/38E-03B	207			35.79546	-117.87382	10/7/2019	288.70	2,168	4/23/2020	289.50	2,167	-0.80
25S/38E-12L01	191	✔	USBR-06-S	35.77607	-117.84203	10/7/2019	184.22	2,169	5/4/2020	184.11	2,169	0.11
25S/38E-12L02	192	✔	USBR-06-M	35.77607	-117.84203	10/7/2019	188.30	2,165	5/4/2020	188.54	2,164	-0.24
25S/38E-12L03	193	✔	USBR-06-D	35.77607	-117.84203	10/7/2019	157.90	2,195	5/4/2020	162.92	2,190	-5.02
25S/38E-13J01	184			35.75829	-117.83480	10/7/2019	125.60	2,166				
25S/38E-14A	248			35.76809	-117.85244	10/7/2019	231.50	2,163	6/30/2020	231.71	2,162	-0.21
25S/38E-14Q01	183			35.75542	-117.85372	10/7/2019	225.70	2,165				
25S/38E-25J01	173			35.73218	-117.83175	10/7/2019	110.70	2,166	4/23/2020	112.70	2,164	-2.00
25S/38E-25J02	174			35.73208	-117.83087	10/7/2019	115.00	2,161				
25S/38E-25J03	175			35.73218	-117.83175	10/7/2019	116.80	2,159				
25S/38E-25M	208			35.73135	-117.84767	10/7/2019	205.80	2,167				
25S/38E-34A01	168			35.72453	-117.87024	10/5/2019	361.68	2,167				
25S/38E-34G01	157	✔	USBR-05-S	35.71813	-117.87090	10/7/2019	358.52	2,162	5/13/2020	358.25	2,162	0.27
25S/38E-34G02	158	✔	USBR-05-M	35.71801	-117.87175	10/7/2019	360.92	2,160	5/13/2020	364.45	2,156	-3.53
25S/38E-34G03	159	✔	USBR-05-D	35.71801	-117.87175	10/7/2019	360.87	2,160	5/13/2020	363.97	2,156	-3.10
25S/38E-35B01	169			35.72509	-117.85286	10/7/2019	236.24	2,160				
25S/38E-35C	165			35.72307	-117.85805	10/7/2019	262.40	2,161				
25S/38E-35H	160			35.71860	-117.85238	10/7/2019	187.10	2,170				
25S/38E-36D	166			35.72366	-117.84667	10/7/2019	182.20	2,162				
25S/38E-36G01	161	✔	NR 2-S	35.71868	-117.84271	10/7/2019	156.06	2,159				
25S/38E-36G02	162	✔	NR 2-M	35.71868	-117.84271	10/7/2019	161.77	2,153				
25S/38E-36G03	163	✔	NR 2-D	35.71868	-117.84271	10/7/2019	165.66	2,149				
25S/38E-36P	156			35.71076	-117.83996	10/7/2019	168.30	2,161				
25S/39E-03R01	195	✔	Baker Range	35.78412	-117.76257	10/7/2019	50.45	2,176	5/4/2020	50.70	2,176	-0.25
25S/39E-12R01	187			35.77039	-117.72496	10/7/2019	24.30	2,178	5/4/2020	24.45	2,178	-0.15
25S/39E-22J01	238			35.74300	-117.76290	10/7/2019	41.50	2,177				
25S/39E-28P01	171			35.72551	-117.78701	10/7/2019	52.81	2,176				
25S/39E-29M01	172			35.73190	-117.81286	10/7/2019	57.70	2,175				
25S/39E-30E01	176			35.73301	-117.82675	10/7/2019	52.13	2,196	5/4/2020	48.50	2,200	3.63
25S/39E-31R01	155			35.71051	-117.81536	10/7/2019	89.92	2,172				
25S/40E-30E01	210	✔	TTBKMW14	35.73254	-117.72033	10/7/2019	14.20	2,177	5/4/2020	14.39	2,177	-0.19
25S/40E-31P	154			35.70996	-117.71563	10/7/2019	19.52	2,172				
25S/41E-18R01	211	✔	TTBKMW12	35.75969	-117.60148	10/7/2019	21.52	1,982	5/4/2020	21.49	1,982	0.03
26S/38E-01E03	212			35.70417	-117.84716	10/7/2019	206.30	2,167				
26S/38E-01G02	147			35.70363	-117.83580	10/7/2019	180.30	2,158				
26S/38E-01H05	215			35.70406	-117.83200	10/7/2019	163.35	2,156				
26S/38E-01H06	216			35.70453	-117.83447	10/7/2019	172.90	2,146				
26S/38E-01M05	146			35.70215	-117.84707	10/7/2019	213.70	2,160				
26S/38E-02B01	151			35.70886	-117.85615	10/7/2019	212.90	2,160				
26S/38E-02Q01	145			35.70000	-117.85645	10/7/2019	251.40	2,158				

Grounwater Level Data

Fall 2019 & Spring 2020

						Fall 2019			Spring 2020			
State ID	DBID	CASGEM	Alternate Well Name	Latitude	Longitude	Date	DTW (ft, bgs)	GW Elev (ft, msL)	Date	DTW (ft, bgs)	GW Elev (ft, msL)	Change in DTW WY 2020
26S/38E-02Q02	144			35.69941	-117.85503	10/7/2019	248.90	2,161				
26S/38E-02R01	141			35.69703	-117.84962	10/7/2019	238.90	2,159				
26S/38E-22B	218			35.66466	-117.86875	10/7/2019	427.30	2,239				
26S/38E-22D	114			35.66566	-117.87597	10/7/2019	59.20	2,789				
26S/38E-35B	219			35.63608	-117.85408	10/7/2019	343.00	2,232				
26S/38E-35D	220			35.63714	-117.86398	10/7/2019	448.30	2,237				
26S/39E-01A01	152			35.70940	-117.72341	10/7/2019	44.42	2,173	5/4/2020	43.95	2,174	0.47
26S/39E-01A02	153			35.70940	-117.72313	10/7/2019	40.44	2,177				
26S/39E-02N01	139			35.69579	-117.75591	10/7/2019	113.24	2,173				
26S/39E-06P01	140			35.69639	-117.82502	10/7/2019	162.60	2,157				
26S/39E-08F	136			35.69051	-117.80952	10/7/2019	164.77	2,155	5/4/2020	165.50	2,154	-0.73
26S/39E-09E	137			35.69079	-117.79452	10/7/2019	164.06	2,148				
26S/39E-11E01	134	✔	Sandquist Spa	35.68857	-117.75647	10/7/2019	134.61	2,173	5/4/2020	135.60	2,172	-0.99
26S/39E-13R03	115			35.66663	-117.72424	10/7/2019	151.36	2,168	5/4/2020	151.90	2,167	-0.54
26S/39E-13R04	116			35.66663	-117.72424	10/7/2019	196.73	2,123				
26S/39E-14E01	124			35.67440	-117.75841	10/7/2019	168.50	2,167				
26S/39E-15J	119			35.66774	-117.75980	10/7/2019	202.63	2,145				
26S/39E-17G02	126			35.67635	-117.80452	10/7/2019	202.68	2,154				
26S/39E-20C02	109			35.66337	-117.80541	10/7/2019	238.60	2,152				
26S/39E-20L	94			35.66560	-117.81374	10/7/2019	237.10	2,191				
26S/39E-26A03	88	✔	USBR-04-SM	35.64966	-117.74213	10/7/2019	247.25	2,130	4/30/2020	253.81	2,123	-6.56
26S/39E-26P01	75			35.64024	-117.75147	10/7/2019	264.40	2,139				
26S/39E-26P02	76			35.64052	-117.75313	10/7/2019	266.70	2,140				
26S/39E-27C01	223			35.64849	-117.76864	10/7/2019	268.90	2,146				
26S/39E-27D02	84	✔	MW-32-SM	35.64852	-117.77493	10/8/2019	293.66	2,125				
26S/39E-27D03	85	✔	MW-32-DM	35.64857	-117.77591	10/8/20119	281.86	2,137				
26S/39E-27D04	86	✔	MW-32-D	35.64857	-117.77591	10/8/2019	271.45	2,147				
26S/39E-28B03	90			35.65050	-117.78352	10/7/2019	251.30	2,175				
26S/39E-28G02	80			35.64601	-117.78135	10/7/2019	283.70	2,149				
26S/39E-28L02	78			35.64182	-117.78619	10/7/2019	301.00	2,148				
26S/39E-29J02	77			35.64181	-117.79611	10/7/2019	300.30	2,129				
26S/39E-31R03	59			35.62389	-117.81543	10/7/2019	260.50	2,240				
26S/39E-32L01	57			35.62902	-117.80461	10/7/2019	340.90	2,151				
26S/39E-34C01	224			35.63472	-117.77080	10/7/2019	298.80	2,152				
26S/39E-34K03	56			35.62791	-117.76635	10/8/2019	326.00	2,150				
26S/39E-34Q01	227			35.62502	-117.76733	10/8/2019	334.00	2,149				
26S/39E-34R02	51			35.62351	-117.76068	10/8/2019	319.50	2,131				
26S/40E-12C	138			35.69329	-117.63174	10/7/2019	6.00	2,160	5/4/2020	5.70	2,160	0.30
26S/40E-12R01	131			35.68246	-117.61980	10/7/2019	3.24	2,182				
26S/40E-13C02	129			35.67913	-117.62952	10/8/2019	9.93	2,178				
26S/40E-14B01	127			35.67774	-117.64285	10/8/2019	7.26	2,184				
26S/40E-14L01	122			35.67190	-117.64702	10/8/2019	19.69	2,186				
26S/40E-15N01	118			35.66718	-117.67035	10/8/2019	58.00	2,187				
26S/40E-15N02	120			35.66885	-117.66869	10/8/2019	51.01	2,185				
26S/40E-17J01	121			35.67107	-117.69480	10/8/2019	86.91	2,179				
26S/40E-17N01	117			35.66690	-117.70591	10/8/2019	142.29	2,153				

Grounwater Level Data

Fall 2019 & Spring 2020

State ID	DBID	CASGEM	Alternate Well Name	Latitude	Longitude	Fall 2019 Date	Fall 2019 DTW (ft, bgs)	Fall 2019 GW Elev (ft, msL)	Spring 2020 Date	Spring 2020 DTW (ft, bgs)	Spring 2020 GW Elev (ft, msL)	Change in DTW WY 2020
26S/40E-17Q01	241	✔	S. Hanger 5	35.66638	-117.69659	10/7/2019	141.94	2,133	5/4/2020	141.05	2,135	0.89
26S/40E-19N02	100			35.65413	-117.72147	10/8/2019	209.96	2,127				
26S/40E-20L01	104			35.65857	-117.70147	10/8/2019	145.68	2,151				
26S/40E-21K03	103			35.65663	-117.67924	10/8/2019	99.63	2,167	5/4/2020	100.00	2,167	-0.37
26S/40E-22H01	105			35.66190	-117.65424	10/8/2019	33.33	2,195				
26S/40E-22H02	106			35.66190	-117.65424	10/8/2019	33.33	2,195				
26S/40E-22H03	107			35.66190	-117.65424	10/8/2019	33.33	2,194	5/4/2020	33.27	2,194	0.06
26S/40E-22N01	101			35.65423	-117.66940	10/8/2019	91.64	2,173				
26S/40E-22P02	95			35.65191	-117.66313	10/8/2019	66.50	2,201	5/4/2020	66.20	22.01.02	0.30
26S/40E-22P03	97			35.65357	-117.66452	10/8/2019	110.60	2,148	5/4/2020	111.10	2,148	-0.50
26S/40E-22P04	98			35.65357	-117.66452	10/8/2019	54.10	2,205	5/4/2020	53.20	2,206	0.90
26S/40E-26F01	82			35.64746	-117.64508	10/8/2019	58.40	2,174				
26S/40E-27D01	92			35.65052	-117.66730	10/8/2019	71.40	2,197				
26S/40E-27D02	87			35.64941	-117.66785	10/8/2019	45.60	2,221	5/4/2020	45.20	2,222	0.40
26S/40E-28J01	229			35.64121	-117.67128	10/7/2019	133.30	2,158	4/30/2020	133.30	2,158	0.00
26S/40E-29M01	230			35.64186	-117.70314	10/8/2019	202.20	2,128				
26S/40E-29M02	231			35.64125	-117.69973	10/8/2019	198.80	2,126				
26S/40E-29N01	72			35.63792	-117.70175	10/8/2019	207.60	2,125				
26S/40E-29P01	73			35.63791	-117.70032	10/8/2019	199.70	2,131				
26S/40E-31K01	53			35.62580	-117.71330	10/8/2019	275.20	2,116				
26S/40E-35H01	63			35.63191	-117.63896	10/8/2019	89.70	2,163	5/4/2020	89.90	2,162	-0.20
26S/40E-35H02	64			35.63191	-117.63869	10/8/2019	93.00	2,159	5/4/2020	96.20	2,156	-3.20
26S/40E-35Q02	50			35.62274	-117.64257	10/8/2019	93.60	2,159				
27S/38E-02C01	46	✔	USBR-02-S	35.62280	-117.85761	10/7/2019	281.66	2,373	7/1/2020	281.92	2,373	-0.26
27S/38E-02C02	47	✔	USBR-02-M	35.62274	-117.85841	10/7/2019	270.72	2,384	7/1/2020	271.79	2,383	-1.07
27S/38E-02C03	48	✔	USBR-02-D	35.62274	-117.85841	10/7/2019	282.17	2,373	7/1/2020	280.62	2,374	1.55
27S/38E-08R01	19			35.59367	-117.90300	10/7/2019	504.70	2,699	7/1/2020	501.75	2,702	2.95
27S/38E-09C01	25		AB303-04	35.60665	-117.89378	10/7/2019	380.20	2,690	7/1/2020	381.32	2,689	-1.12
27S/38E-09P01	18			35.59363	-117.89246	10/7/2019	416.60	2,696	7/1/2020	418.27	2,694	-1.67
27S/38E-09Q02	17		AB303-02	35.59362	-117.89262	10/7/2019	419.30	2,686	7/1/2020	420.31	2,685	-1.01
27S/38E-10B02	24		AB303-03	35.60662	-117.87407	10/7/2019	425.20	2,470	4/30/2020	427.65	2,467	-2.45
27S/38E-13A01	16			35.59345	-117.83060	10/7/2019	224.95	2,429	7/1/2020	224.51	2,429	0.44
27S/38E-13A02	20		AB303-01	35.59369	-117.83070	10/7/2019	223.00	2,427	7/1/2020	223.16	2,427	-0.16
27S/38E-15R01	13		AB303-06	35.58195	-117.86617	10/7/2019	274.60	2,657	5/7/2020	274.00	2,658	0.60
27S/38E-21L01	11	✔	AB303-05	35.56985	-117.89592	10/7/2019	359.79	2,664	5/13/2020	357.92	2,668	1.87
27S/38E-23F01	7	✔	USBR-01-S	35.56959	-117.86289	10/7/2019	183.24	2,667	5/7/2020	182.75	2,668	0.49
27S/38E-23F02	8	✔	USBR-01-SM	35.56968	-117.86369	10/7/2019	180.32	2,670	5/7/2020	180.16	2,670	0.16
27S/38E-23F04	10	✔	USBR-01-D	35.56968	-117.86369				5/7/2020	182.21	2,668	
27S/38E-27M01	5			35.55387	-117.88132	10/7/2019	194.60	2,679				
27S/39E-02K	234			35.61218	-117.74813	10/8/2019	313.50	2,145				
27S/39E-07R01	22		Inyo	35.59634	-117.81589	10/7/2019	421.60	2,142	5/13/2020	Dry @ 425	-	
27S/39E-08A01	235			35.60721	-117.79818	10/7/2019	391.10	2,143				
27S/39E-08M02	23			35.60045	-117.80947	10/7/2019	411.10	2,142				
27S/39E-08P02	21			35.59393	-117.80371	10/7/2019	435.90	2,145				
27S/39E-11D01	26	✔	USBR-03-S	35.60731	-117.75485							
27S/39E-11D02	27	✔	USBR-03-M	35.60718	-117.75563							

