concentration of 6 ppm to non-detect levels. This type of trend indicates that there are confining layers in the aquifer preventing nitrate from migrating with the water levels.

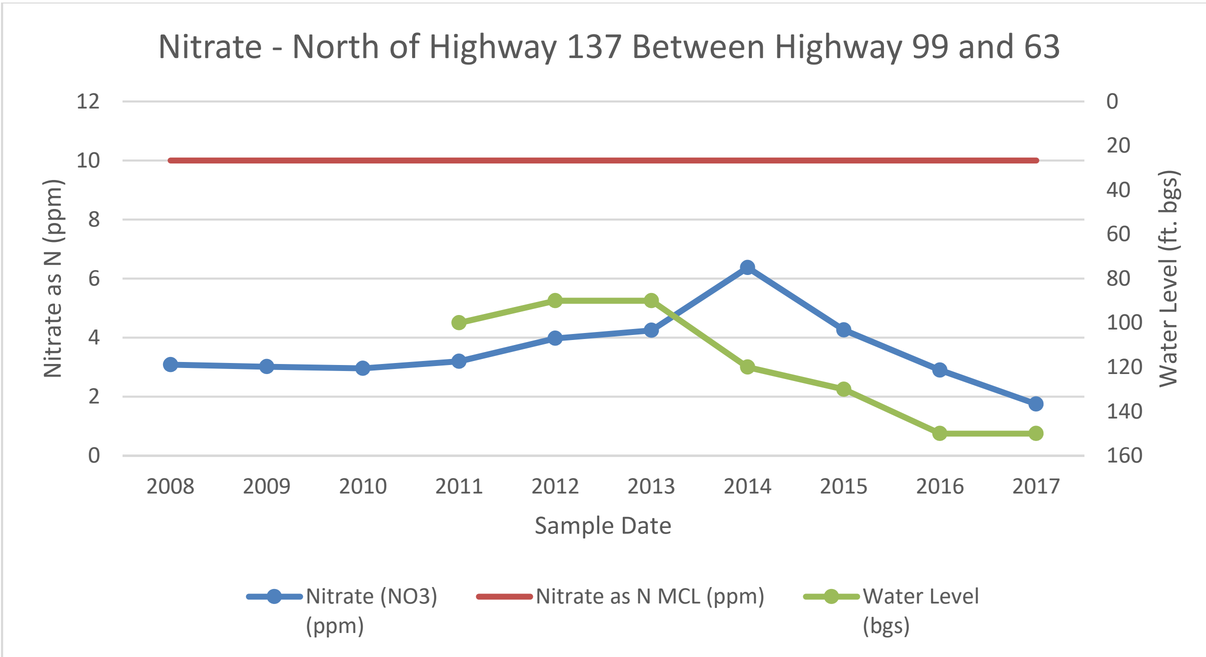


Figure 75: Nitrate levels decrease north of Hwy 137

2.7.3.3 Hexavalent Chromium

Hexavalent chromium is not commonly found in concentrations greater than 10 ppb in the Kaweah Subbasin. An evaluation of hexavalent chromium results indicates that only one well has historic levels with a maximum result of 14 ppb and an increasing trend. This well is located on the eastern border of the Subbasin, near the Friant-Kern Canal in hydrogeologic zone eight.

The federal MCL for total chromium (which includes chromium-3 and chromium -6) is 100 ppb, a specific federal MCL for chromium-6 has not been established. In California, the MCL for chromium-6 is currently 50 ppb. This MCL is a reversion from the July 2014 establishment of a primary MCL of 10 ppb. While DDW repeats the regulatory process for adopting the new MCL, the federal MCL of 50 ppb for total chromium applies. There is no Agricultural Water Quality Goal for hexavalent chromium.

2.7.3.4 Dibromochloropropane (DBCP)

Dibromochloropropane (DBCP) is a synthetic organic contaminant with a drinking water MCL of 0.2 ppb. There is no Agricultural Water Quality Goal. DBCP is a banned nematicide that is still present in soils and groundwater due to runoff or leaching from former use on soybeans, cotton, vineyards, tomatoes, and tree fruit.

Since the use of this pesticide was banned in 1977, concentrations of DBCP detected in the public water system wells have been either steady or decreasing trends. Presently, detections are found in 7 of the 47 public water systems, at concentrations below the MCL of 0.2 ppb.

Studies on the half-life of DBCP in groundwater estimate it will last from 3 to 400 years depending on ambient conditions. In 2008 the Department of Public Health (transferred to State Water Board as DDW in July 2014) estimated the median half-life of DBCP in the Central Valley is 20 years. This is consistent with the data that's been evaluated for this Subbasin since the levels are steady or decreasing.

2.7.3.5 1,2,3-Trichloropropane (TCP)

TCP is a semi-volatile organic compound with a primary drinking water MCL of 5 ppt. There is currently no federal MCL and no Agricultural Water Quality Goal. The majority of TCP in California's Central Valley is believed to be from an impurity in certain 1,3-D soil fumigants used to kill nematodes. When applied to land, TCP passes through soil and bonds to water, then sinks into the aquifer. It is a highly stable compound, meaning that it is resistant to degradation and has a half-life of hundreds of years[3].

Large public water systems began sampling their wells for TCP using a low-level analytical method around 2003, as a requirement of the Unregulated Chemical Monitoring Rule. From this data, DDW determined that the most impacted counties are Kern, Fresno, Tulare, Merced and Los Angeles. All water systems are required to test their wells quarterly beginning January 2018. Since only a few of the 47-public water system had data available in SDWIS at the time data was extracted for this report, the majority of detections were located in the central portion of the Subbasin. ***Figure 78*** shows wells with historical TCP detections in the Kaweah Subbasin.

2.7.3.6 Tetrachloroethylene (PCE) / Contamination Plumes

PCE is a volatile organic compound with a primary drinking water MCL of 5 ppb. There is no Agricultural Water Quality Goal for PCE. Sources of PCE include discharges related to dry cleaning operations and metal degreasing processes. An evaluation of contamination plumes in the Subbasin was identified through the SWRCB – GeoTracker and Department of Toxic Substances (DTSC) – EnviroStor databases. There is a total of 21 sites identified within the Kaweah Subbasin.

The largest PCE contamination plume involves nine sites in the city of Visalia, which are all dry cleaners. DTSC is leading this case and it's considered a city-wide investigation. According to the DTSC Fact Sheet dated January 2009, this investigation began after DTSC identified 25 public drinking water wells having detection of PCE. It is believed that the PCE plume is related to solvent releases from dry cleaning facilities in the city of Visalia. Soil and groundwater samples were first collected in 2007. Currently, the database indicates that from the nine sites identified there are three municipal drinking water wells that are within 1,500 feet of the plume vicinity. The three wells are located within the Cal Water area. One of the wells was shut down in 2000 due to PCE detection over the MCL. The well is now back online with PCE treatment.

Cal Water and DTSC entered into their first agreement in May 2007. One of the agreements identified between the two parties was for Cal Water to assist in preventing groundwater wells from spreading the PCE plume by early identification of problem areas or determination of appropriate remedial actions such as continued monitoring, pumping, not pumping, treatment, or well

---

[3] Transformation and biodegradation of 1,2,3-trichloropropane (TCP) 2012. https://link.springer.com/content/pdf/10.1007%2Fs11356-012-0859-3.pdf

destruction. The agreement was amended in June 2009 and again in March 2013. The most recent agreement stated for Cal Water to evaluate the effects of pumping groundwater at two specific well locations. Subsequently the evaluation was focused to one well and based on a report completed in November 2015 of that well, it showed that the well resides in a dynamic geohydrologic environment. When the well is not pumping or under ambient condition, fresh water displaces PCE contaminated water from the shallow part of the aquifer near the well. When the well is pumping, it draws in the water from deep and shallow sources, including upper aquifer contaminated water. ***Figure 76*** shows the increasing PCE levels of the Cal Water well, with it peaking at 270 ppb in July 2014. Levels have significantly decreased but intermittently show increasing trends.

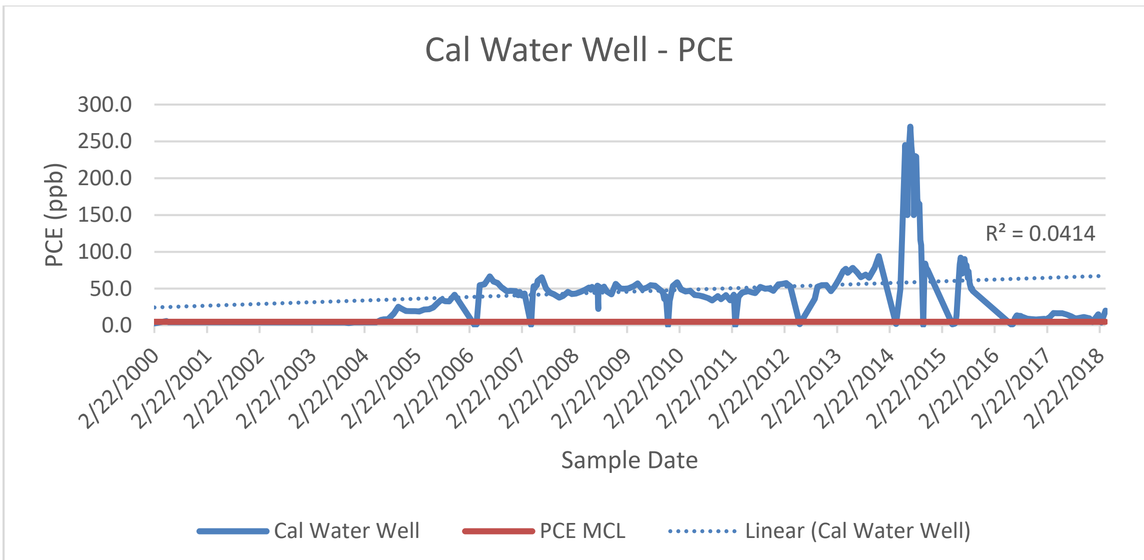


Figure 76: Historical PCE Levels of Cal Water Well Impacted by PCE Plume

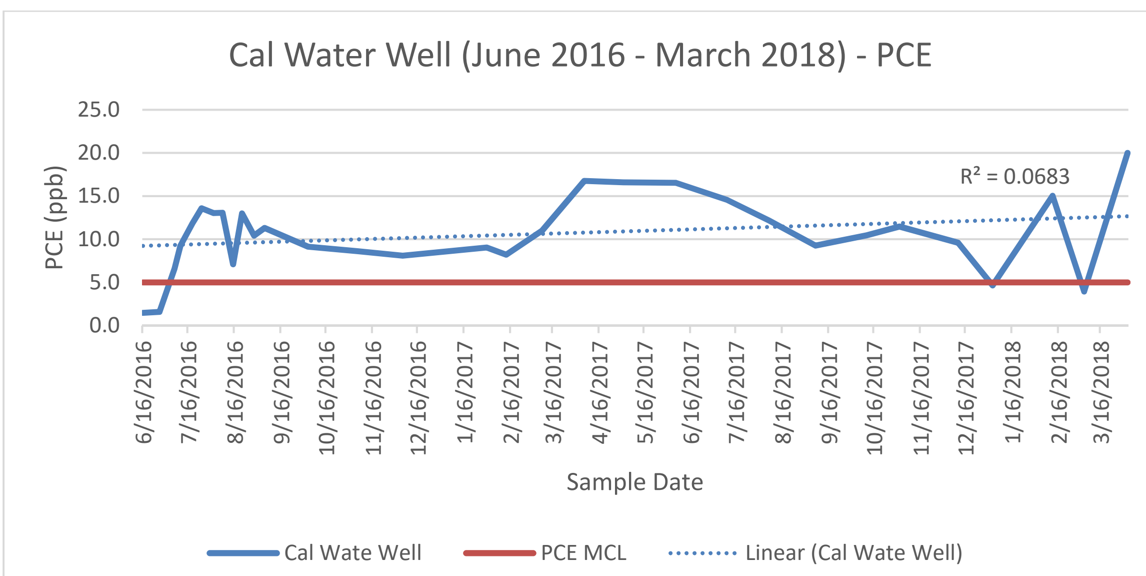


Figure 77: PCE Levels of Cal Water Well Impacted by PCE Plume from June 2016 – March 2018

This city-wide PCE investigation is still underway and each of the nine sites are in varying stages of investigation with work plans approved by DTSC. Monitoring wells that have been installed with screens about 100 feet below ground surface (bgs) have detected PCE levels above 5 ppb. The size of the plume has not been determined and is still under investigation. ***Figure 79*** shows the nine sites in relation to the municipal drinking water wells.