Grounwater Level Data

Fall 2019 & Spring 2020

						Fall 2019			Spring 2020			
State ID	DBID	CASGEM	Alternate Well Name	Latitude	Longitude	Date	DTW (ft, bgs)	GW Elev (ft, msL)	Date	DTW (ft, bgs)	GW Elev (ft, msL)	Change in DTW WY 2020
27S/39E-11D03	28	✔	USBR-03-D	35.60718	-117.75563							
27S/39E-19E01	12			35.57400	-117.82969	10/7/2019	203.80	2,436				
27S/39E-28L01	6			35.55472	-117.79253	10/7/2019	289.10	2,531				
27S/40E-01K02	36	✔	George Air Corridor	35.61470	-117.62469	10/7/2019	161.50	2,161	5/7/2020	161.63	2,161	-0.13
27S/40E-02J01	240			35.61176	-117.63510	10/7/2019	145.10	2,160				
27S/40E-06D01	30			35.62198	-117.72253	10/7/2019	282.15	2,125				
27S/40E-06E01	40			35.61855	-117.72040	10/8/2019	314.90	2,118				
27S/40E-06F01	37			35.61629	-117.71810	10/8/2019	319.90	2,120				
27S/40E-06N02	31			35.60898	-117.72155	10/8/2019	350.00	2,124				
28S/38E-18F01	2	✔		35.49928	-117.92844	10/7/2019	211.12	2,816	5/13/2020	210.87	2,816	0.25
28S/38E-18R	1			35.49364	-117.92094	10/7/2019	197.40	2,820	5/7/2020	196.80	2,820	0.60

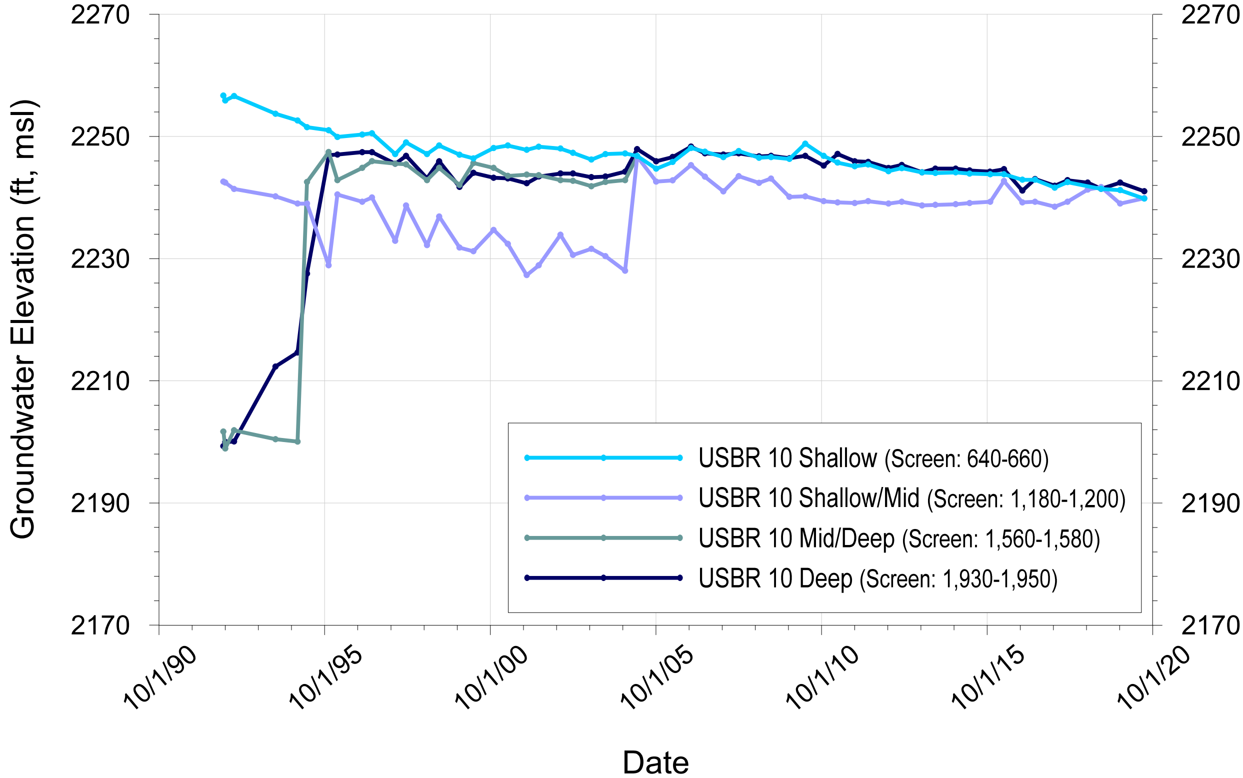
Attachment D

Hydrographs for Select Monitoring Wells

Groundwater Elevation Hydrographs

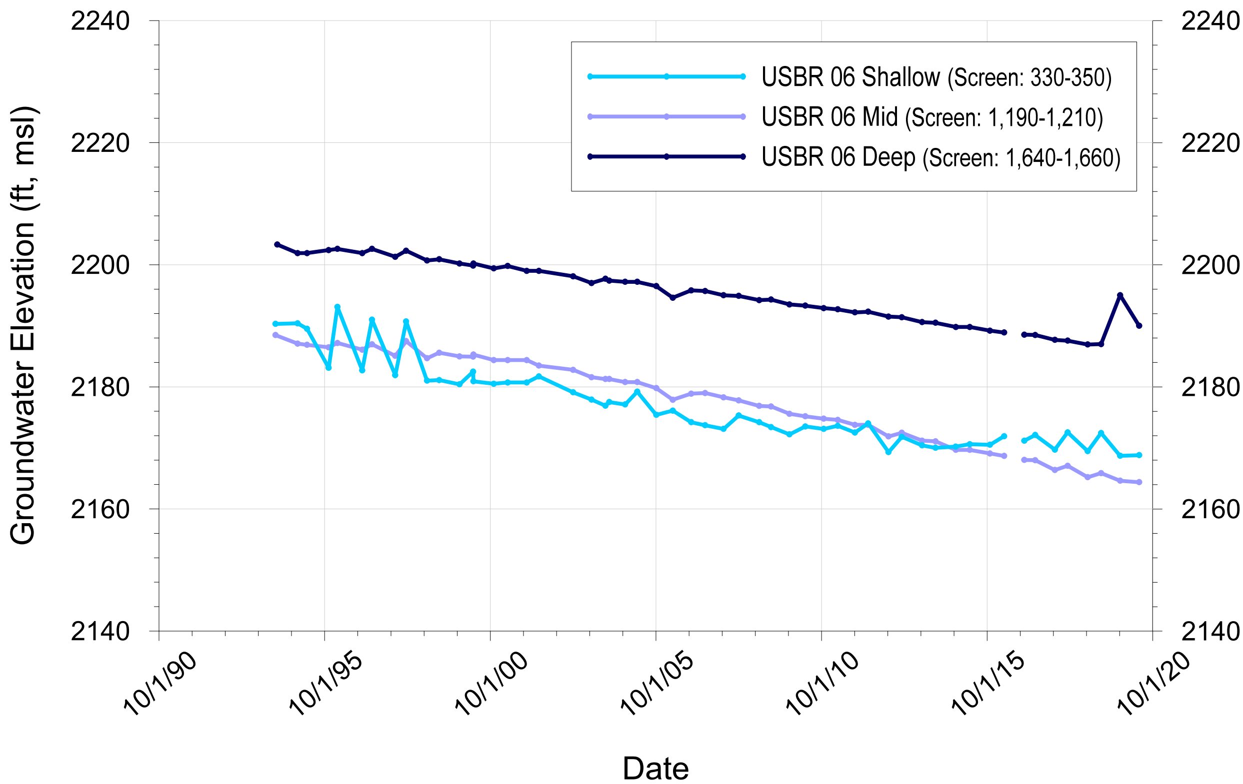
USBR 10 (2559 ft, msl)

24S/38E-21A1 - 24S/38E-21A4

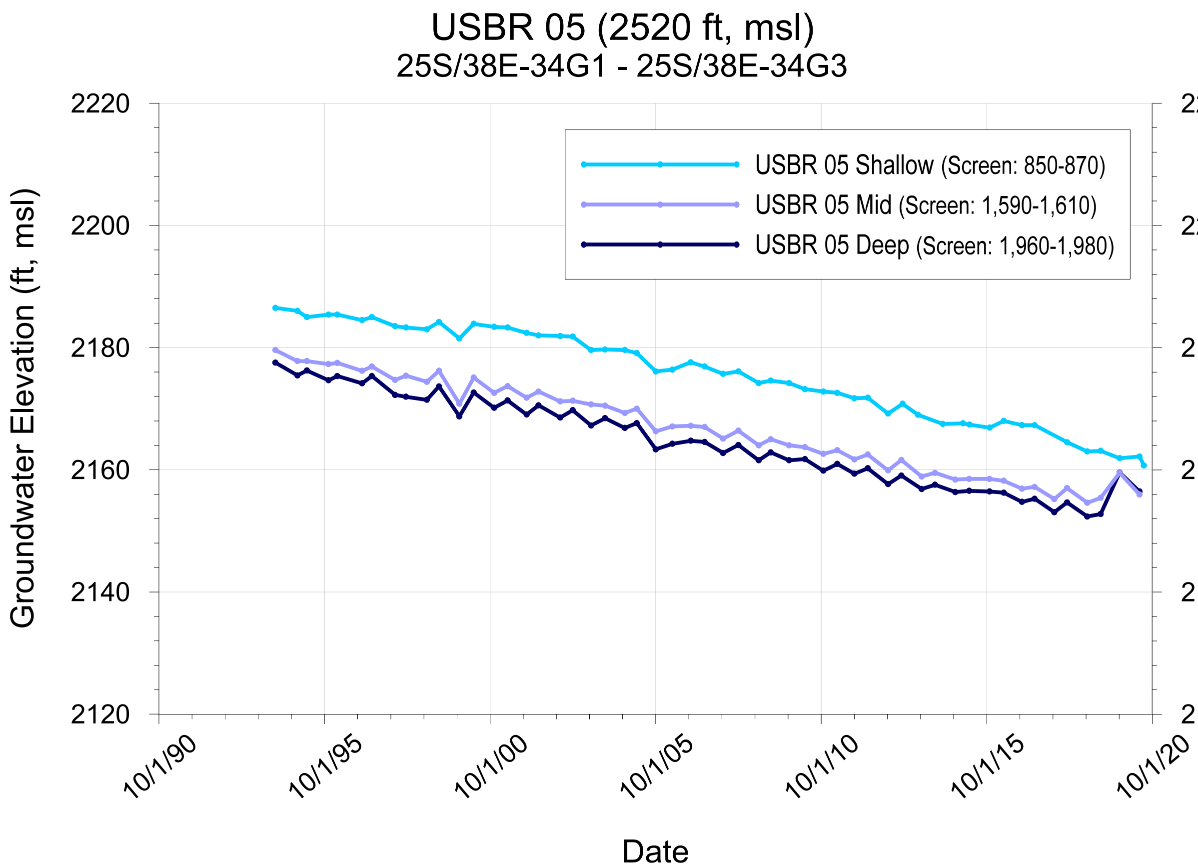


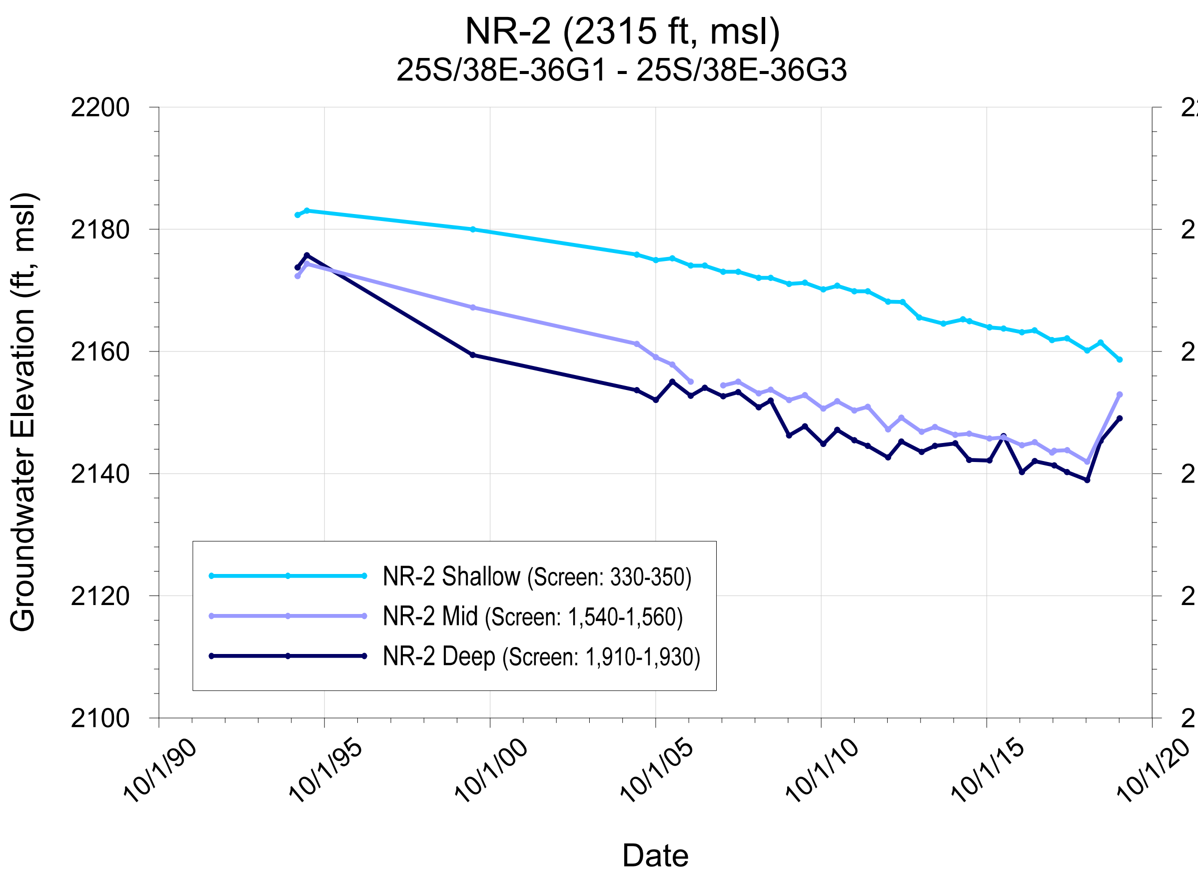
USBR 06 (2353 ft, msl)

25S/38E-12L1 - 25S/38E-12L3



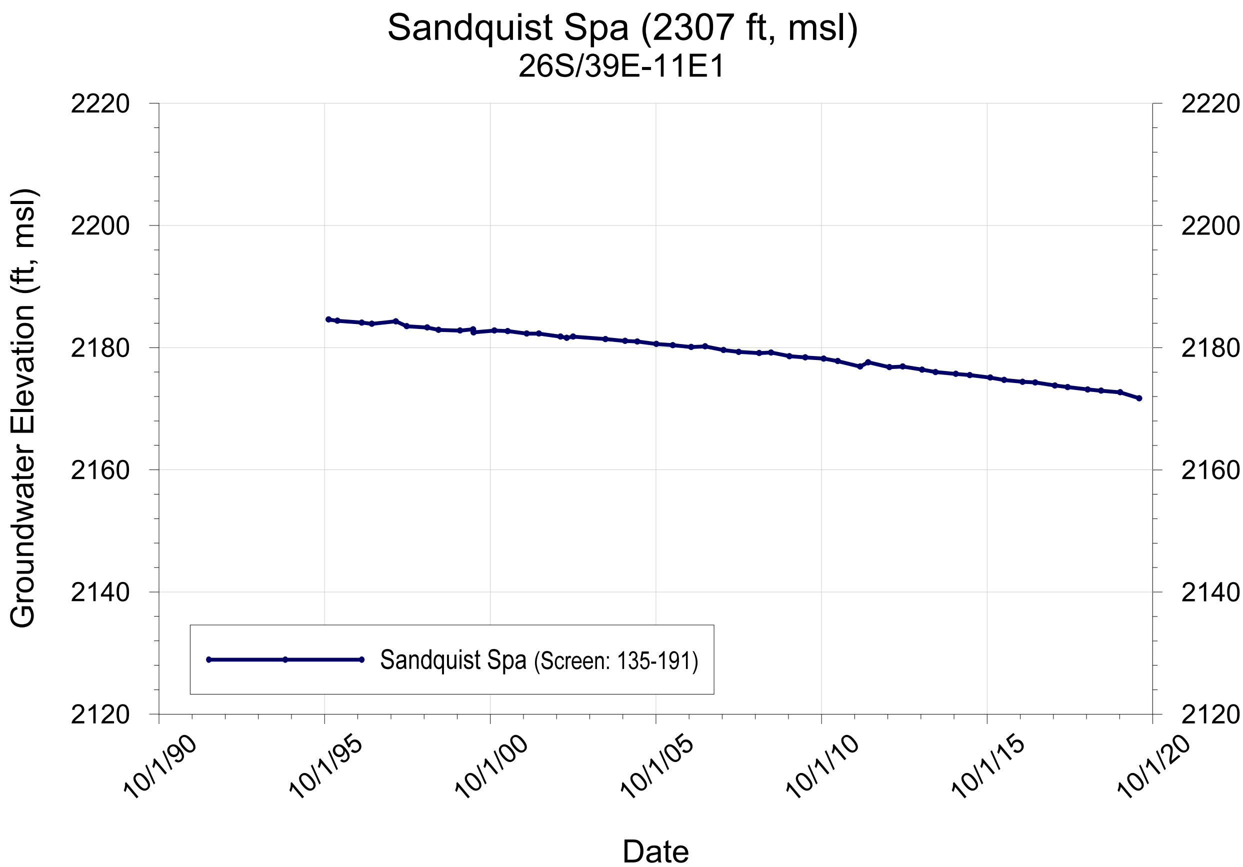
Groundwater Elevation Hydrographs

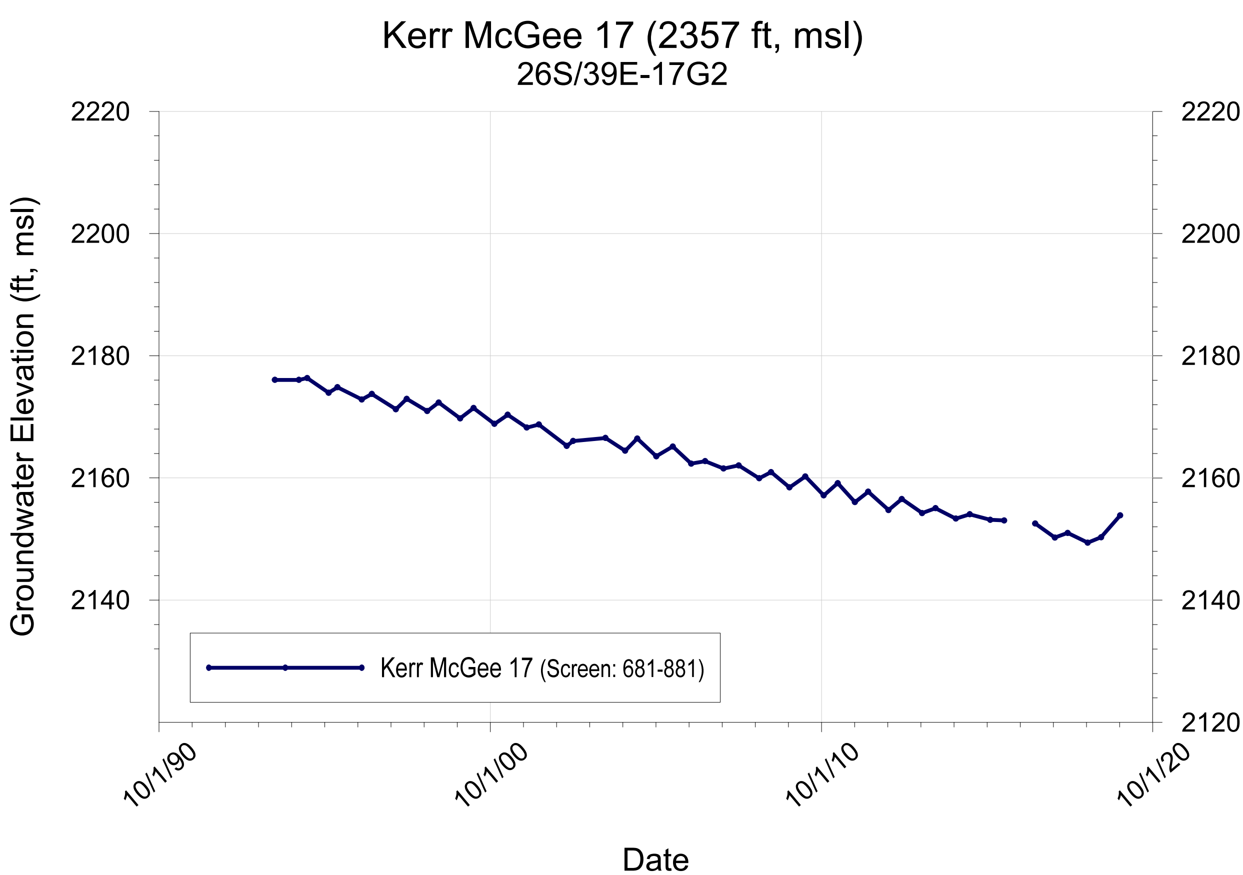




Note: Spring 2020 groundwater levels were not measured at NR-2 Shallow, Mid and Deep due to COVID-19