Other contamination sites were identified within the Subbasin. These other sites are summarized in ***Table 42*** An extensive summary for each of the contamination sites is not presented since most did not have more recent information or reports on the ongoing investigation of these sites. From reviewing the available reports, none of the sites listed have been determined to have an impact on the aquifer.

Table 42: Summary of Active Contamination Sites Not Part of PCE City-Wide Investigation

Global ID# / EnviroStor ID#	Lead Agency	Potential Contaminants of Concern	DDW Wells within 1500 Feet of Site	Status
SLT5FR184373 / 54270005	DTSC	VOC	No	Open – Remediation as of 5/12/10
SLT5FT344509	Regional Board	TCA, DCE, other inorganic/salt	Yes, but well inactivated in 2014	Open – Site Assessment as of 4/18/16
SL0610711757	Regional Board	Gasoline, MTBE, TBA, other fuel oxygenates, Diesel	Yes, but well was destroyed in 1995	Open – Inactive as of 4/28/16
T0610700032	Regional Board	Gasoline	No	Open – Eligible for closure as of 8/30/17
T0610700138	Regional Board	Gasoline	Yes	Open – Assessment & interim remedial action as of 1/29/17
T0610700075	Regional Board	Gasoline	Yes	Open – Site assessment as of 8/1/17
T10000011363	Regional Board	Polychlorinated biphenyls (PCBs), insecticides, pesticides, herbicides, arsenic, lead, mercury, total petroleum hydrocarbons (TPH) After testing, focus is arsenic	Yes – 4 total, but 3 have been inactivated in 1984 due to water system inactivation	Open – Site assessment as of 3/5/18
SL205194270	Regional Board	PCE, TCE, other chlorinated hydrocarbons	None identified, but reports indicate impacts to wells	Open – Verification monitoring as of 4/18/16

Global ID# / EnviroStor ID#	Lead Agency	Potential Contaminants of Concern	DDW Wells within 1500 Feet of Site	Status
SLT5FT424517	DTSC	Pesticides/ Herbicides	No	Open – Site assessment as of 1/22/87
SLT5S3483663	Regional Board	Pesticides, herbicides	No	Open – Inactive as of 5/21/09
80001396	DTSC	Soil - Lead, Sulfuric acid, TPH	No	Open – Active as of 1/1/08
80001510	DTSC	Cadmium, copper, lead, and zinc	Unknown	Open – Active as of 3/1/17

Out of all the contamination sites identified, there are 16 contamination sites that will need to be monitored to determine the extent of impact to the groundwater (***Figure 80***). Sites that have no information at all or eligible for closure is not counted towards the 16 contamination sites that needs further monitoring. The 9 PCE sites that are not listed in the table are also included in the count of 16 sites. In some of the sites, shallow monitoring wells went dry due to the water table levels dropping and deeper monitoring wells had to be drilled to continue the investigations. Currently, there is not enough information to determine if the contaminants are sinking with the groundwater levels. The main constituents of concern due to contamination plumes in this Subbasin are volatile organic compounds (VOCs), more specifically PCE and TCE, and gasoline related constituents. The two pesticide/herbicide plumes that were identified in the GeoTracker database have no information or data available.

2.7.3.7 Sodium and Chloride

Based on drinking water standards, the recommended secondary maximum contaminant level (SMCL) of chloride is 250 parts per million (ppm) with an upper limit of 500 ppm. There is no primary drinking water standard for sodium, however Water Quality Goals for Agriculture, published by the Food and Agriculture Organization of the United Nations in 1985, has set Agricultural Water Quality Goals for sodium and chloride at 69 ppm and 106 ppm, respectively. The criteria identified are protective of various agricultural uses of water, including irrigation of various types of crops and stock watering. These levels are used as a baseline to compare against and are not intended to represent an acceptable maximum value for the Subbasin. Since a majority of the land use in the Subbasin is irrigated lands, the Agricultural Water Quality Goals for sodium and chloride are used for this portion of the water quality evaluation.

There are four primary sources of sodium: agriculture, municipal, industrial, and natural. Agriculture practices result in evaporation of irrigation water which removes water and leaves the salts behind. Plants may also naturally increase soil salinity as they uptake water and exclude the salts. Application of synthetic fertilizers and manure from confined animal facilities are also other means by agriculture. A municipal source of sodium occurs through the use of detergents, water softeners, and industrial processes. Wastewater discharged to Publicly Owned Treatment Works (POTWs) and septic systems can increase salinity levels. An industrial source is by industrial processes such as cooling towers, power plants, food processors, and canning facilities. The last source is naturally from the groundwater, which contains naturally-occurring salts from dissolving rocks and organic material.

Only a few wells within the Kaweah Subbasin that have increasing or elevated sodium and chloride levels. However, there are small pockets within the Subbasin that have increasing or elevated sodium and chloride levels. ***Figure 81*** identifies where those wells are located. Sodium and chloride levels are increasing and, in some cases, already over the Agricultural Water Quality goals.

Figure 82 shows trends from two wells in a public water system located between Highway 65 and the Friant-Kern Canal with increasing chloride trends that have exceeded the Agricultural Water Quality goals and in one well, also exceeding the secondary drinking water standard. ***Figure 83*** also shows trends from wells within the City of Lindsay, where the chloride levels show a similar trend.

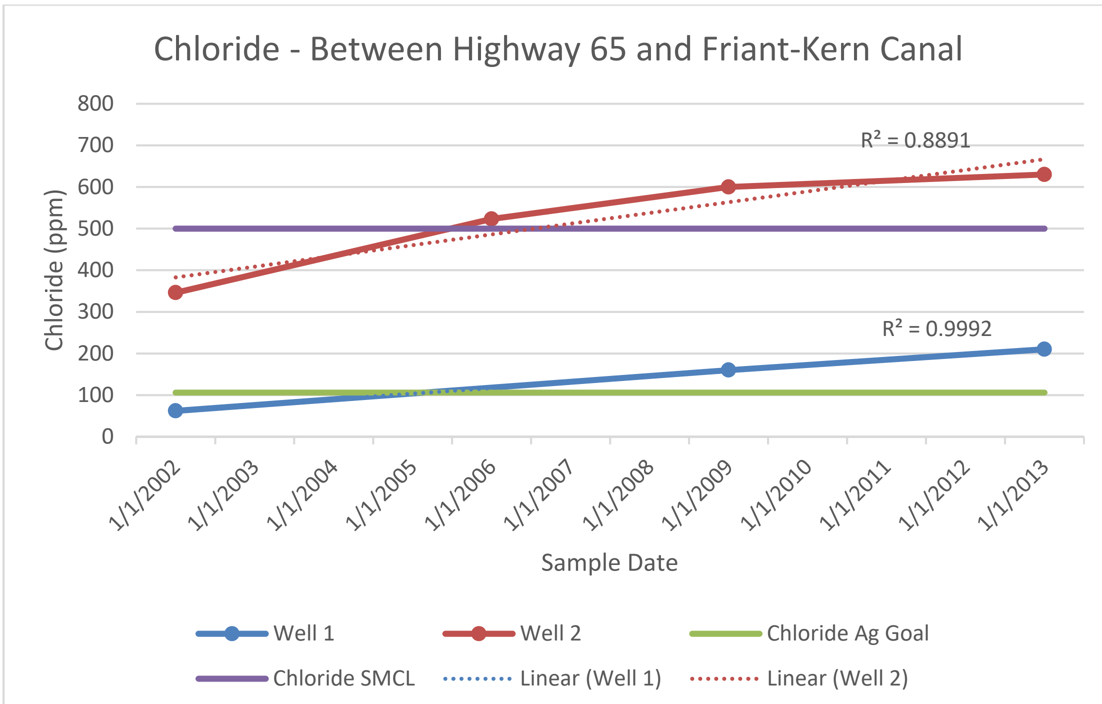


Figure 82: Chloride Trend of Two Wells Located Between Highway 65 and Friant-Kern Canal

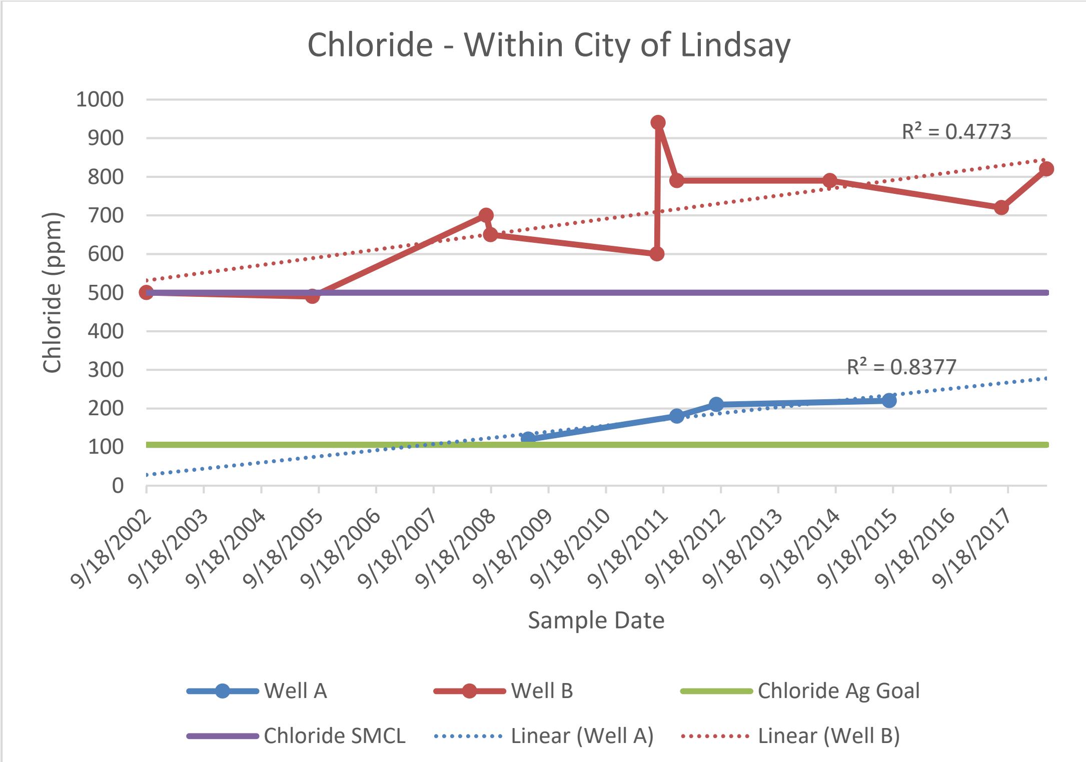


Figure 83: Chloride Trends of a Public Water System with Wells Within City of Lindsay

Findings from this evaluation show that the most common water quality issues within the Subbasin are: nitrate, arsenic, and PCE. Wells with high arsenic correlates with deeper, older water that is associated with the Corcoran Clay. The pH levels were also higher with wells having arsenic levels over 10 ppb. Nitrate is prevalent throughout the Subbasin with higher concentrations from east of Highway 63 to Highway 245 in the north and from Road 152 to the eastern extent of the Subbasin. These zones had greater than 50% of the land use as orchard and vineyards. Also, septic system density is greater in these areas compared to the rest of the Subbasin. Well construction also plays a factor in both elevated arsenic and nitrate levels. Deeper wells, greater than 250 ft., tend to have higher arsenic levels. On the other hand, shallow wells or wells with sanitary seals less than 250 ft. tend to have higher nitrate levels. The city-wide PCE plume in Visalia is something that needs to be monitored since it is an ongoing investigation. All other constituents that were evaluated are not a Subbasin-wide issue.