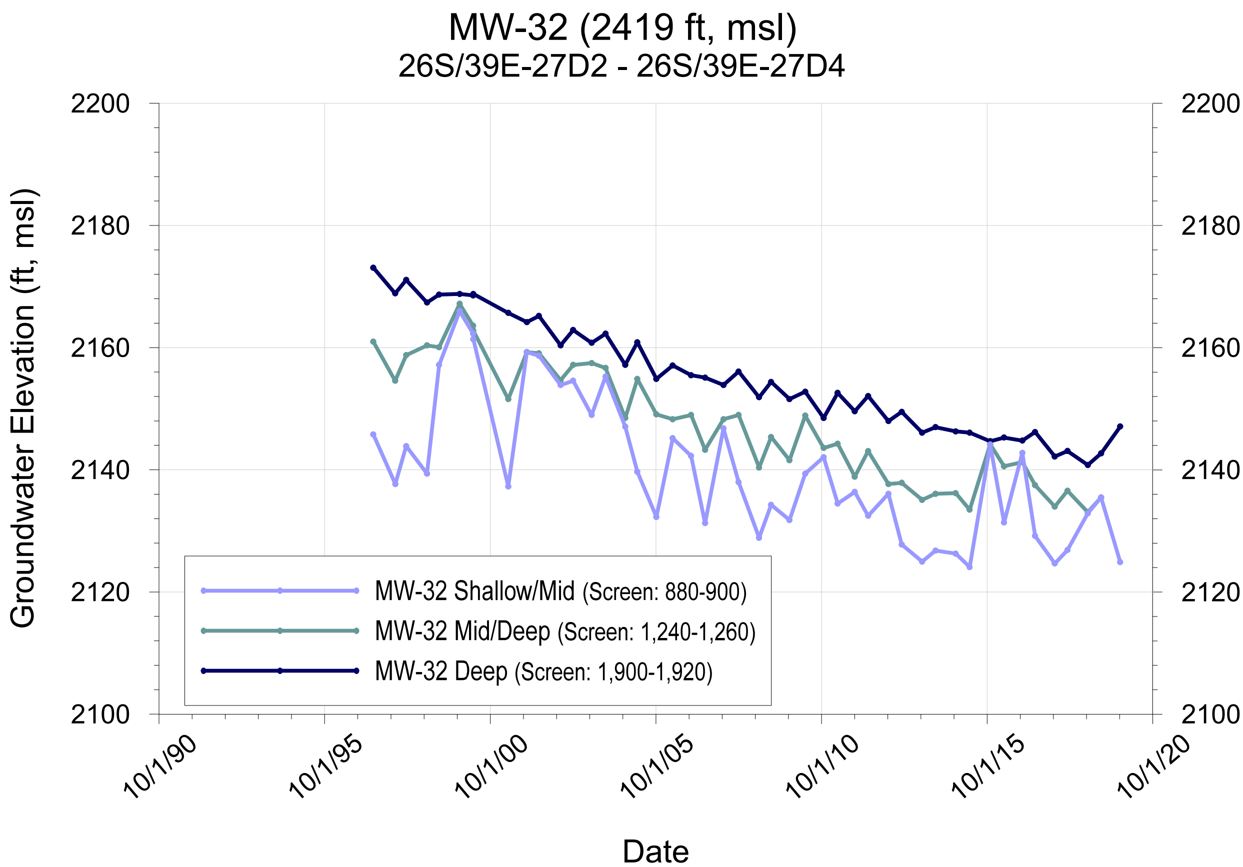
Groundwater Elevation Hydrographs

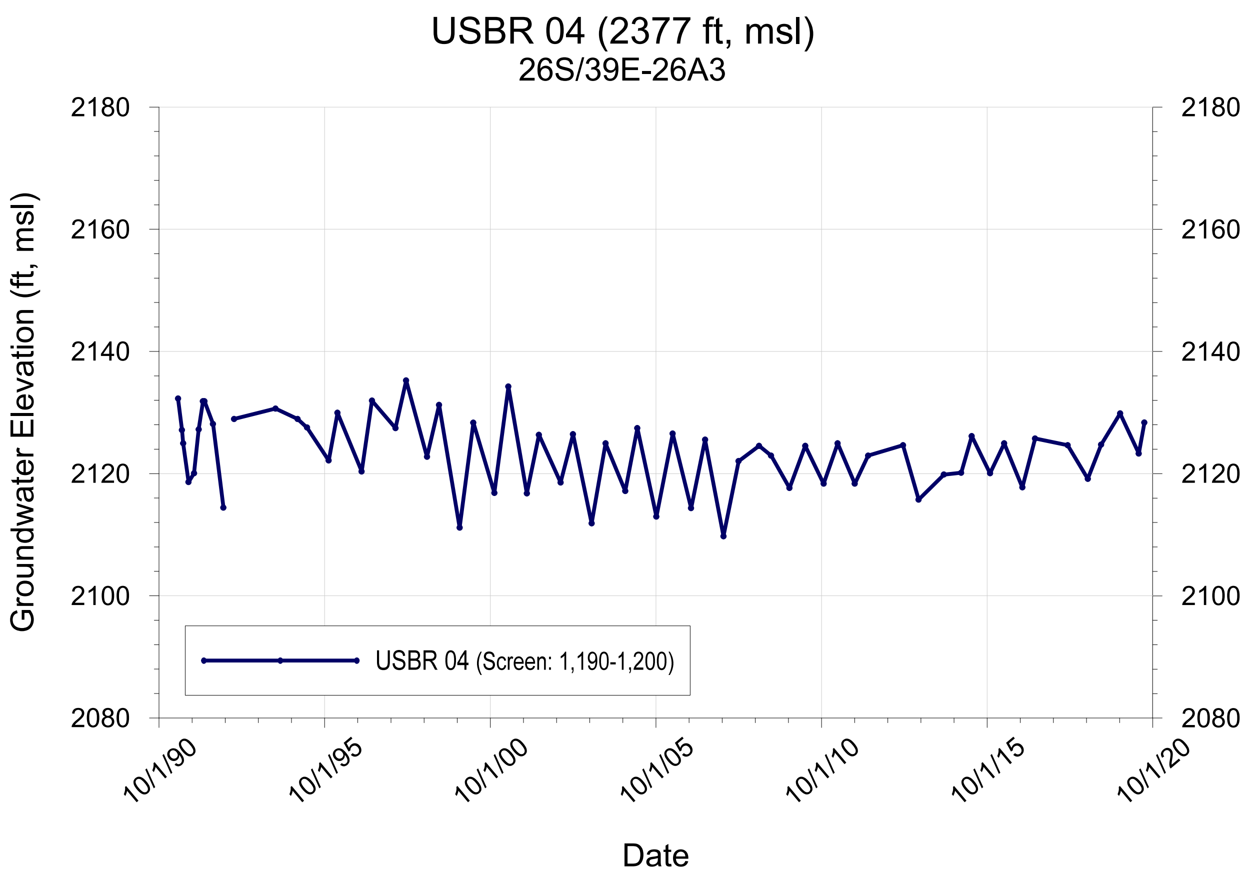




Note: Spring 2020 groundwater levels were not measured at Kerr McGee due to COVID-19

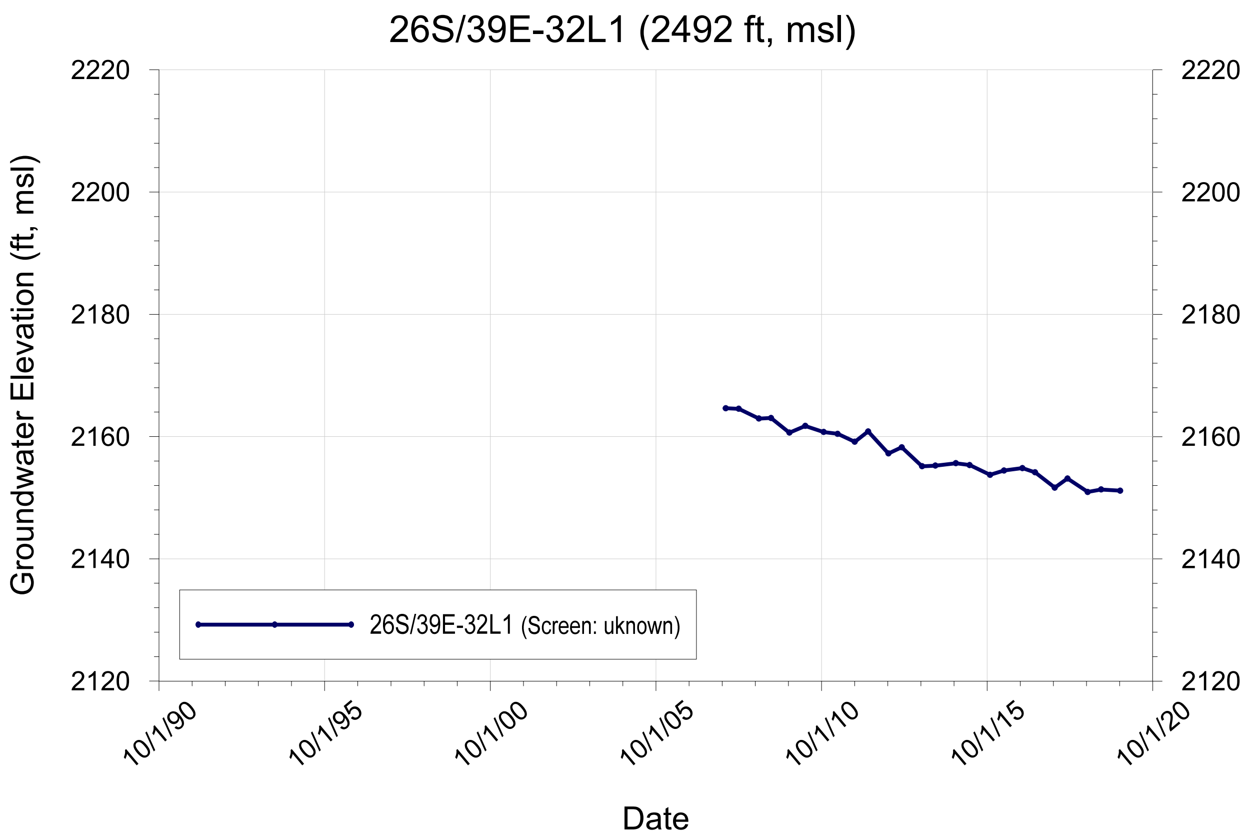
Groundwater Elevation Hydrographs

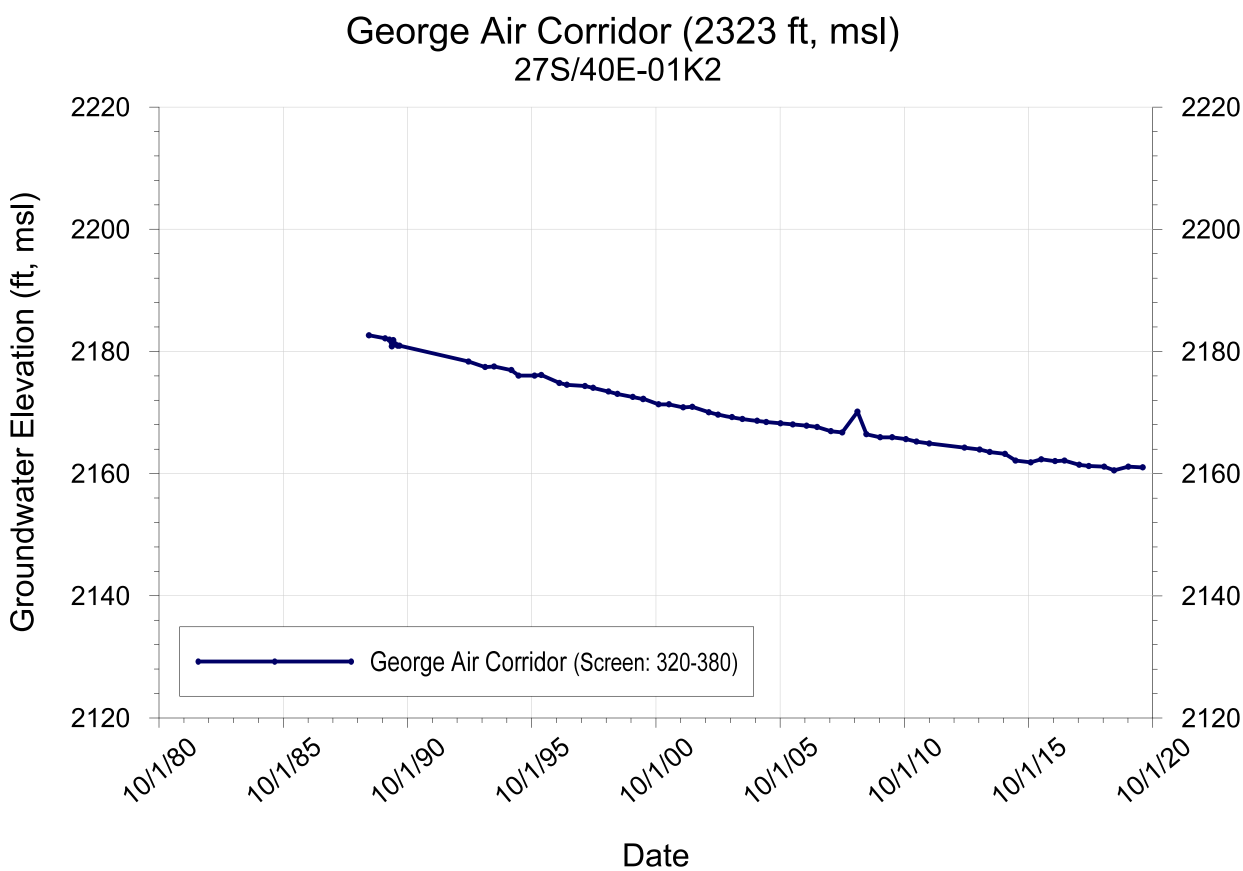




Note: Spring 2020 groundwater levels were not measured
at MW-32 Shallow/Mid and MW-32 Mid/Deep due to COVID-19