2.8 Land Surface Subsidence §354.16 (e)

Inelastic (irrecoverable) land subsidence (subsidence) is a major concern in areas of active groundwater extraction due to increased flood risk in low lying areas; well casing, canal and infrastructure damage or collapse; and permanent reduction in the storage capacity of the aquifer.

2.8.1 Cause of Land Subsidence

Several processes contribute to land subsidence in the Subbasin and include, in order of decreasing magnitude: aquifer compaction by overdraft, hydrocompaction (shallow or near-surface subsidence) of moisture deficient deposits above the water table that are wetted for the first time since deposition, petroleum reservoir compaction due to oil and gas withdrawal, and subsidence caused by tectonic forces.

Inelastic compaction (subsidence) typically occurs in the fine-grained beds of the aquifers and in the aquitards due to the one-time release of water from the inelastic specific storage of clay layers caused by groundwater pumping. When long-term groundwater pumping and overdraft occurs, the aquifer system can become depressurized, and water originally deposited within the fine-grained units can be released from the clay layers. This depressurization allows for the permanent collapse and rearrangement of the structure, or matrix, of particles in fine-grained layers. Groundwater cannot re-enter the clay structure after it has inelastically collapsed. This condition represents a permanent loss of the water storage volume in fine-grained layers due to a reduction of porosity and specific storage in the clay layers. Although space within the overall aquifer is reduced by subsidence of the land surface and reduced thickness of the clay layers, this storage reduction does not substantially decrease usable storage for groundwater because the clay layers do not typically store significant amounts of recoverable, usable groundwater (LSCE, 2014). However, this one-time release of water from compaction has been substantial in some areas of the San Joaquin Valley. Although the largest regional clay unit in and adjacent to the Kaweah Subbasin is the Corcoran Clay, a relatively insignificant volume of water has been released from storage from it (Faunt et al., 2009). This is likely because of its large thickness and low permeability. However, the groundwater quality of the aquifers, however, could be impacted by the lower quality of groundwater emanating from the depressurized clay layers.

2.8.2 Regional Cause and Effect of Subsidence

Figure 84 through ***Figure 88*** of this section present land subsidence at a subbasin scale; however, the data also show that subsidence occurs regionally where the Corcoran Clay and other associated fine-grained units are present in the subsurface. Areas where greater groundwater pumping has occurred coupled with newly installed deeper well screen intervals below the Corcoran Clay may contribute to land subsidence from dewatered clays in previously unpumped depth intervals of the aquifer system. This topic is further discussed in the sustainable management criteria section of this report. These pumping intervals occur in the Kaweah Subbasin as well as in neighboring subbasins to the Northwest, West, Southwest, and South of the Subbasin. Additional data and coordination between subbasins are recommended to better understand the effects of groundwater management on the mitigation of land subsidence.

2.8.3 Past Land Subsidence

Historical documentation of subsidence within the Central Valley has relied on various types of data, including topographic mapping and ground surveys (including the remote sensing NASA JPL InSAR data), declining groundwater levels, borehole extensometers, and continuous GPS station information. Within the Subbasin, subsidence has been documented by the National Geodetic Survey at up to 8 feet from 1926 to 1970, as shown on ***Figure 84***. Groundwater overdraft (when there is a lack of surface water supply for irrigation) is considered to be the primary driver for historical land subsidence in the Central Valley (Faunt et. al., 2009). USGS estimates that about 75 percent of historical subsidence in the Central Valley occurred in the 1950s and 1960s, corresponding to extensive groundwater development. Time-series charts of historical water levels were compared with the DWR water year indices corresponding to above normal, below normal, and normal climatic conditions. In general, water levels declined during below normal water year indices (critical, dry, or below normal), while water levels were more stable or recovering during high water year indices (wet, above normal).

2.8.4 Recent Land Subsidence

Recent subsidence studies of the Central Valley, including the Subbasin, have utilized satellite-based, remote sensing data from the InSAR and aircraft-based L-band SAR or Unmanned Aerial Vehicle Synthetic Aperture Radar (UAVSAR) programs, led by NASA/JPL, as well as other international researchers. These datasets, shown on ***Figure 85*** and ***Figure 86***, provide a continuous estimate of subsidence over a large portion of the Subbasin. The annual rate of subsidence for these datasets are shown on ***Figure 87*** through ***Figure 88***.

Recent subsidence in the Subbasin and in the Tule Subbasin (immediately to the south) can also be observed at two continuous GPS (CGPS) stations, shown on ***Figure 85*** through ***Figure 88***. These monitoring points are located to the northwest of Farmersville (station P566), and southwest of Porterville (P056) and provide recent, localized subsidence data from November 2005 to present. These CGPS stations are monitored as a part of UNAVCO's Plate Boundary Observation (PBO), the California Real Time Network (CRTN) and California Spatial Reference Center (CSRC) of the Scripps Orbit and Permanent Array Center (SOPAC). Daily CGPS position time-series data with 6 month moving averages are plotted and displayed with InSAR data for comparative purposes on ***Figure 85*** through ***Figure 88***. The quality of these datasets is deemed "reproducible" by UNAVCO, and cumulative rates of subsidence were calculated by taking annual water year averages of the dataset. Annual averages of CGPS or future extensometer data may permit a more meaningful comparison with InSAR data in future calculations and analyses. Another dataset to be used in the future for comparing InSAR and CGPS data, are level surveying data from local subsidence monitoring benchmarks. These benchmarks represent a piece of the subsidence monitoring network as described in the monitoring section of this report.

Time-series charts of subsidence data are included on ***Figure 85*** and ***Figure 86***, and are compared with the DWR water year indices. Greater rates of compaction/subsidence generally correlate with below normal water year indices (critical, dry, or below normal), while lower rates of subsidence are observed during high water year indices (wet, above normal). The inserted hydrographs show that, in recent times, nearby water levels do not consistently correspond with DWR water year indices, likely due to changes in groundwater management practices and improved surface water supplies since the 1960's. Upon further examination of time-series data for the Corcoran Station, water levels in the lower aquifer (deep) better correlate with the water year indices and changes in subsidence rates, in contrast to the water levels in the upper aquifer (shallow), which do not correlate as readily with changes in subsidence rates.

Recent and historical subsidence data are summarized in ***Table 43.*** It includes a summary of InSAR data published in a subsidence study commissioned by the California Water Foundation (LSCE, 2014), and by JPL. The InSAR data were collected from a group of satellites (Japanese PALSAR, Canadian Radarsat-2, and ESA's satellite-borne Sentinel-1A and -1B), from 2006 to 2017, with a data gap from 2011 to 2014 because there was a gap in satellite data collection until the ESA Sentinel satellites were launched in 2014.

According to the California Water Foundation study (LSCE, 2014), subsidence is on-going and leading to significant impairment of water deliveries from the Friant-Kern Canal south of the Kaweah Subbasin. According to DWR (2014), the Kaweah Subbasin was rated at a high risk for future subsidence due to 1) a significant number of wells with water levels at or below historical lows; 2) documented historical subsidence; and 3) documented current subsidence. Moreover, greater amounts of subsidence are occurring to the west, southwest, and south of Kaweah in adjacent subbasins. The amount of future subsidence will depend on whether future water level elevations decline below previous lows and remain at these levels for years. Maintaining water at a suitable water level elevation (threshold) may limit future subsidence caused by groundwater pumping within the Kaweah Subbasin.

2.8.5 Subsidence Locations

Historical subsidence within the Subbasin, as determined by the data sources discussed above, are presented on ***Figure 84*** through ***Figure 88***. Hydrographs for selected wells are plotted with subsidence data for comparison purposes. Although undesirable results due to subsidence are dependent up on declines in groundwater elevations and potentiometric surfaces for deeper aquifers, the presence of regional fine-grained stratigraphic units, such as the Corcoran Clay, and localized areas of substantial thicknesses of fine-grained layers is also a major factor. Likewise, key infrastructure that may be impacted by land subsidence should also be considered to determine areas that are sensitive to impacts from subsidence.

In general, groundwater levels lowered by pumping correspond with observed land subsidence, as seen on ***Figure 84***. The groundwater elevation declines shown on this figure can also be compared to the subsidence trends shown on other subsidence maps. The magnitude and annual rate of subsidence increases toward the west and southwest within the Kaweah Subbasin, and progressively increase to the south and west of the Subbasin boundaries, according to InSAR data as well as CGPS data and historical data from the Deer Creek Extensometer and surveying information along the Friant-Kern Canal.

Cumulative and annual rates of recent subsidence (Spring 2015 through 2017) are presented in ***Figure 86*** and ***Figure 88***, respectively. When compared to the cumulative and annual rates of subsidence shown for January 2007 through May 2011, shown on ***Figure 85*** and ***Figure 87***, it is apparent that land subsidence has increased in recent years, in response to drought conditions and increased groundwater demand. This trend is also reinforced by regional extensometer and CGPS data. Overall the limited CGPS data presented in the figures reasonably corresponds with the estimated magnitude of subsidence estimated by the InSAR data.

2.8.6 Measured Subsidence

The following tabulated data includes cumulative inches of subsidence within Kaweah, and approximate annual rates for various data collection periods.

Table 43: Land Subsidence Data

Subbasin Area	Date Range	Cumulative Subsidence (inches)	Calculated Annual Rate of Subsidence (inches/year)	Source
Kaweah Subbasin	1926 - 1970	~0 - 96	0 – 2.2	Ireland, 1984. Topographic Maps and Leveling Data.
North of Farmersville	2007 - 2017	4.9	0.5	CGPS PBO (P566). Data are averaged by water year 2007 to 2017
South of Porterville (just outside of Subbasin)	2007 - 2017	21.3	2.1	CGPS PBO (P056 just south of Subbasin). Data are averaged by water year 2007 to 2017
Deer Creek. South of Porterville	1970 – 1982	15.8	1.3	Extensometer Data from USGS CA Water Science Center
Corcoran[4]	Sep. 2010 – May. 2017	76.35	11.4	Corcoran CGPS Station (CRCN). Central Valley Spatial Reference Network (CVSRN) Caltrans via California Real Time Network (CRTN) at SOPAC.
West and central Kaweah Subbasin *(Highest values in SW near Corcoran)*	Jan. 2007 – Mar. 2011	0 – 33.9	0 - 8	LSCE, 2014. Compiled from InSAR.
Kaweah Subbasin *(Highest values in SW near Corcoran)*	2015 - 2017	0 – 26.7	0 – 13.4	InSAR. Downloaded from DWR SGMA Viewer.
Mile Post 88. Friant-Kern Canal (FKC). Between Lindsay and Strathmore	1945/1951 to 2017	~4.6	~0.07	USBR FKC Subsidence Monitoring Surveys. NGVD29 to NAVD88
Mile Post 92 FKC. South of Subbasin	1945/1951 to 2017	~6.7	~0.1	
Mile Post 95 FKC. Tule River Siphon	1945/1951 to 2017	~21.6	~0.3	

[4] Cumulative Subsidence calculated from Annual Rate Value of 11.4 inches per year.

Subbasin Area	Date Range	Cumulative Subsidence (inches)	Calculated Annual Rate of Subsidence (inches/year)	Source
	1959 to 2017	~20.3	~0.4	
Mile Post 96 FKC. South of Tule River.	1945/1951 to 2017	~27.4	~0.4	
	1959 to 2017	~25.2	~0.4	
Mile Post 99 FKC. West of CGPS P056	1945/1951 to 2017	~78.9	~1.1	

Although the highest rates of subsidence occur outside of the Kaweah Subbasin; to the west and south in the Tulare Lake and Tule subbasins, respectively; there has been significant subsidence within the Subbasin, largely focused in the western and southwest portions. It is apparent that this subsidence is coincident with both a decline in water levels from pumping near Corcoran, as well as pumping within the Kaweah and the Tule subbasins. Higher levels of subsidence have also been estimated southeast of Tulare and appear to correlate with neighboring subsidence in the Tule Subbasin. Overall, annual subsidence rates vary spatially but have increased in magnitude during the recent drought conditions, as groundwater supplied a higher percentage of agricultural demand.

2.8.7 Release of Water from Compression of Fine-Grained Units

Long-term overdraft conditions from groundwater pumping can lead to depressurization of the aquifer system and corresponding dewatering of fine-grained units (or dewatering of clays). The one-time release of water from dewatered clays may represent a one-time principle source of groundwater released from storage to the aquifer system, because fine-grained deposits constitute more than half of the unconsolidated sediments in the Central Valley (Faunt et. al., 2009). The 1989 USGS model (CV-RASA) and other studies attributed most of this one-time release of water to the aquifer system to dewatering of fine grained interbeds of clays and not from regional confining beds such as the Corcoran Clay (Ireland and others, 1984; Williamson and others, 1989; and Faunt et. al., 2009). It is further postulated that "a relatively significant volume of water has not yet been released from storage in the Corcoran Clay" (Faunt et. al., 2009).

2.8.7.1 Water Volume Calculation

The dewatering of clays may lead to measurable land subsidence, in which case, a rudimentary estimate of the volume of water contributing to the aquifer system by the dewatering of clays can be calculated. The land subsidence is a proxy for estimating one-time release of water from clays to aquifer system. A rough estimate of the volume water is calculated herein, by taking the land surface area multiplied by the measured change in vertical elevation of land surface, mostly attributed to land subsidence. Ideally, extensometers would provide depth-specific measurements of compaction of specific zones, instead of using changes in land surface; however, CGPS measuring points were used in the absence of extensometer data for this calculation. In addition, reliable InSAR data are not available for this time period, or for the entire Subbasin, to use as a control for this calculation. For a preliminary volume calculation of one-time water release from the clay layers to the aquifer system, the Subbasin was divided into relative zones of decreasing subsidence starting from the Southwest of the basin to the East-Northeast. These zones were approximated by using the 2015 to 2017 InSAR data as a qualitative tool to identify regimes or different zones of cumulative subsidence.

Figure 77 illustrates the zones which were chosen to correspond with nearby areas of subsidence that have a CGPS station. The Southwest zone corresponds with the 1. CRCN Corcoran station, the adjacent area to the Northeast corresponds with the 2. P056 Porterville station, the next adjacent area corresponds with the 3. P566 Visalia station which is situated in this zone, and the 4. Eastern-most area where negligible to zero subsidence has historically been recorded is not assigned to a CGPS station but is estimated as zero for this calculation. These areas or regimes of subsidence are base only on InSAR data and would require further refinement by additional data for better accuracy. It is likely that the Southwestern-most zone is overestimating the amount of water contributed to the system due to clay dewatering because the Corcoran station reports very high values of subsidence, which decreases rapidly toward the Northeast. The date range of analysis was chosen from September 30, 2011 to September 30, 2017, for the CGPS Stations as presented in ***Table 44***.

Table 44: Preliminary Estimate of Volume of Water (AF) by Land Subsidence (2011 to 2017)

Year	1. CRCN	2. P056	3. P566	4. East
	(Mean Vertical Change (inches))			
2011	-0.8	-5.2	-2.4	--
2012	-3.7	-6.1	-2.7	--
2013	-15.5	-7.4	-3.1	--
2014	-27.2	-9.5	-3.5	--
2015	-38.9	-12.5	-4.0	--
2016	-52.4	-16.9	-4.6	--
2017	-62.1	-22.1	-5.3	--
Cumulative Total (inches) (9/30/11 to 9/30/17)	-61.3 (-5.1 ft)	-16.9 (-1.4 ft)	-2.9 (-0.2 ft)	-- (0 ft)
Rate (inches/year) (9/30/11 to 9/30/17)	-10	-2.8	-0.2	--
Acreage for each Subsidence Area	98,100	156,000	127,700	64,300
Preliminary Estimate of Volume of Water (AF) by Land Subsidence (2011 to 2017)	500,600	219,300	31,700	0

2.9 Interconnected Surface Water

Both the loss of streamflow to groundwater (losing streams) and the loss of groundwater to surface streams (gaining streams) are part of the natural hydrologic system. The direction of flow depends on the relative elevation of these inter-connected waters, and the rate of flow depends on the properties of the aquifer matrix and the gradients of the water sources. Many surface water-groundwater systems reverse the flow direction seasonally in response to either groundwater extraction or significant groundwater recharge related to spring and early summer runoff.

The flow rate between interconnected surface water-groundwater systems will generally increase as groundwater levels are pumped below the bottom of the surface channel and the flow gradient steepens. While not altogether common in the southern San Joaquin Valley, in many areas, the depth-to-groundwater results in a nearly vertical gradient from the surface stream, and depletion of streamflow becomes nearly constant, varying only with the wetted area of the stream channel.

Declining groundwater levels may decrease the discharge to surface streams and result in reduced instream flow and supply to wetland, estuary areas, and other groundwater dependent ecosystems. Loss of streamflow may reduce the supply available for downstream diverters or require additional releases to be made from surface water reservoirs to meet required instream and downstream needs.

An analysis of baseline conditions has been performed, which considered both local knowledge of natural streamflow within the Kaweah River system including timing and flow regimes (gaining and losing stretches) and gaged streamflow compared to groundwater-level information. Based on this, an estimate of streamflow contribution to the groundwater supply is included in the water budget for the period between water years 1981 and 2017.

Because the streamflow data has been compiled from continuous monitors (Parshall flumes) located throughout a majority of the Subbasin and compiled for every month of the base period, the cumulative effects of both wet year and drought year impacts are well-understood. Furthermore, semiannual groundwater-level measurements collected within Subbasin wells support the understanding of the variability of the relative proximity and/or separation of the surface water from the groundwater in both wet and drought conditions.

In general, the vast majority of the natural streams and manmade ditches (channels) throughout the Subbasin are considered losing channels throughout the year with considerable vertical separation between the channels and groundwater. This vertical separation and disconnection between surface and groundwater throughout much of the San Joaquin Valley floor is recognized by DWR and USGS in the conceptualizations for their regional numerical groundwater models CVHM and C2VSim. Streams located in the eastern portion of the Subbasin, generally between the Friant Kern Canal eastward to McKay Point (See ***Figure 20***), are more likely to be relatively neutral to gaining stream reaches during limited times of year.

2.10 Groundwater Dependent Ecosystems

Where groundwater and surface water are separated by significant distances, as is the case with most of the Kaweah Subbasin, the groundwater does not interact with the natural streams or manmade ditches. In these areas, therefore, no possibility exists for the presence of Groundwater Dependent Ecosystems to exist. However, where the base of the aquifer is relatively shallow, as is the case along the eastern boundary of the Subbasin adjacent the Sierra Nevada, groundwater levels are closer to the surface.

As presented on ***Figure 19***, areas where groundwater is within 50 feet of the ground surface are located along the Kaweah River (Greater Kaweah GSA) and in two areas within the East Kaweah GSA. Notably, these represent areas where groundwater elevations as of the Spring of 2015 has risen to within 50 feet of the ground surface. The indicated areas are preliminary and subject to review of the local GSAs, who know better which areas can be considered Potential GDEs. This can be addressed as part of a further study.

2.11 Conditions as of January 1, 2015

Groundwater levels measured in the spring and fall of each year by the DWR and member agencies provide the data required to document groundwater conditions January 1, 2015, as required. To document the groundwater conditions as of January 1, 2015 when SGMA was enacted, we are using the first round of groundwater level measurements that occurred after that date as the "baseline" condition against which future conditions will be compared. Groundwater levels at that time are presented as ***Figure 30***, along with the water level hydrographs presented as ***Figure 35***.

Review of the map and hydrograph indicate that water levels were near the lowest levels on record. In the spring of 2015 groundwater elevations varied from as low below sea level in the western portion of the basin near the cities of Hanford and Corcoran, to a high of over 400 feet above in the East Kaweah GSA area. As discussed, the exceptionally high pumpage was due in part to the severe drought coupled with a complete lack of delivery of imported CVP water for two years leading up to this period.

2.12 References

Ayers, R.S., and Westcot, D.W. 1985. Water Quality for Agriculture – FAO Irrigation and Drainage Paper 29 rev. 1. Food and Agriculture Organization of The United Nations (FAO). (http://www.fao.org/docrep/003/t0234e/t0234e00.htm)

Bertoldi, Gilbert L., Johnston, Richard H., and Evenson, K.D. 1991. *Ground Water in the Central Valley, California - A Summary Report*, USGS Professional Paper 1401-A.

Bookman-Edmonston Engineering (B-E). 1972. *Report on Investigation of the Water Resources of Kaweah Delta Water Conservation District*, consultant's unpublished report prepared for the Kaweah Delta Water Conservation District, February.

Belitz, K. and Burton, C, 2012, *Groundwater quality in the Southeast San Joaquin Valley, California*: U.S. Geological Survey Fact Sheet 2011-3151, 4 p. (https://pubs.usgs.gov/fs/2011/3151/pdf/fs20113151.pdf)

Bureau of Reclamation (USBR). Technical Studies in Support of Factual Report, Ivanhoe Irrigation District. Fresno; Apr 1949. 199 p.

Bureau of Reclamation (USBR). Exeter Irrigation District and Stone Corral Irrigation District Irrigation Suitability Land Classification Report, Volume 2 of 2, Technical Studies in Support of Factual Report, Exeter Irrigation District. Fresno; Nov 1949. 174 p.

_____, 1948. Geologic Study of the Lindmore Irrigation District. Fresno; 29 p, June.

____, 1949. Exeter Irrigation District and Stone Corral Irrigation District Irrigation Suitability Land Classification Report, Volume 2 of 2, Technical Studies in Support of Factual Report, Exeter Irrigation District. Fresno, 174 p, November.

____, 1949. *Factual Report Ivanhoe Irrigation District, Central Valley Project, California*. U.S. Bureau of Reclamation, Region II, Tulare Basin District, 80 pages.

Burton, C.A., Shelton, J.L., and Belitz, Kenneth, 2012, Status and understanding of groundwater quality in the two southern San Joaquin Valley study units, 2005–2006—California GAMA Priority Basin Project: U.S. Geological Survey Scientific Investigations Report 2011–5218, 150 p. (https://pubs.usgs.gov/sir/2011/5218/)

Burton, C.A., and Belitz, Kenneth, 2008, *Ground-water quality data in the Southeast San Joaquin Valley, 2005-2006 – Results from the California GAMA Program*: U.S. Geological Survey Data Series Report 351, 103 p. (https://pubs.usgs.gov/ds/351/)

California Department of Water Resources (CDWR), 2003. *California's Groundwater Bulletin 118, Update 2003.*

___, 2014. Historical, and Estimated Potential for Future Land Subsidence in California.

___, 2016. *California's Groundwater Bulletin 118, Update* 2016.

___, 2018. Guidance Document for the Sustainable Management of Groundwater, Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development.