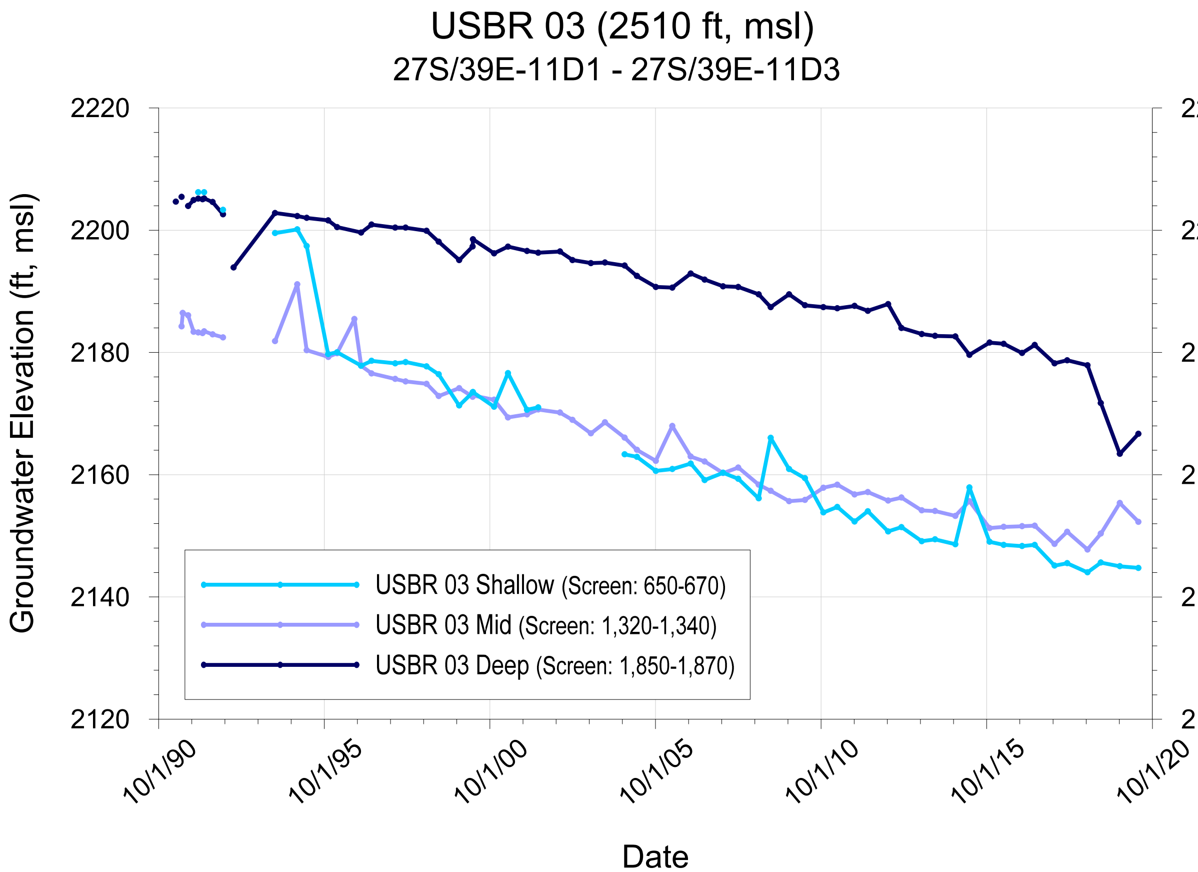
Groundwater Elevation Hydrographs

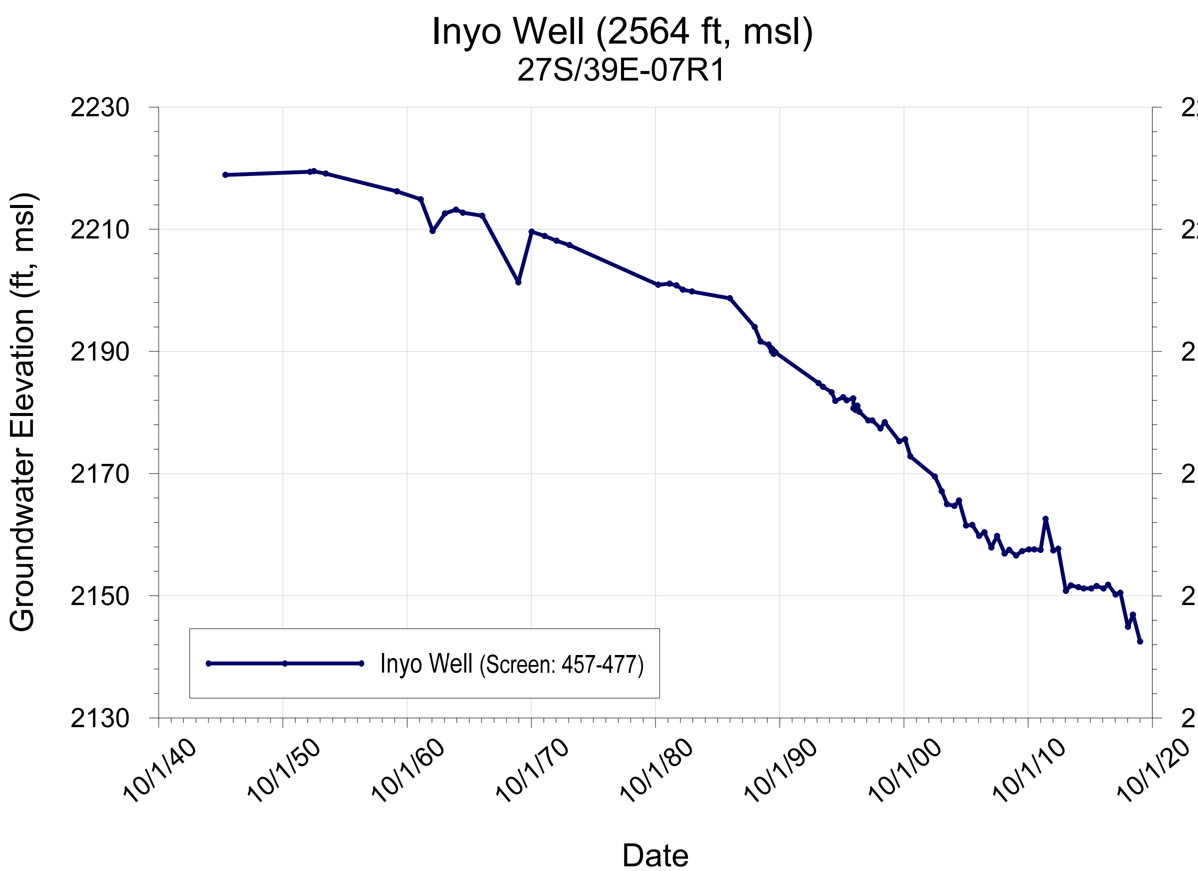




Note: Spring 2020 groundwater level was not measured in 26S/39E-32L1 due to COVID-19

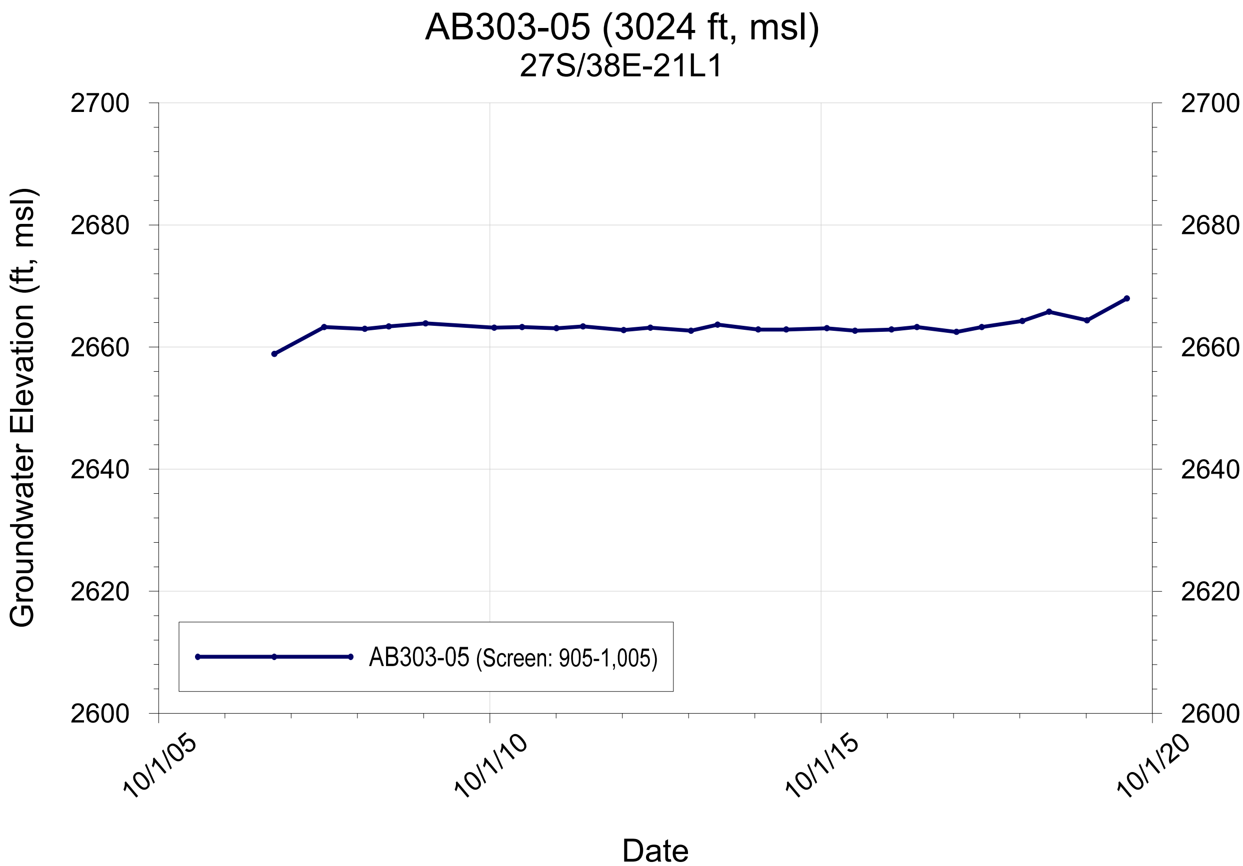
Groundwater Elevation Hydrographs

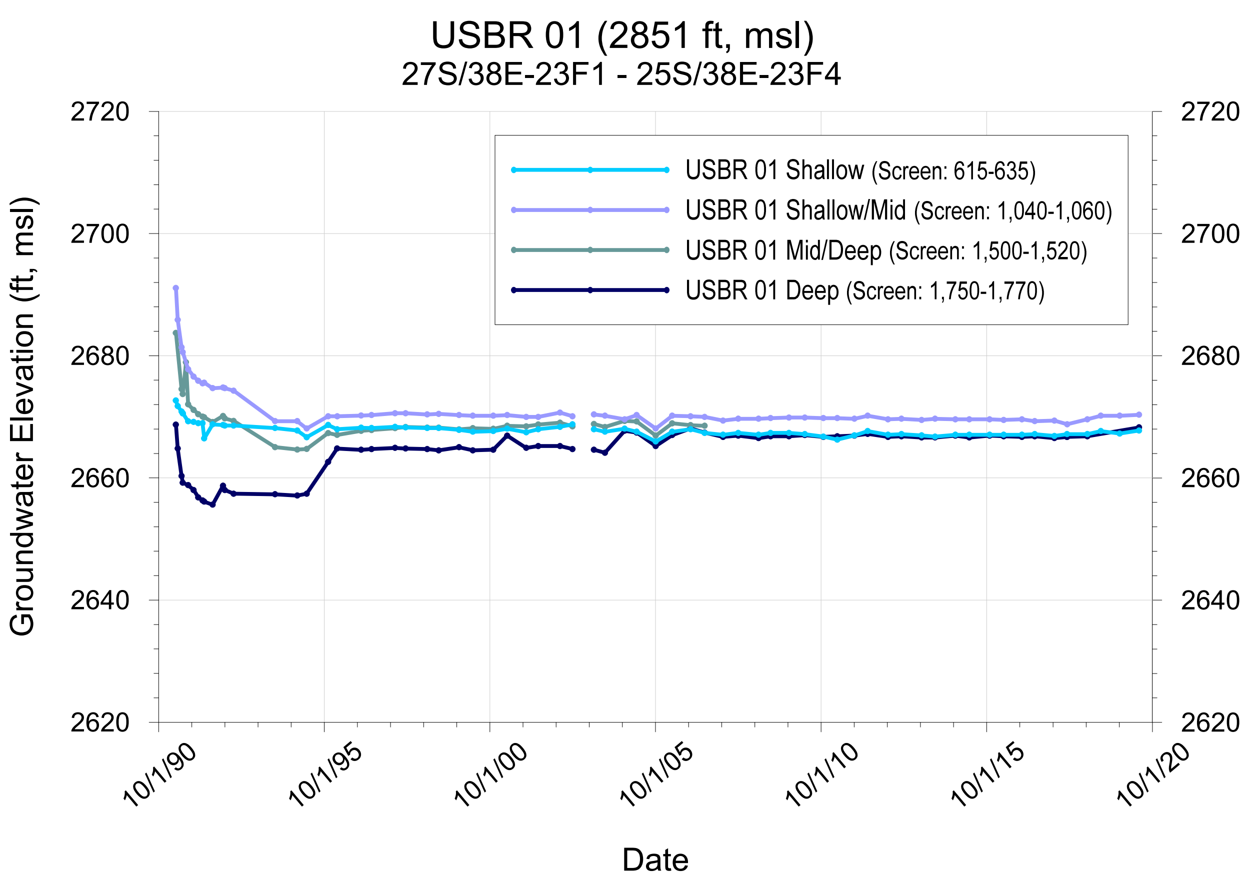




Note: Inyo Well was dry in Spring 2020.