California Regional Water Quality Control Board. 2003. *Initial Site Investigation Report, Country Club Cleaners, 2000 West Whitendale Avenue, Visalia, Tulare County*, July (http://geotracker.waterboards.ca.gov/regulators/deliverable_documents/8753980338/July%2016%202003%20Country%20Club.pdf)

California State Water Resources Control Board. 2016. Groundwater Ambient Monitoring and Assessment (GAMA) Domestic Well Project Groundwater Quality Data Report – Tulare County Focus Area, July 2016. (https://www.waterboards.ca.gov/water_issues/programs/gama/docs/tularesummaryreport.pdf)

Croft, M.G. 1968. Geology and Radiocarbon Ages of Late Pleistocene Lacustrine Clay Deposits, Southern Part of San Joaquin Valley, California, USGS Professional Paper 600-B, p. B151-B156.

Croft, M.G. and Gordon, G.V., 1968. Geology, hydrology, and quality of water in the Hanford-Visalia area, San Joaquin Valley, California (No. 68-67).

Davids Engineering. 2013. *Time Series Evapotranspiration and Applied Water Estimates from Remote Sensing*, consultant's unpublished report prepared for the Kaweah Delta Water Conservation District, March.

Davids Engineering, 2018. *Kaweah Subbasin Development of Evapotranspiration and Applied Water Estimates Using Remote Sensing,* consultant's unpublished report prepared for the Kaweah Delta Water Conservation District, November.

Davis G.H., Green, J.H., Olmsted, F.H., and Brown, D.W. 1959. *Ground-Water Conditions and Storage Capacity in the San Joaquin Valley, California*, USGS Open-file Report 1469.

Duffield, Glenn M., 2016. *Representative Values of Hydraulic Properties.* AQTESOLV. (http://www.aqtesolv.com/aquifer-tests/aquifer_properties.htm)

Dziegielewski, B. and Kiefer, J.C. 2010. *Water Conservation Measurement Metrics Guidance Report*. The American Water Works Association Water Conservation Division Subcommittee Report. January 22, 2010.

Farr, T.G., C. Jones, Z. Liu, 2015, Progress report: Subsidence in the Central Valley, California. Submitted to California Department of Water Resources. Available at: (http://www.nasa.gov/jpl/nasa californiadrought-causing-valley-land-to-sink)

___, 2016, Progress report: Subsidence in the Central Valley, California. Submitted to California Department of Water Resources

Faunt, C., R.T. Hanson, K. Belitz, W. Schmid, S. Predmore, D. L. Rewis, and K. McPherson, 2009, Groundwater availability of the Central Valley Aquifer, California. USGS Professional Paper 1766. Reston, Va.: United States Department of the Interior, Geological Survey. http://pubs.usgs.gov/pp/1766, 225.

Faunt, C.C., R.T. Hanson, and K. Belitz, 2009, Development of a three-dimensional model of sedimentary texture in valley-fill deposits of Central Valley, California, USA, Hydrogeology Journal (2010) 18: 625– 649.

Freeze, R.A., and Cherry, J.A., 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs.

Frink, J.W. and Kues, H.A. 1954. *Corcoran Clay, a Pleistocene Lacustrine Deposit in San Joaquin Valley, California*, American Association of Petroleum Geologists Bulletin, v. 38, no. 11, p. 2357-2371.

Fugro West, Inc. 2003 (revised 2007). *Water Resources Investigation of the Kaweah Delta Water Conservation District*, consultant's unpublished revised report prepared for the Kaweah Delta Water Conservation District, July.

Fugro Consultants, Inc. 2016. *Water Resources Investigation Update, Kaweah Delta Water Conservation District*, consultant's unpublished report prepared for the Kaweah Delta Water Conservation District, January.

GEI Consultants, Inc. 2016. *Review of Kaweah Delta Water Resources Investigation Reports*, consultant's unpublished technical memorandum prepared for the Mid-Kaweah Groundwater Sustainability Agency Technical Advisory Committee, July 28.

Grismer, M.E. 1990. *Leaching Fraction, Soil Salinity, and Drainage Efficiency*. Journal of California Agriculture, Vol. 44, No. 6.

Hilton, G.S., McClelland, E.J., Klausing, R.L, and Kunkel, F. 1963. Geology, Hydrology, and Quality of Water in the Terra Bella-Lost Hills Area, San Joaquin Valley, California, USGS Open-file Report, 158 p.

Jennings, C.W., 2010. Geologic Map of California, California Geological Survey.

KDWCD, 2012. *Groundwater Management Plan 2010 Annual Report,* consultant's unpublished report prepared for the Kaweah Delta Water Conservation District, August. (http://www.tulare.ca.gov/home/showdocument?id=2301)

Klausing, R.L. and Lohman, K.E. 1964. *Upper Pliocene Marine Strata on the East Side of the San Joaquin Valley, California, Art. 124* in Short papers in geology and hydrology, USGS Professional Paper 189-C, p. 81-102.

Luhdorff & Scalmanini Consulting Engineers (LSCE), J.W. Borchers, M. Carpenter. 2014. *Land Subsidence from Groundwater Use in California. Full Report of Findings* prepared for California Water Foundation. April 2014. 151 p (http://ca.water.usgs.gov/land_subsidence/california-subsidence-cause-effect.html).

Malcolm Pirnie, Inc. 2001. Evaluation Monitoring Program Report, An Interim Report for Phase I Investigations, Visalia Solid Waste Disposal Site, Visalia, California, Volume 1 of 2, consultant's unpublished report prepared for the county of Tulare Resource Management Agency, Solid Waste Division. May 2001.

Page, R.W. 1986. *Geology of the Tulare Formation and Other Continental Deposits, Kettlemen City Area, San Joaquin Valley, California*, with a Section on Ground-Water Management Considerations and Use of Texture Maps, USGS Water Resources Investigations Report 83-4000.

Park, W.H. and Weddle, J.R. 1959. Correlation Study of Southern San Joaquin Valley, Summary of Operations, in California Oil Fields, V. 45, No. 1, p. 33-34.

Provost and Pritchard, 2010. *Groundwater Management Plan,* consultant's unpublished report prepared for the Tulare Irrigation District, September. (https://water.ca.gov/LegacyFiles/groundwater/docs/GWMP/TL-22_TulareID_GWMP_2010.pdf)

Tulare Irrigation District (TID), 2012. *2012 Agricultural Water Management Plan.* PDF.

USDA, 2018. USDA National Agricultural Statistics Cropland Data Layer. 2018. Published crop-specific data layer (online). *Available at https://nassgeodata.gmu.edu/CropScape/ (accessed 3/29/2019). USDA-NASS, Washington, DC.*

USGS, 2015. *California Water Service Well 32-01 Final Results*. USGS Report. November 15, 2015. (https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/6835767984/usgs%20well%2032-01%20%20%20%2011%2010%202015.pdf).

___, 2012. *Status and Understanding of Groundwater Quality in the Two Southern San Joaquin Valley Study Units, 2005-2006: California GAMA Priority*. Scientific Investigations Report 2011-5218.

___, 1998. *Environmental Setting of the San Joaquin-Tulare Basins, California*. Water Resources Investigations Report 97-4205.

USGS and State Water Resources Control Board (SWRCB) 2017. *Groundwater Quality in the Shallow Aquifers of the Tulare, Kaweah, and Tule Groundwater Basins and Adjacent Highlands areas, Southern San Joaquin Valley, California,* Fact Sheet, January.

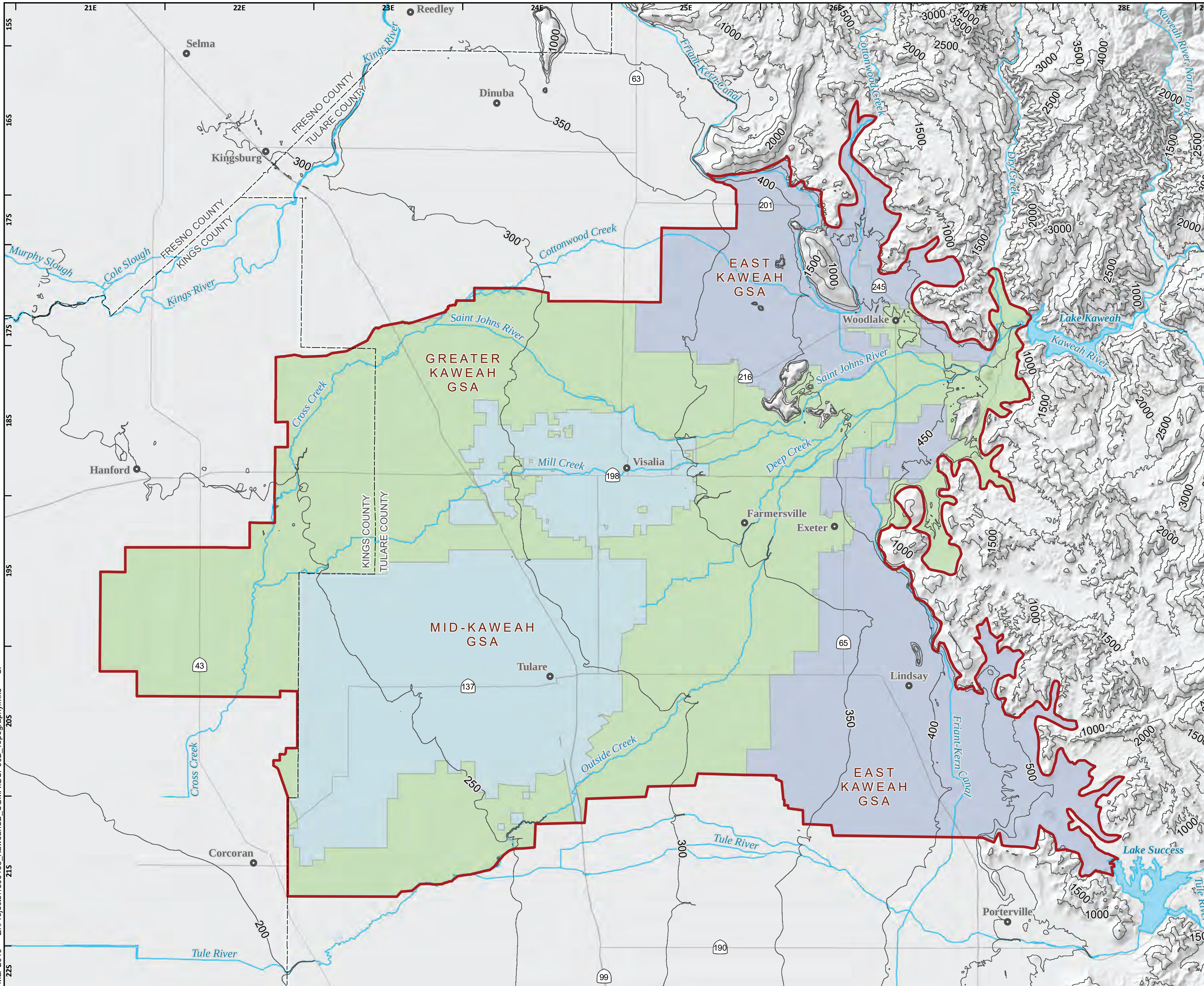
___, 2008. *Groundwater Quality Data in the Southeast San Joaquin Valley, 2005-2006: Results from the California GAMA Program,* Data Series 351.

Williamson, A.K., Prudic, D. E., and Swain, L. A., 1989. *Ground-Water Flow in the Central Valley, California*. USGS Professional Paper 1401-D.

Woodring, W.P., Stewart, Ralph, and Richards, R.W. 1940. *Geology of the Kettleman Hills Oil Field, California*, USGS Professional paper 195, 170 p., 15 figs.

Large Format Figures

TOPOGRAPHIC MAP



Topographic Elevation Contours

Ground Surface Elevation Contours (500-ft interval at greater than 500 ft msl; 50-ft interval at less than 500 ft msl)

GSA Boundaries

- East Kaweah GSA
- Greater Kaweah GSA
- Mid-Kaweah GSA
- Kaweah Subbasin Boundary

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

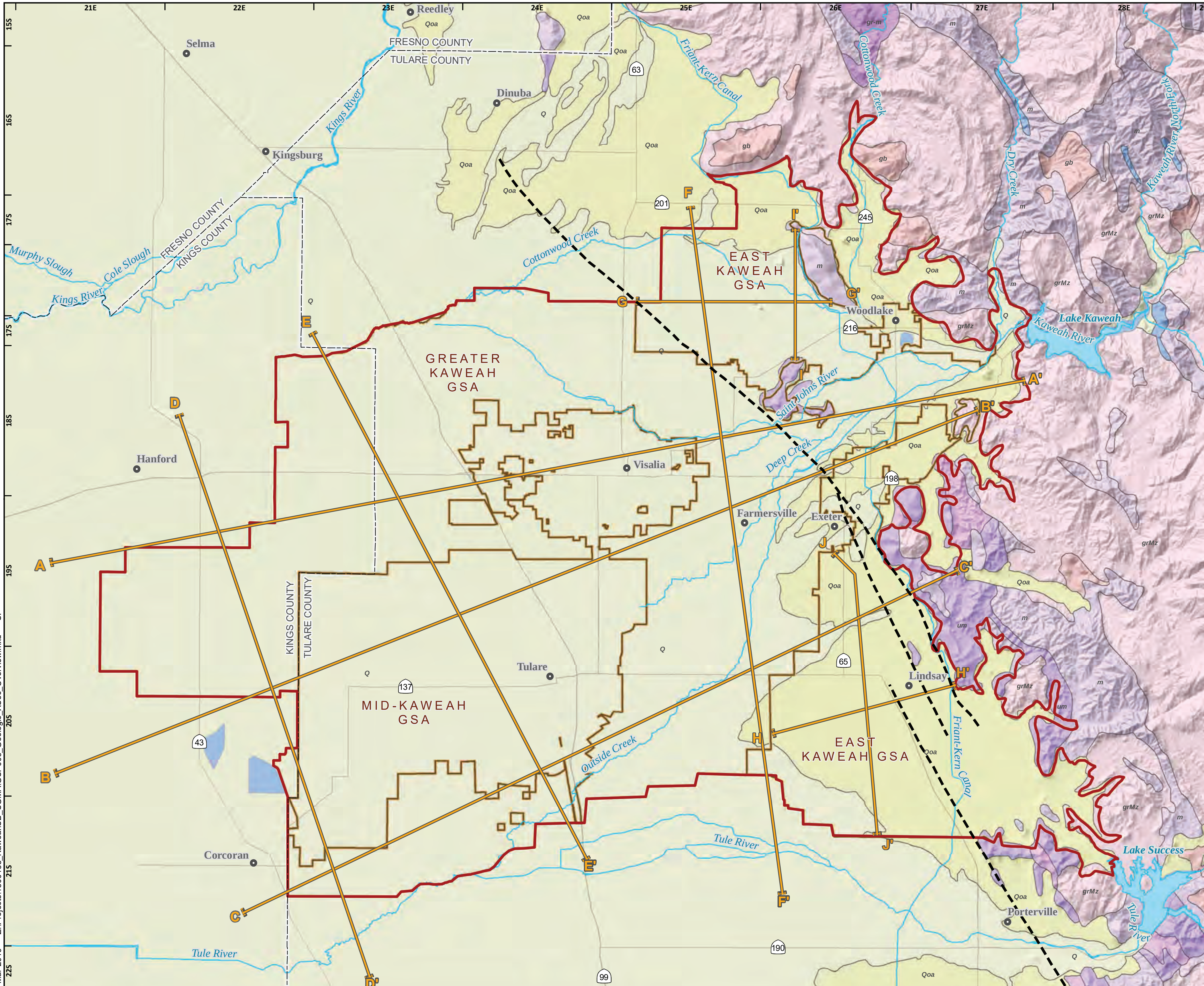
GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 1

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP002_Topography.mxd SI

GEOLOGIC AND CROSS SECTION LOCATION MAP



- Rocky Hill Fault Zone
- Cross Section Line

Surficial Geology

- Alluvium (Q)
- Older Alluvium (Qoa)
- Marine Sedimentary Rocks (ls)
- Mixed Granitic and Metamorphic Rocks (gr-m)
- Metavolcanic Rocks (mv)
- Granite (grMz)
- Ultramafic Plutonic Rocks (um)
- Gabbro (gb)
- Undated Granitic Rocks (gr)
- Mixed Rocks (m)
- Water
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lakes

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 3

Z:\Projects\1800138_KaweahSB_SGMA\GSP003_Geologic_XSec_Overview.mxd SI

15-Mar-2019

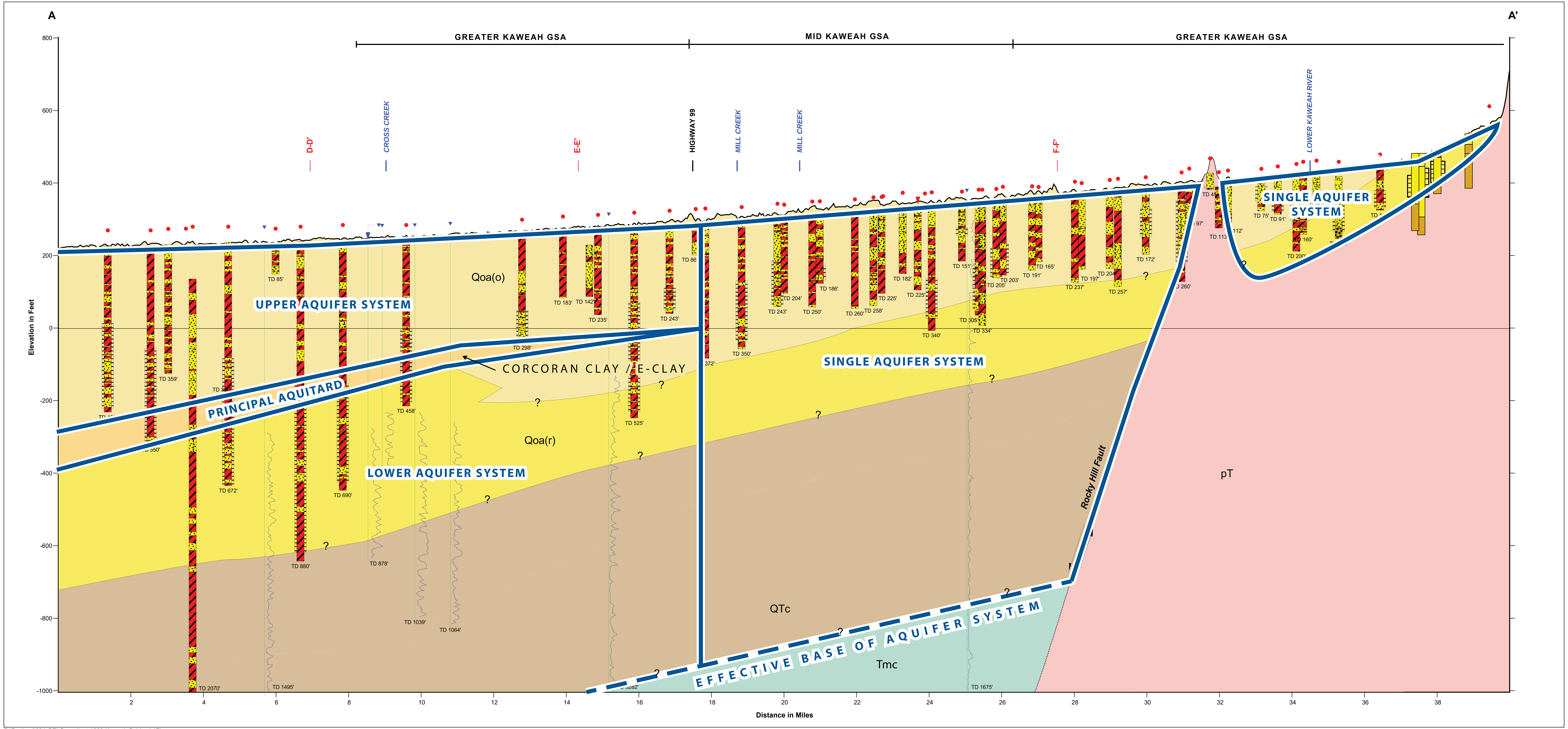


FIGURE 4

Cross Section A

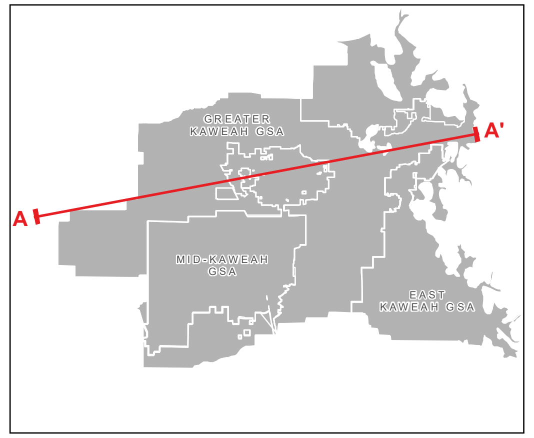
Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System

Boring

- Clay
- Sand
- Sandstone/Rock



NOTES:

Cross section modified from Fugro, 2007, Plate 14, Geologic Cross Section A

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.

SCALE

200 ft

0 — 2 mi

VERTICAL EXAGGERATION: 52.8X

GEI Consultants

GSI Water Solutions, Inc.