Groundwater Elevation Hydrographs





Attachment E

USBR-03 Water Level Record Correction

STETSON
ENGINEERS INC.

TECHNICAL NOTE

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TEL: (760) 730-0701 FAX: (415) 457-1638 e-mail: stever@stetsonengineers.com

February 10, 2021

USBR-03 Water Level Record Correction

USBR-03 was drilled in 1991 (USBR, 1993) as a multi-level nested well with three 2-inch piezometers screened at shallow, mid, and deep locations at different aquifer depths. All three piezometers are in the same stovepipe completion above land surface. Given the depth of these piezometers, the bottom is typically not confirmed during groundwater level measurements. During 2019 and 2020 monitoring and sampling activities, the depth of the shallow piezometer was measured and a discrepancy of historical data from the shallow and mid piezometers was noted. This Technical Note serves as a summation of these observation and resolution of the discrepancy.

USBR-03 is located southwest of Ridgecrest, east of Highway 395 and south of Bowman Road (27S/39E-11D). The following table summarizes the March 1991 well completion data from the USBR 1993 report and current data in the KCWA database.

USBR-03 PIEZOMETER CASING DEPTHS AND ELEVATIONS (USBR, 1933, VOL II AND KCWA)

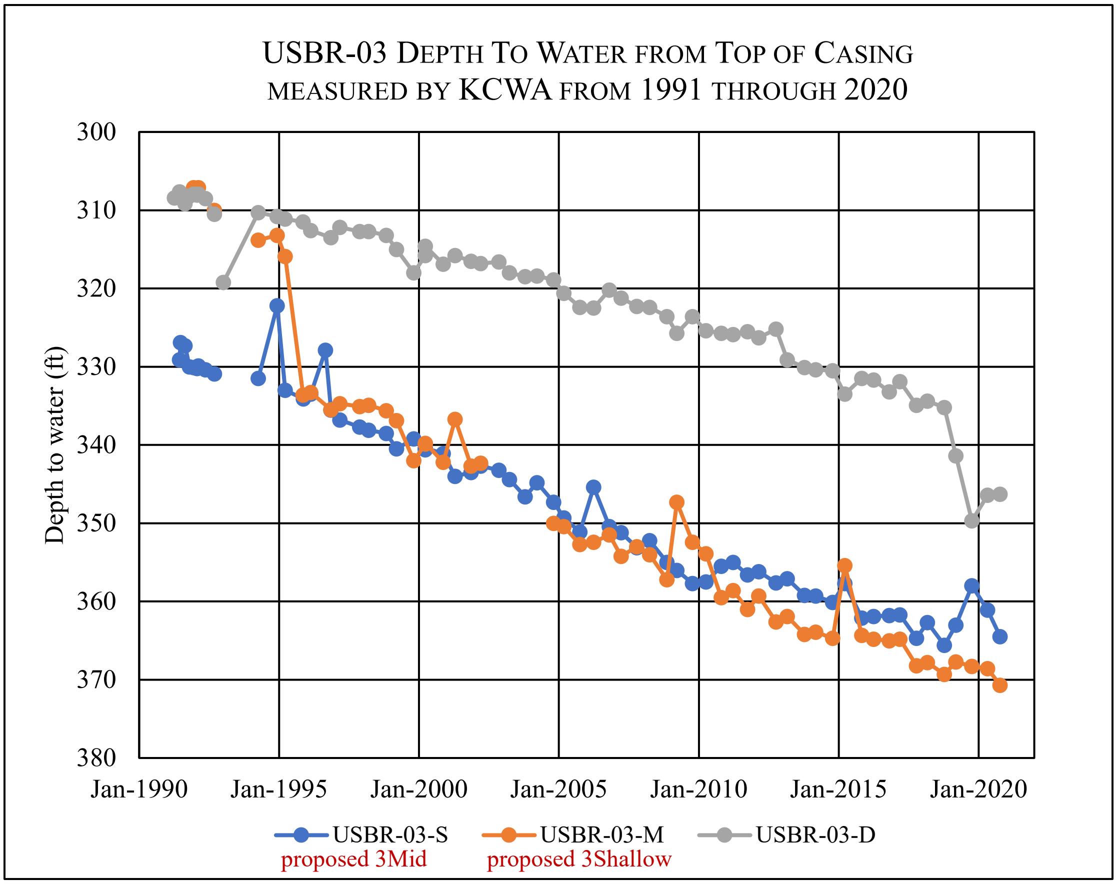
Piezometer	USBR 1993, Vol II					KCWA GWMP	
	Total Depth[2] (ft bgs)	Screen Interval[2] (ft bgs)	Casing Stickup[1]	TOC to TOP[1] (feet)	Elevation TOP[1] (feet)	TOC Elevation[3] (ft)	Land Surface Elevation[3] (ft)
Shallow	670	650-670	medium	.43	2511.43	2513.36	2510.4035
Mid	1340	1320-1340	tall	.39	2511.48	2513.32	2510.4035
Deep	1870	1850-1870	short	.64	2511.22	2513.11	2510.4035

Notes:
1. *Data from USBR, 1993 Vol II, Appendix X, page 12 (attached)*
2. *Data from KCWA (Feb 2021) and USBR, 1993 vol II (both attached).*
3. *Elevations are sourced from data information received from KCWA.*
ft bgs: feet below ground surface; TOC: top of casing; TOP: top of piezometer

Depth to water measurements were collected and casing stickup heights were confirmed during the first two years after installation in Volume 2, Attachment X of the 1993 USBR report.

At that time, it was noted that the piezometer completion was related to: medium (shallow), tall (medium), and short (deep). This arrangement is different from the other multi-level well completions within the basin where the tallest stickup casing height relates to the shallowest piezometer and the shortest casing height relates to the deepest piezometer. The top of casing elevations of the mid and shallow piezometers are very close, only 0.04 feet different.

KCWA has maintained groundwater level records for Indian Wells Valley of Spring and Fall measurements since April 1991 through present (2020). The water level records KCWA has collected are presented in the following depth to water hydrograph below, utilizing the naming convention on record.



Starting in 2019, Stetson Engineers has begun conducting monitoring fieldwork at USBR-03 in association with groundwater quality sampling and augmentation of groundwater level monitoring with pressure transducers and real-time telemetry equipment. During the course of the work, Stetson has had the opportunity to collect additional water level measurements and verify piezometer depths. Water level measurements collected by Stetson correlate closely with the KCWA measurements on record. The following two field visit observations called attention to transposed piezometer naming.

1) October 2019 – Stetson and sampling subcontractors attempted to conduct sampling activities at USBR-03. A diaphragm sampling pump/equipment was deployed down the recognized 'Mid' piezometer and encountered what was thought to be an obstruction at a depth of 647 feet below the top of well casing. It is likely this "obstruction" was the casing joint at the top of the screen interval.

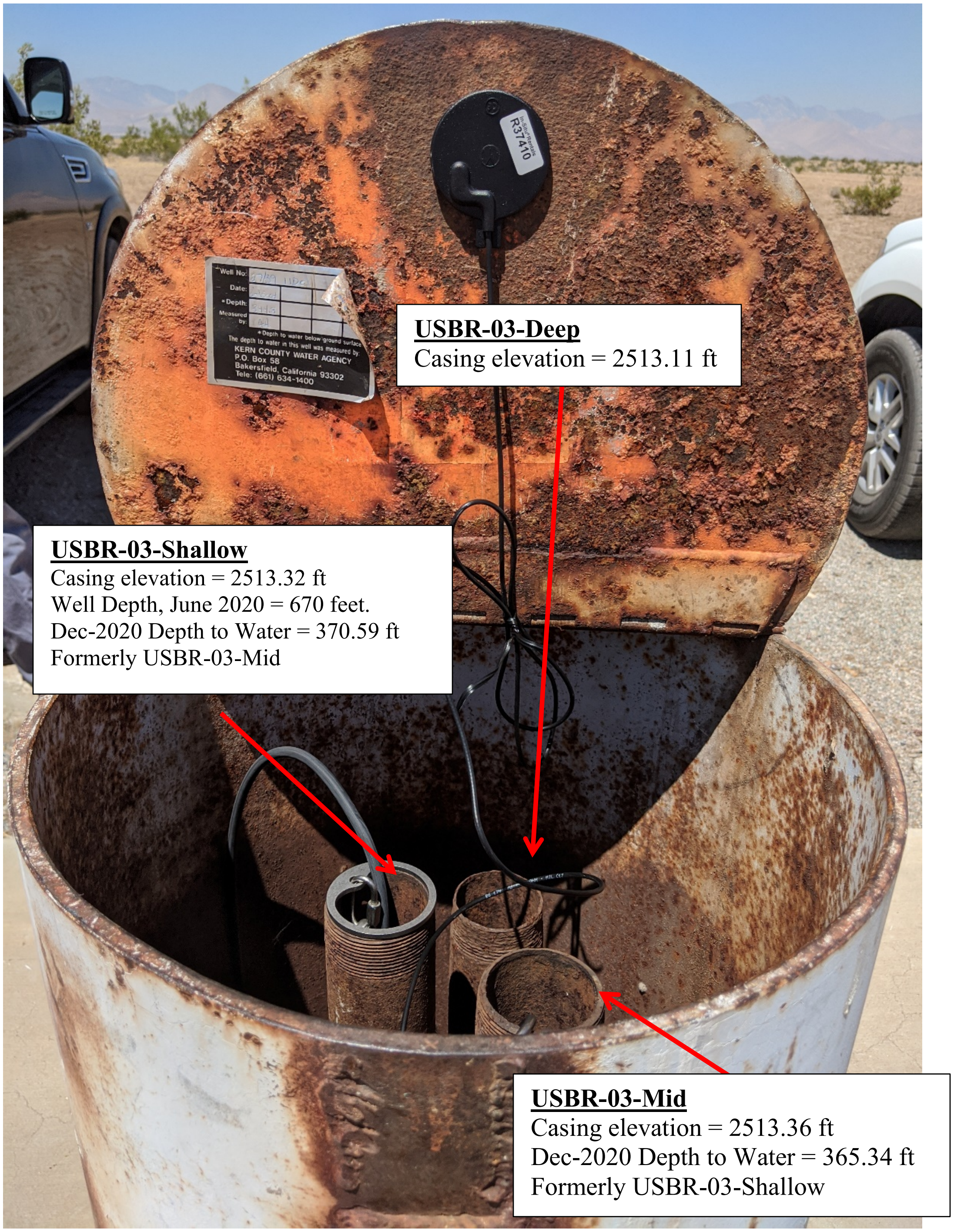
2) June 2020 – Stetson personnel conducted a verification measurement of the total depth of the piezometer casing recognized at USBR-03 Mid. This measurement resulted in a sounding depth of 670 feet below the top of the casing; the recognized total depth of USBR-03 Shallow.

Based on these observations, the original USBR 1993 construction notes, and those water level measurements collected by Stetson, it is apparent that the piezometers previously recognized as Shallow and Mid, have been interchanged, possibly since the beginning of monitoring. The following table lists the most recent KCWA water level measurements and those collected by Stetson. The table shows that the piezometers measured by KCWA and Stetson have been the same.

RECENT WATER LEVEL MEASUREMENTS
USBR-03 SHALLOW & USBR-03 MID

Recommended Revised Name	Name on Record	Date	DTW at TOC (ft)	Measurer
USBR-03 Shallow	USBR-03 Mid	3/13/2019	367.70	KCWA
		10/8/2019	368.30	KCWA
		10/30/2019	369.49	Stetson
		4/30/2020	368.58	Searles
		7/1/2020	371.28	Stetson
		8/6/2020	371.85	Stetson
		10/13/2020	370.70	KCWA
		12/16/2020	370.59	Stetson
USBR-03 Mid	USBR-03 Shallow	3/13/2019	363.00	KCWA
		10/8/2019	358.00	KCWA
		10/29/2019	361.22	Stetson
		4/30/2020	361.08	Searles
		10/13/2020	364.50	KCWA
		12/16/2020	365.34	Stetson

The following photograph shows the inside of USBR-03 well casing with notes for each piezometer. The photograph shows the installed monitoring and telemetry equipment in verified USBR-03-Shallow.



The origin of this error may have been immediately following well construction. The attached “Diagrammatic Completion and Well Data Summary Sheet” from (1) KCWA and (2) USBR 1993 show a discrepancy between shallow and mid-level water level measurements, where the measurements have been interchanged with each other. The top of casing elevations of the mid and shallow piezometers are very close, only 0.04 feet different. Additionally, with the interchange, casing heights do not follow standard installation practices of installing shallow casings at higher stickup heights than deeper casings.

Revisions to the water level data record, consist of interchanging well identifications, USBR-03 Mid and USBR-03 Shallow, for water level datasets maintained by KCWA, IWVGA Data Management System (IWVGSP.com), and State CASGEM database.

REFERENCES

USBR, 1993. Indian Wells Valley Groundwater Project Technical Report Volume II, a cooperative effort among the Bureau of Reclamation, the Indian Wells Valley Water District, the North American Chemical Company, and the Naval Air Weapons Station; December 1993.

Indian Wells Valley Groundwater Project
Depth to Water Measurements

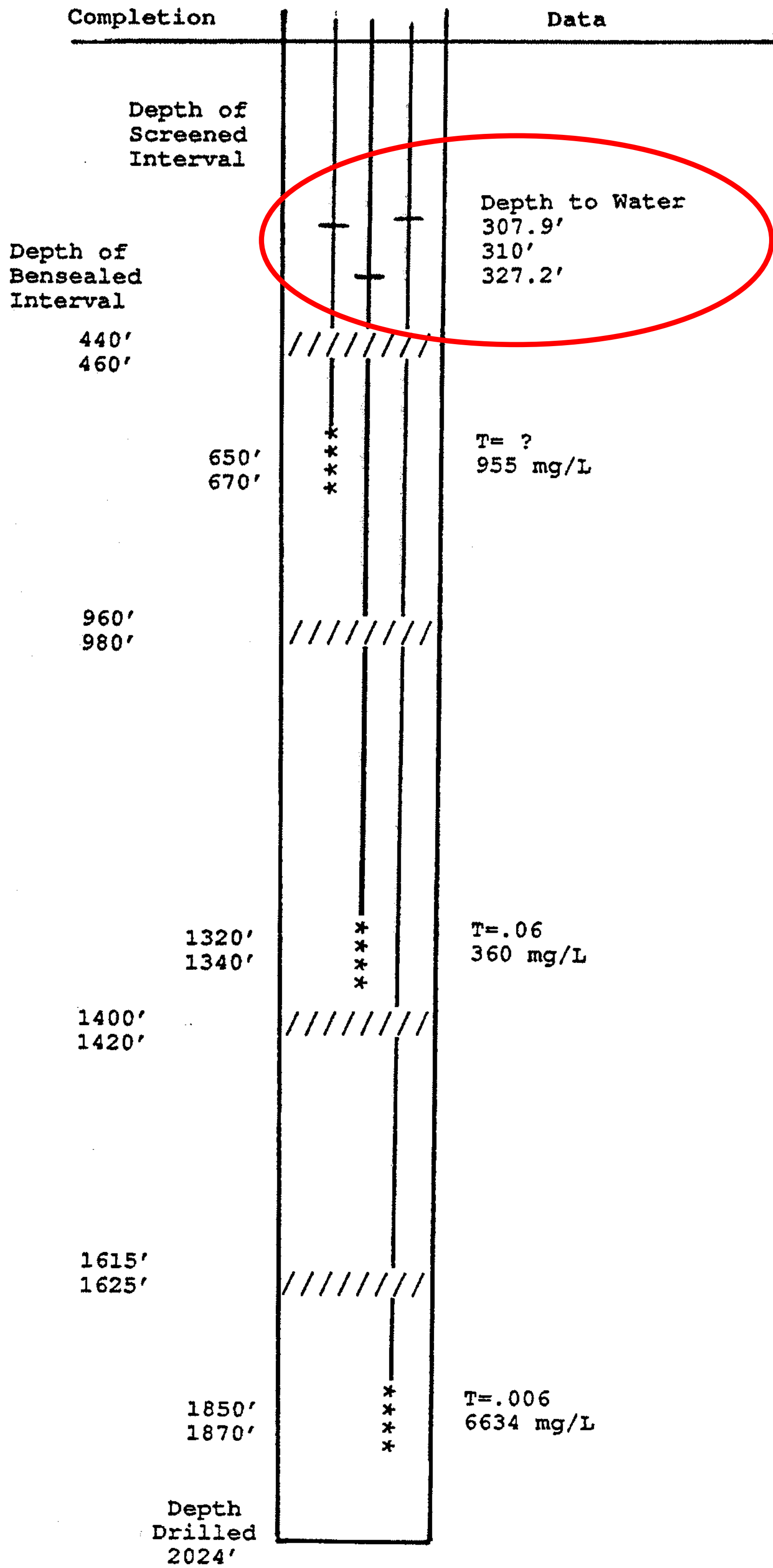
All measurements on September 10, 1992, by Dennis Watt using (the old) 1000 foot "twin-lead" electric sounder. All measurements are in feet from the top of each 2 inch piezometer pipe.

Well	Piezometer		Depth to Water	TOC to TOP	Elev TOP	Water Elev Comments
BR-3	medium	(shal)	328.03	.43	2511.43	2183.40
	tall	(med)	(310?)	.39	2511.48	2201.48
	short	(deep)	310.51	.64	2511.22	2200.71
BR-1	tall	(shal)	185.33	.12	2852.05	2666.72
	next tall	(sh/med)	182.88	.25	2851.91	2669.03
	next short	(dp/med)	187.38	.36	2851.80	2664.42
	short	(deep)	195.00	.39	2851.77	2656.77
BR-2	tall (blue)	(shal)	276.14	.20	2658.64	2382.50
	(yellow)	(med)	272.38	.40	2658.44	2386.06
	(red)	(deep)	281.48	.42	2658.42	2376.94
BR-5	tall	(shal)	335.26	.19	2521.28	2186.02
	medium	(med)	342.21	.41	2521.07	2178.86
	short	(deep)	343.80	.64	2520.84	2177.04
BR-10	tall	(shal)	307.63	.25	2561.14	2253.51
	next tall	(sh/med)	321.59	.42	2560.97	2239.38
	next short	(dp/med)	362.35	.54	2560.85	2198.50
	short	(deep)	364.62	.68	2560.71	2196.09
BR-6	tall	(shal)	163.85	.38	2353.75	2189.90
	medium	(med)	164.88	.70	2353.43	2188.55
	short	(deep)	149.30	1.08	2353.05	2203.75
NR-2	tall	(shal)	133.07	.32	2317.38	2184.31
	medium	(med)	141.08	.59	2317.11	2176.08
	short	(deep)	139.46	.79	2316.91	2177.45
NR-1	(red)	(shal)	95.18	.91	2271.67	2176.49
	(yellow)	(med)	69.48	.33	2278.26	2208.78
	(white)	(deep)	101.78	.93	2267.65	2165.87
MW-32	tall	(shal)	241.93	.31	~2418.69	2176.76
	next tall	(sh/med)	243.08	.42	~2418.58	2175.50
	next short	(dp/med)	241.92	.50	~2418.50	2176.58
	short	(deep)	240.51	.64	~2418.36	2177.85
BR-4			264.51	.27	2377.20	2112.69
SW Wells (SE Mon Well)			396.75		2582.82	2186.07

Well Diagram Received
from KCWA 2/3/2021

Indian Wells Valley Groundwater Project (IWVGWP)*
Diagrammatic Completion and Data Summary Sheet

**** Well BR-3 ****
3 - 2" Piezometers



Notes

T = Transmissivity. See note below on slug tests.

mg/L = Total filterable residue at 180 C in milligrams per liter.

DRILL SITE:
The well is located on the south side of Bowman Road about 1500 east of Hwy. 395.

DRILLING METHOD:
Direct rotary with bentonite mud. 12 1/4 inch roller cone bit from surface to total depth.

HOLE COMPLETION:
Installed three 2" diameter steel pipes with a 20' two inch diameter screen on the bottom of each.

DEVELOPMENT:
Each piezometer was air-lifted for about 12-20 hours and discharged an estimated 5-10 gallons per minute. Water samples for lab analysis were collected at the end of development.

DEPTH TO WATER:
All depths reported below were measured on December 12, 1991 from the top of the outer casing. Shallow was measured with temperature logger.

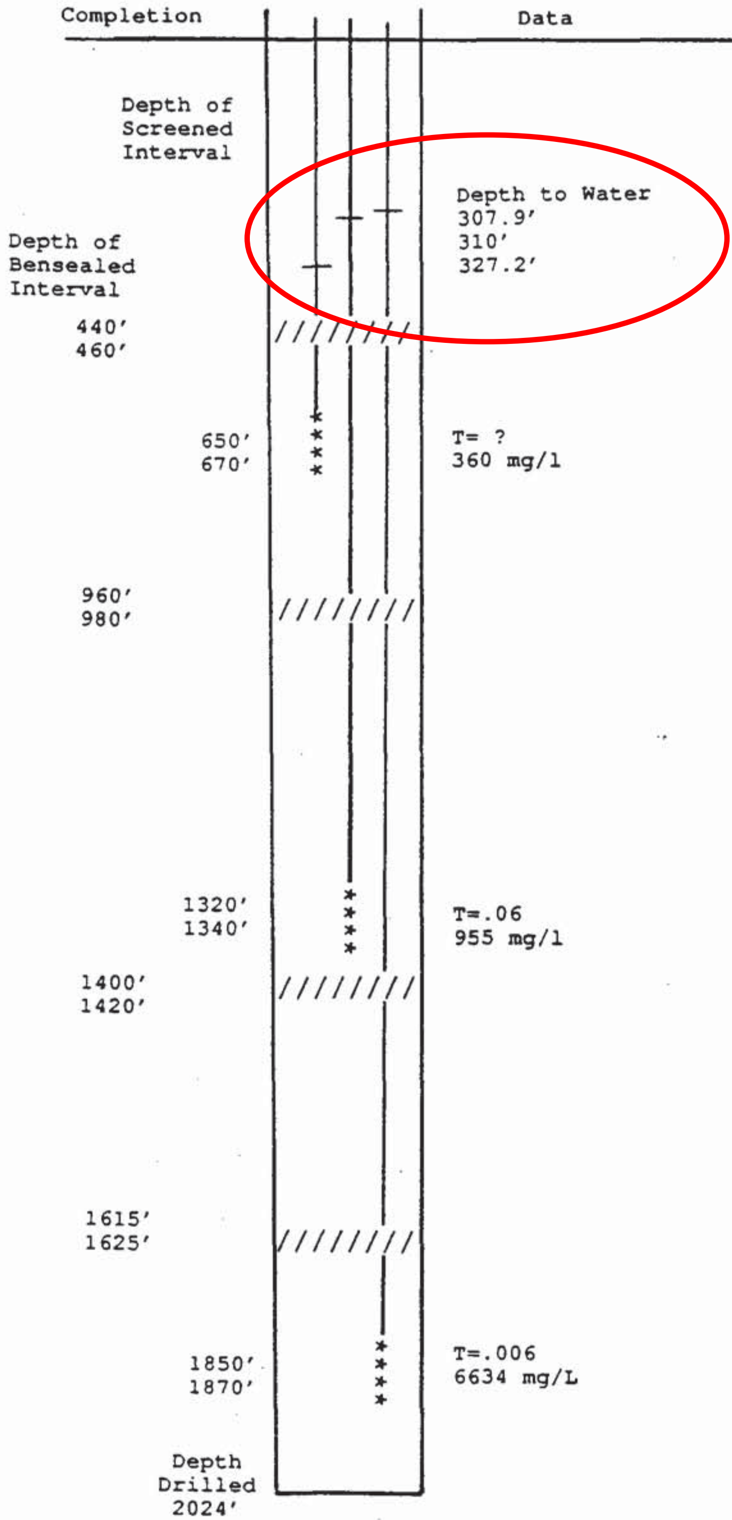
SLUG TEST RESULTS:
Estimated transmissivity (ft^2/min) by the Cooper (1967) method for the 20 feet of aquifer at each screen.

* The IWVGWP (1990-1992) was a cooperative endeavor by Indian Wells Valley Water District, China Lake Naval Weapons Center, North American Chemical Company, and the U.S. Bureau of Reclamation to install nested piezometers, such as the one shown, in holes drilled to 2000 +/- feet.

Well BR-3 Completion and Data Summary; USBR, 1993 Vol II

Indian Wells Valley Groundwater Project (IWVGWP)*
Diagrammatic Completion and Data Summary Sheet

**** Well BR-3 ****
3 - 2" Piezometers



Ground Elevation - 2508.6

Notes

T = Transmissivity. See note below on slug tests.

mg/L = Total filterable residue at 180 C in milligrams per liter.