P:\Portland\634-GEI Consultants\003-Kaweah Subbasin\Figures

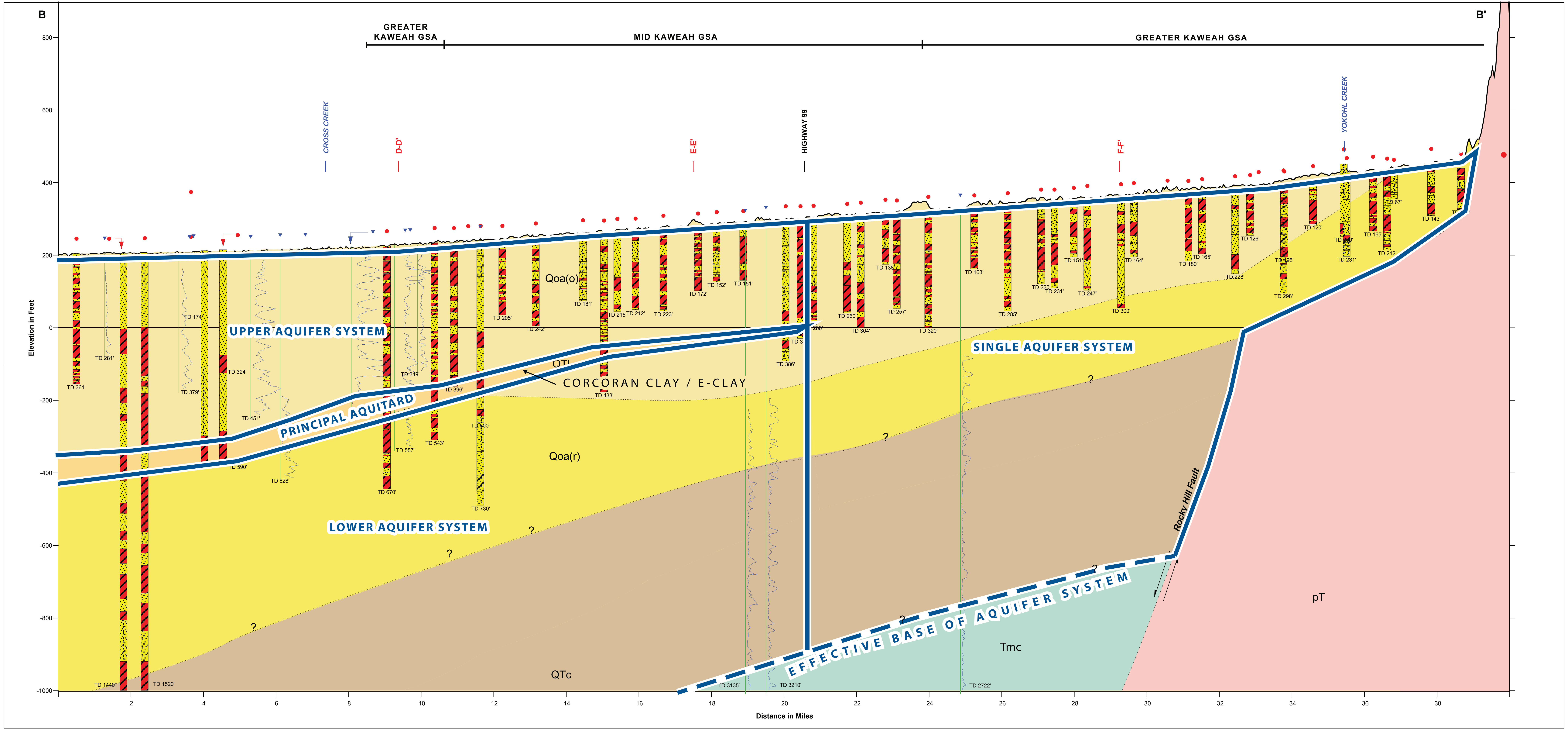


FIGURE 5

Cross Section B

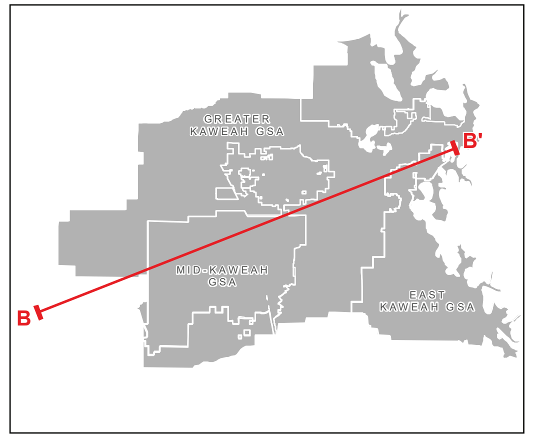
Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System

Boring

- Clay
- Sand
- Sandstone/Rock



NOTES:

Cross section modified from Fugro, 2007, Plate 15, Geologic Cross Section B

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.

SCALE

200 ft / 0 / 2 mi

VERTICAL EXAGGERATION: 52.8X

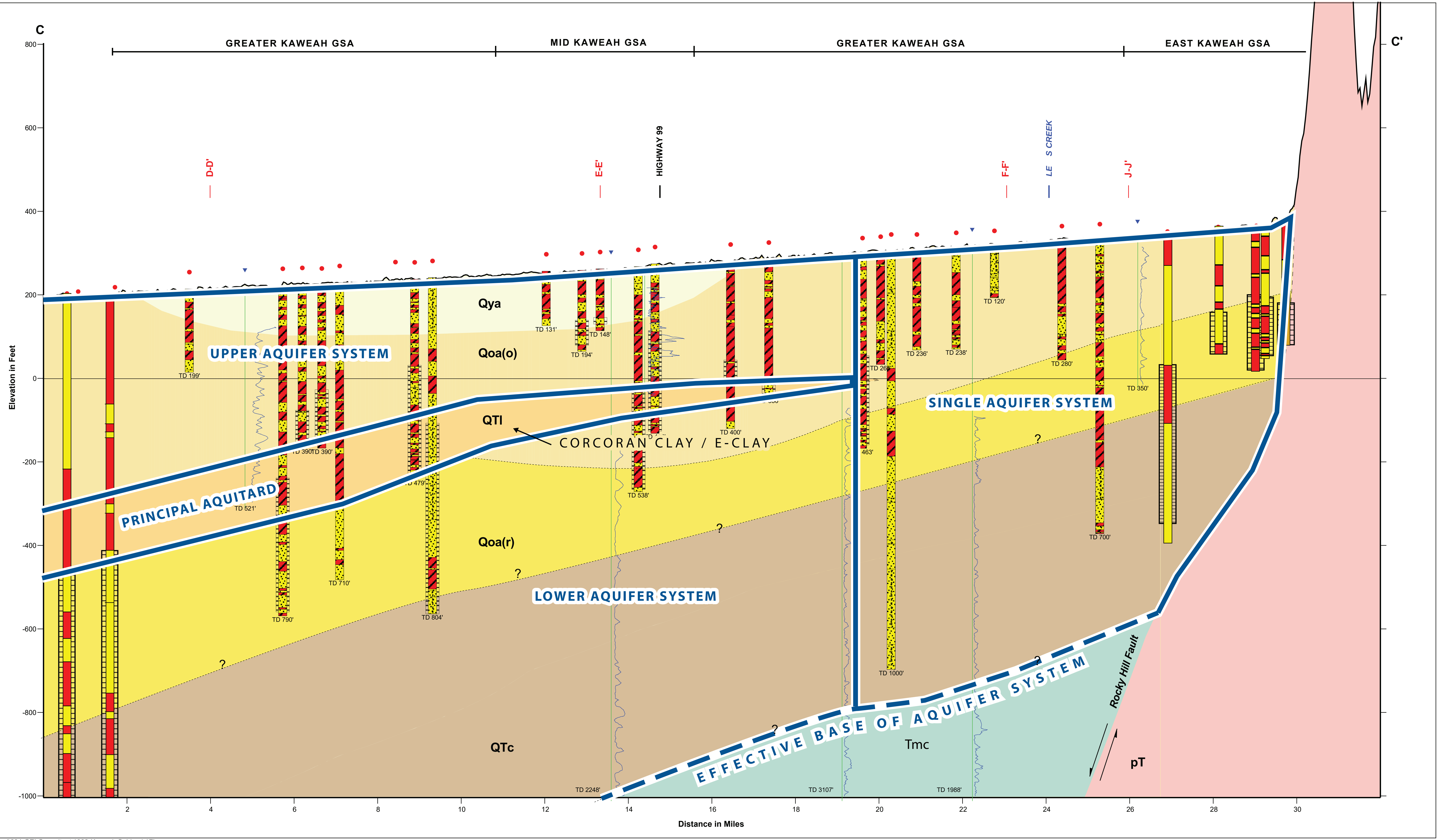
GEI Consultants
GSI Water Solutions, Inc.

P:\Portland\634-GEI Consultants\003-Kaweah Subbasin\Figures

FIGURE 6

Cross Section C

Kaweah Subbasin
Groundwater Sustainability Plan

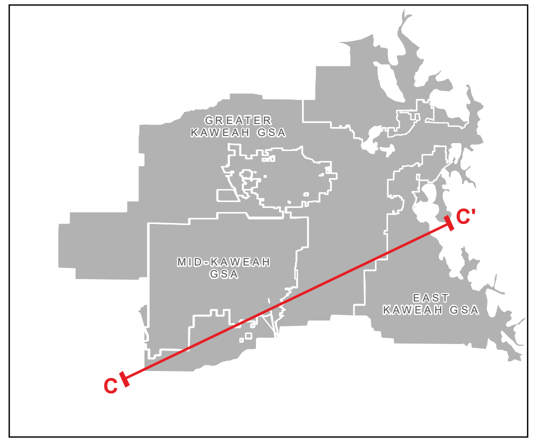


LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System

Boring

- Clay
- Sand
- Sandstone/Rock



NOTES:

Cross section modified from Fugro, 2007, Plate 16, Geologic Cross Section C

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.

SCALE

200 ft — 0 — 2 mi

VERTICAL EXAGGERATION: 52.8X

GEI Consultants
GSI Water Solutions, Inc.

P:\Portland\634-GEI Consultants\003-Kaweah Subbasin\Figures

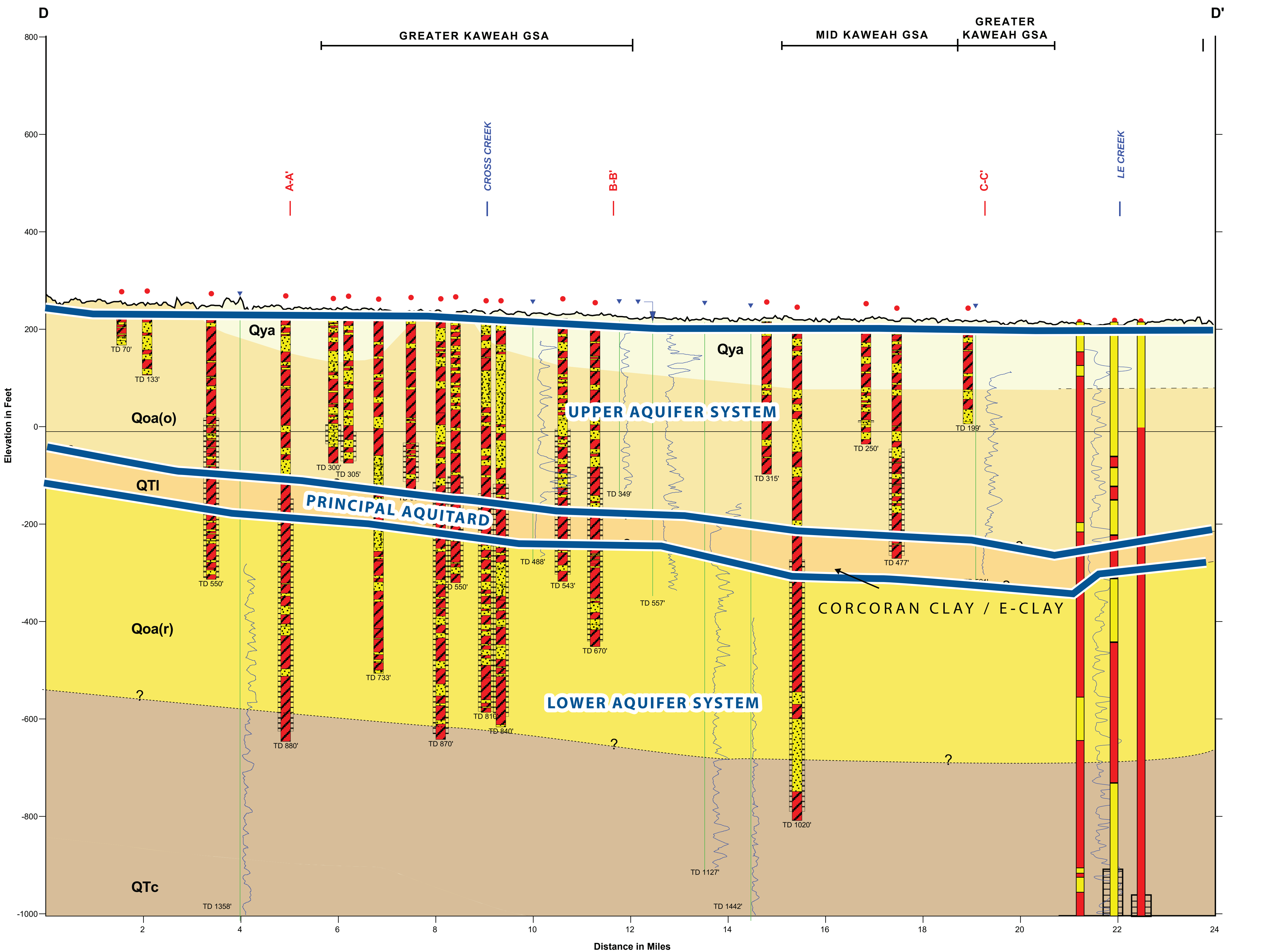


FIGURE 7

Cross Section D

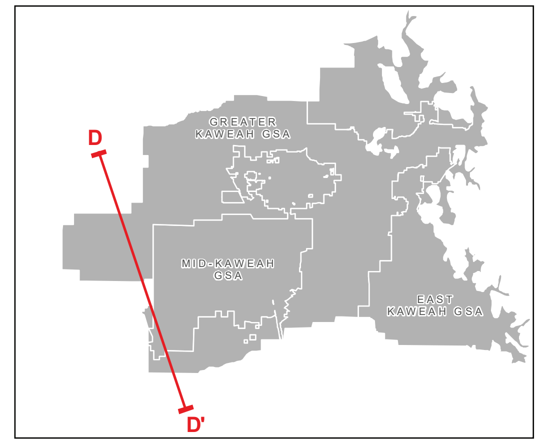
Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System