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Attachment F

Groundwater Storage Change - Thiessen Polygon Method

Attachment F

INDIAN WELLS VALLEY GROUNDWATER BASIN

GROUNDWATER STORAGE CHANGE, WY 2016 to 2020

Thiessen Polygon	State ID T/R-S	Basin Area	Specific Yield	Land Surface (ft, msl)	Aquifer Area (Acres)		Spring Depth to Water (Feet) 2015	2016	2017	2018	2019	2020	Change in Depth (Feet) 2015 -2016	2016 -2017	2017 -2018	2018 -2019	2019 -2020	Annual Change in Storage (Acre-Feet) WY 2016	WY 2017	WY 2018	WY 2019	WY 2020	5-year Cumulative Change
TP-1	24S/38E-21A01	NW	0.21	2,559	11,675		315.5	315.6	316.5	316.9	318.0	319.6	-0.1	-0.9	-0.4	-1.1	-1.6	-245	-2,207	-981	-2,697	-3,923	-10,052
TP-2	24S/38E-19H	NW	0.21		2,840	1					8.2	7.9					0.3	-60	-537	-239	-656	179	-1,312
TP-3	25S/38E-03B	NW	0.21	2,456	4,655		284.8	285.7	286.3	286.7	288.1	289.5	-0.9	-0.6	-0.4	-1.4	-1.4	-880	-587	-391	-1,369	-1,369	-4,594
TP-4	25S/38E-12L01	NW	0.21	2,353	6,627		182.3	181.0	180.8	180.4	180.5	184.1	1.3	0.2	0.4	-0.1	-3.6	1,809	278	557	-139	-5,010	-2,505
TP-5	25S/38E-14Q01	NW	0.21	2,391	3,641	6	227.7	222.9	225.1	225.8	225.6		4.8	-2.2	-0.7	0.2	-2.3	3,670	-1,682	-535	153	-1,789	-184
TP-6	25S/38E-25J01	NW	0.21	2,277	4,192		111.2	114.2	115.7	114.6	115.4	112.7	-3.0	-1.5	1.1	-0.8	2.7	-2,641	-1,321	969	-704	2,377	-1,321
TP-7	25S/38E-34G01	NW	0.21	2,520	3,859		353.0	352.4	353.1	355.9	357.3	358.3	0.6	-0.7	-2.8	-1.4	-1.0	486	-567	-2,269	-1,135	-811	-4,295
TP-8	26S/38E-02R01	NW	0.21	2,398	3,511	6	231.9	232.9	233.3	234.5	236.4		-1.0	-0.4	-1.2	-1.9	-0.5	-737	-295	-885	-1,401	-339	-3,658
TP-10	26S/39E-20C02	NW	0.18	2,391	4,359	6	233.6	234.4	234.9	236.4	237.4		-0.8	-0.5	-1.5	-1.0	-0.6	-628	-392	-1,177	-785	-471	-3,452
TP-11	26S/38E-22B	SW	0.21	2,666	3,350	6	426.3	426.5	430.5	430.6	426.6		-0.2	-4.0	-0.1	4.0	1.2	-141	-2,814	-70	2,814	865	654
TP-13	26S/39E-31R03	SW	0.08	2,500	5,119	5	355.6	356.0	356.5	357.7	359.1		-0.4	-0.5	-1.2	-1.4	-0.9	-164	-205	-491	-573	-369	-1,802
TP-14	27S/39E-08P02	SW	0.08	2,581	3,760		431.3	432.1	432.3	433.8	434.8	435.7	-0.8	-0.2	-1.5	-1.0	-0.9	-241	-60	-451	-301	-271	-1,324
TP-15	27S/39E-28L01	SW	0.08	2,820	10,847		289.4	289.4	288.8	288.8	288.2	288.6	0.0	0.6	0.0	0.6	-0.4	0	521	0	521	-347	694
TP-16	27S/39E-19E01	SW	0.08	2,639	3,474		203.8	204.0	203.9	204.3	204.1	204.0	-0.2	0.1	-0.4	0.2	0.1	-56	28	-111	56	28	-56
TP-35	26S/39E-26A03	SE	0.18	2,377	2,690		251.0	252.2	251.4	252.5	252.4	253.8	-1.2	0.8	-1.1	0.1	-1.4	-581	387	-533	48	-678	-1,356
TP-36	26S/39E-34C01	SE	0.08	2,451	3,713	6	294.3	294.8	295.1	297.3	298.0		-0.5	-0.3	-2.2	-0.7	-0.7	-149	-89	-654	-208	-214	-1,313
TP-37	27S/39E-11D01	SE	0.08	2,510	7,907		354.7	358.9	358.7	359.7	360.0	358.1	-4.2	0.2	-1.0	-0.3	1.9	-2,657	127	-633	-190	1,202	-2,151
TP-38	27S/40E-06F01	SE	0.08	2,407	8,376	6	324.7	322.6	323.5	322.4	322.1		2.1	-0.9	1.1	0.3	0.8	1,407	-603	737	201	563	2,305
TP-40	26S/40E-28J01	SE	0.21	2,291	4,048		134.0	133.9	134.6	134.7	135.3	133.3	0.1	-0.7	-0.1	-0.6	2.0	85	-595	-85	-510	1,700	595
TP-41	27S/40E-01K02	SE	0.21	2,323	10,631		160.5	160.3	160.5	161.4	162.1	161.6	0.2	-0.2	-0.9	-0.7	0.5	447	-447	-2,009	-1,563	1,116	-2,456
TP-9	26S/39E-08F	NVY	0.21	2,319	3,721		160.0	161.3	162.0	163.4	164.5	165.5	-1.3	-0.7	-1.4	-1.1	-1.0	-1,016	-547	-1,094	-860	-781	-4,298
TP-22	24S/40E-21K02	NVY	0.21		36,916	2					52.3	52.0					0.3	-1,551	-1,551	-1,551	-2,326	2,326	-4,652
TP-23	24S/39E-34D01	NVY	0.21	2,227	13,194	3				46.6	46.9	46.9				-0.3	0.0	-554	-554	-554	-831	0	-2,494
TP-24	25S/39E-12R01	NVY	0.21	2,202	10,162		23.3	23.5	23.7	23.9	24.2	24.5	-0.2	-0.2	-0.2	-0.3	-0.3	-427	-427	-427	-640	-640	-2,561
TP-25	25S/41E-18R01	NVY	0.21	2,003	13,523		22.1	22.0	21.9	22.2	22.1	21.5	0.1	0.1	-0.3	0.1	0.6	284	284	-852	284	1,704	1,704
TP-26	25S/40E-30E01	NVY	0.21	2,191	5,445		13.6	13.7	13.7	14.0	14.2	14.4	-0.1	0.0	-0.3	-0.2	-0.2	-114	0	-343	-229	-229	-915
TP-27	25S/39E-28P01	NVY	0.21	2,229	7,615		47.7	45.5	40.5	40.7	39.4	50.2	2.2	5.0	-0.2	1.3	-10.8	3,518	7,995	-320	2,079	-17,270	-3,998
TP-28	26S/39E-11E01	NVY	0.21	2,307	4,642		131.8	132.6	133.0	133.8	134.4	135.6	-0.8	-0.4	-0.8	-0.6	-1.2	-780	-390	-780	-585	-1,170	-3,704
TP-29	26S/39E-01A01	NVY	0.21	2,218	3,308		47.2	47.7	47.7	48.1	48.2	44.0	-0.5	0.0	-0.4	-0.1	4.2	-347	0	-278	-70	2,918	2,223
TP-30	25S/40E-31P	NVY	0.21	2,192	3,581		20.3	20.3	20.0	20.5	20.5	19.5	0.0	0.3	-0.5	0.0	1.0	0	226	-376	0	752	602
TP-31	26S/40E-12C	NVY	0.21	2,166	9,875		4.3	4.6	4.1	4.7	4.3	5.7	-0.3	0.5	-0.6	0.4	-1.4	-622	1,037	-1,244	830	-2,903	-2,903
TP-32	26S/40E-22H03	NVY	0.21	2,228	4,338		31.2	31.8	32.1	32.8	33.2	33.3	-0.6	-0.3	-0.7	-0.4	-0.1	-547	-273	-638	-364	-91	-1,913
TP-33	26S/40E-21K03	NVY	0.21	2,267	3,065		102.8	101.7	101.2	103.1	101.9	100.0	1.1	0.5	-1.9	1.2	1.9	708	322	-1,223	772	1,223	1,802
TP-34	26S/39E-13R03	NVY	0.21	2,319	2,662		149.7	150.0	150.5	150.8	151.2	151.9	-0.3	-0.5	-0.3	-0.4	-0.7	-168	-280	-168	-224	-391	-1,230
TP-39	26S/40E-17Q01	NVY	0.21	2,278	6,769	4			145.9	146.1	146.0	143.3			-0.2	0.1	2.7	-426	-711	-284	142	3,838	2,559
TP-12	27S/38E-02C01	EP	0.21	2,655	4,116		282.2	282.4	281.9	282.9	282.9	281.9	-0.2	0.5	-1.0	0.0	1.0	-173	432	-864	0	864	259
TP-17	27S/38E-23F01	EP	0.21	2,851	3,475		183.4	183.4	183.3	183.3	182.8	182.8	0.0	0.1	0.0	0.5	0.0	0	73	0	365	0	438
TP-18	27S/38E-09C01	EP	0.21	3,070	4,533		381.2	380.8	380.7	381.3	381.1	381.3	0.4	0.1	-0.6	0.2	-0.2	381	95	-571	190	-190	-95
TP-19	27S/38E-21L01	EP	0.21	3,024	10,409		361.3	361.5	360.9	360.9	358.4	357.9	-0.2	0.6	0.0	2.5	0.5	-437	1,312	0	5,465	1,093	7,432
TP-20	28S/38E-18F01	EP	0.21	3,027	31,788		212.3	211.6	211.3	211.7	210.9	210.9	0.7	0.3	-0.4	0.8	0.0	4,673	2,003	-2,670	5,340	0	9,346
TP-21	28S/38E-18R	EP	0.21	3,017	12,317		197.3	197.2	197.0	196.4	196.8	196.8	0.1	0.2	0.6	-0.4	0.0	259	517	1,552	-1,035	0	1,293

red: field measurement not available, estimated from hydrograph through Oct 2020

red: calculated using nearby well's dtw change

Totals:	WY 2016	WY 2017	WY 2018	WY 2019	WY 2020	5-year Cumulative Change
IWV Main Basin	-3,316	-5,927	-19,382	-10,459	-18,274	-57,358
El Paso Sub-area	4,702	4,432	-2,554	10,326	1,767	18,673
Total	1,387	-1,495	-21,936	-133	-16,508	-38,685

Notes:

Specific Yield values souced from Appendix 3-H GSP Model Documentation Appendix

Spring groundwater levels measured by Kern County Water Agency for Indian Wells Valley.

1- Well 24S/38E-19H was added to the monitoring program in Spring 2019. The DTW change from 2016 - 2019 for TP-1 was estimated to be equal to TP-2.

2- Well 24S/40E-21K02 was added to the monitoring program in Spring 2019. The DTW change from 2016 - 2019 for TP-22 was estimated to be equal to TP-24.

3- Well 24S/39E-34D01 was added to the monitoring program in Spring 2019. The DTW change from 2016 - 2018 for TP-23 was estimated to be equal to TP-24.

4- Well 26S/40E-17Q01 was added to the monitoring program in Spring 2017. The DTW change from 2016 - 2017 for TP-39 was estimated to be equal to TP-34.

5- Due to COVID-19, Spring 2020 groundwater levels were unable to be measured at 12 wells used for the annual groundwater storage calculation.
11 of the 12 wells with missing spring GWLs were able to 1) be replaced with an alternate well from the polygon or 2) estimated from the hydrograph.
TP-13 had no alternate well available with Fall 2020 GWLs for hydrograph estimate, so DTW change from 2019 - 2020 was set equal to TP-14.

6- Due to COVID-19, Spring 2020 groundwater levels were unable to be measured at 12 wells used for the annual groundwater storage calculation.
The DTW change from spring 2019 to spring 2020 was calculated using alternate wells located in 6 polygons

- TP-5: well 25S/38E-14A used in place of 25S/38E-14Q01
- TP-10: WellIntel well (SZ's Well) used in place of 26S/39E-20C02
- TP-36: WellIntel well (GH's Well) used in place of 26S/39E-34C01
- TP-8: WellIntel well (MS's Well) used in place of 26S/38E-02R01
- TP-11: WellIntel well (West Well) used in place of 26S/38E-22B
- TP-38: WellIntel well (Well #2) used in place of 27S/40E-06F01

Attachment G

Estimated WY 2020 Groundwater Production

Attachment G: WY 2020 Groundwater Production Estimate

Water Use Sector (DWR)	Water User	No Action Baseline note	No Action Baseline (AFY)	Reported Groundwater Pumping WY 2019-20 note	Reported Groundwater Pumping WY 2019-20 (AFY)	Estimated Groundwater Pumping WY 2019-20 note	Estimated Groundwater Pumping WY 2019-20 (AFY)
Urban	IWVWD	2	6,518	1	6,290	1	6,290
Urban	City/County	2	425	1	219	1	219
Industrial	Searles Valley Minerals	2	2,907	1	2,818	1	2,818
Other - Federal	U.S. Navy	2	2,041	1	--	6	1,410
Agriculture	Meadowbrook Farms	2	12,303	1	4,431	1	4,431
Agriculture	Mojave Pistachio	2	6,054	1	3,535	1	3,535
Agriculture	Simmons Farm	2	931	1	327	1	327
Agriculture	Sierra Shadows	2	765	1, 3	83	1, 5	391
Agriculture	Quist Farms	2	674	1	643	1	643
Agriculture	Other Small Ag	2	901	1, 3, 4	455	5, 7	525
Other - Co-Ops/Mutuals	Co-Ops/Mutual	2	544	1, 3, 4	553	8	573
Other - Domestic	Domestic	2	832	1	--	2	832
			34,896		19,354		21,994

Notes:

1 Reported data for Pump Fee.

2 Estimated from GSP 'No Action' Baseline analysis.

3 Missing some monthly data. Partial year reported.

4 Missing data. Not all Co-Ops, Mutuals, and agricultural pumpers report.

5 Missing monthly data estimated using other reported data.

6 Data provided by Navy in email to Stetson Engineers Inc dated February 22, 2021.

7 Compiled from best available data source including reported data from pump fee, baseline analysis, and other reported data. Includes additional 70 acre-feet to estimate additional unreported agricultural pumping.

8 Compiled from best available data source including reported data from pump fee, baseline analysis, and other reported data. Includes additional 20 acre-feet to estimate additional unreported mutual and co-op pumping.