Boring

- Clay
- Sand
- Sandstone/Rock



NOTES:

Cross section modified from Fugro, 2007, Plate 14, Geologic Cross Section D

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.
4. Effective Base of Aquifer System is base of continental deposits (Tulare Formation)

SCALE

200 ft

0 2 mi

VERTICAL EXAGGERATION: 52.8X

GEI Consultants

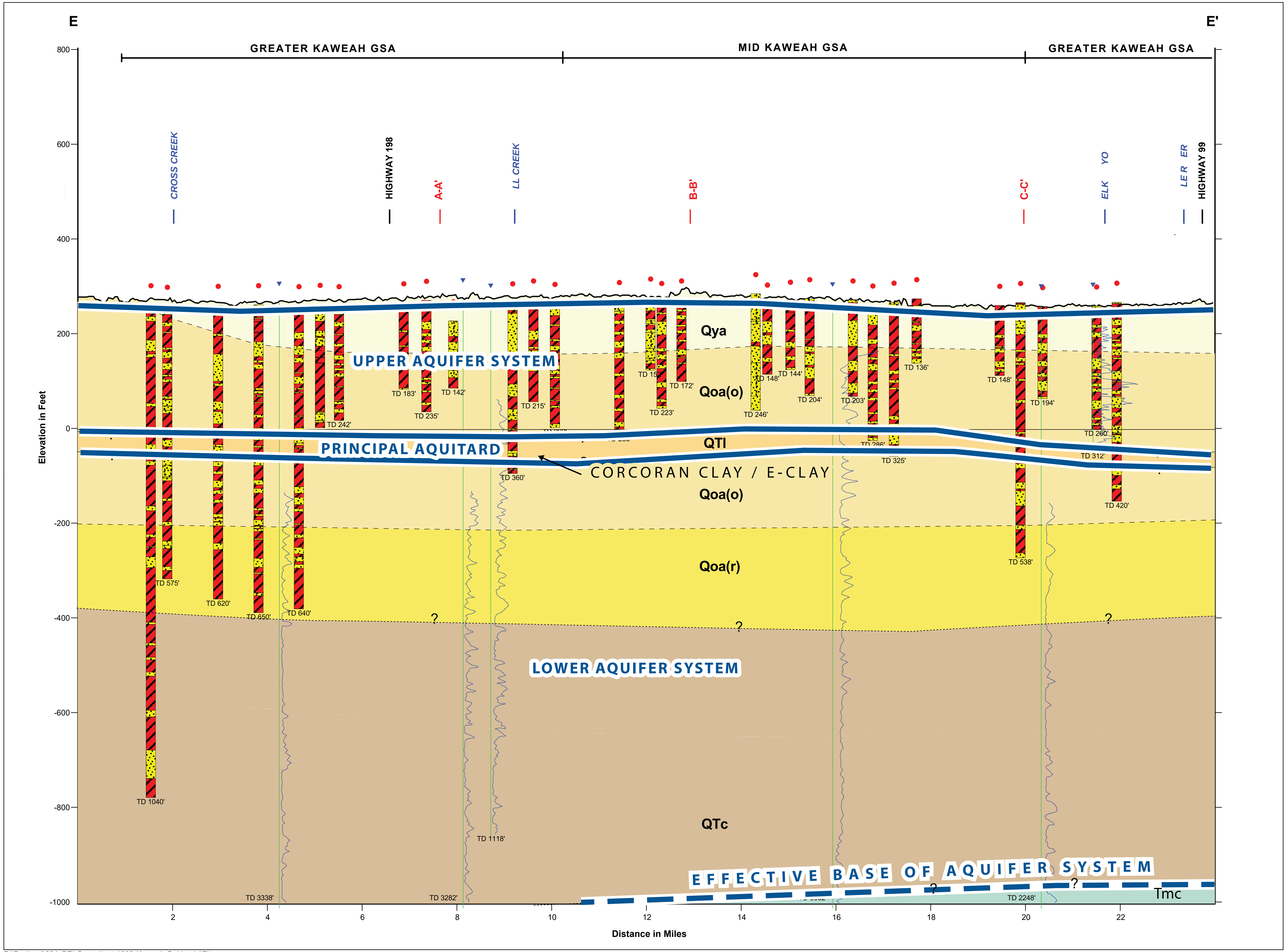
GSI Water Solutions, Inc.

P:\Portland\634-GEI Consultants\003-Kaweah Subbasin\Figures

FIGURE 8

Cross Section E

Kaweah Subbasin
Groundwater Sustainability Plan

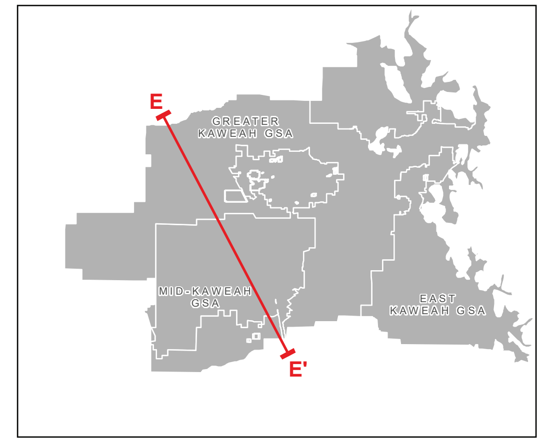


LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System

Boring

- Clay
- Sand
- Sandstone/Rock



NOTES:

Cross section modified from Fugro, 2007, Plate 18, Geologic Cross Section E

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.

SCALE

200 ft

0

2 mi

VERTICAL EXAGGERATION: 52.8X

GEI Consultants

GSI Water Solutions, Inc.

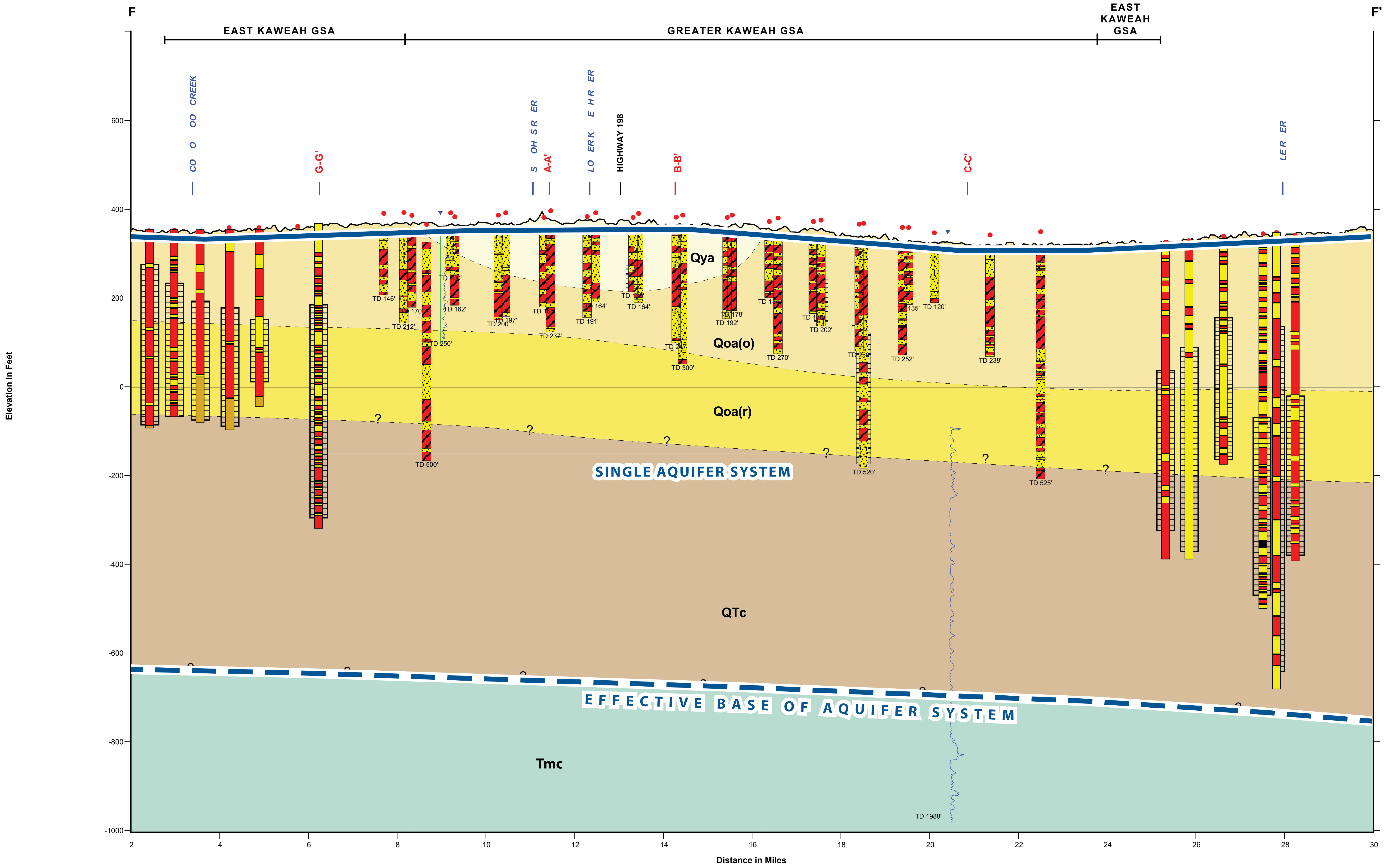


FIGURE 9

Cross Section F

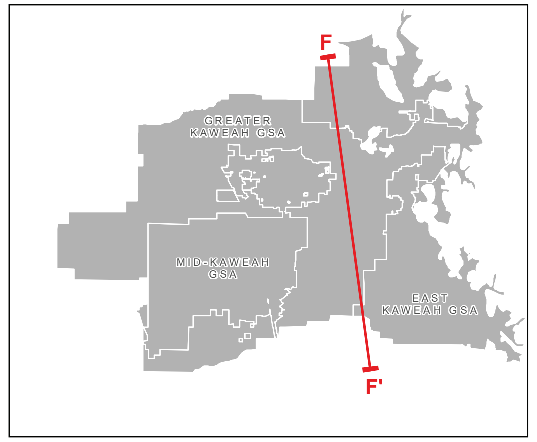
Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System

Boring

- Clay
- Sand
- Sandstone/Rock



NOTES:

Cross section modified from Fugro, 2007, Plate 19, Geologic Cross Section F

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.

SCALE

200 ft

VERTICAL EXAGGERATION: 52.8X

0 — 2 mi

GEI Consultants — GSI Water Solutions, Inc.

P:\Portland\634-GEI Consultants\003-Kaweah Subbasin\Figures

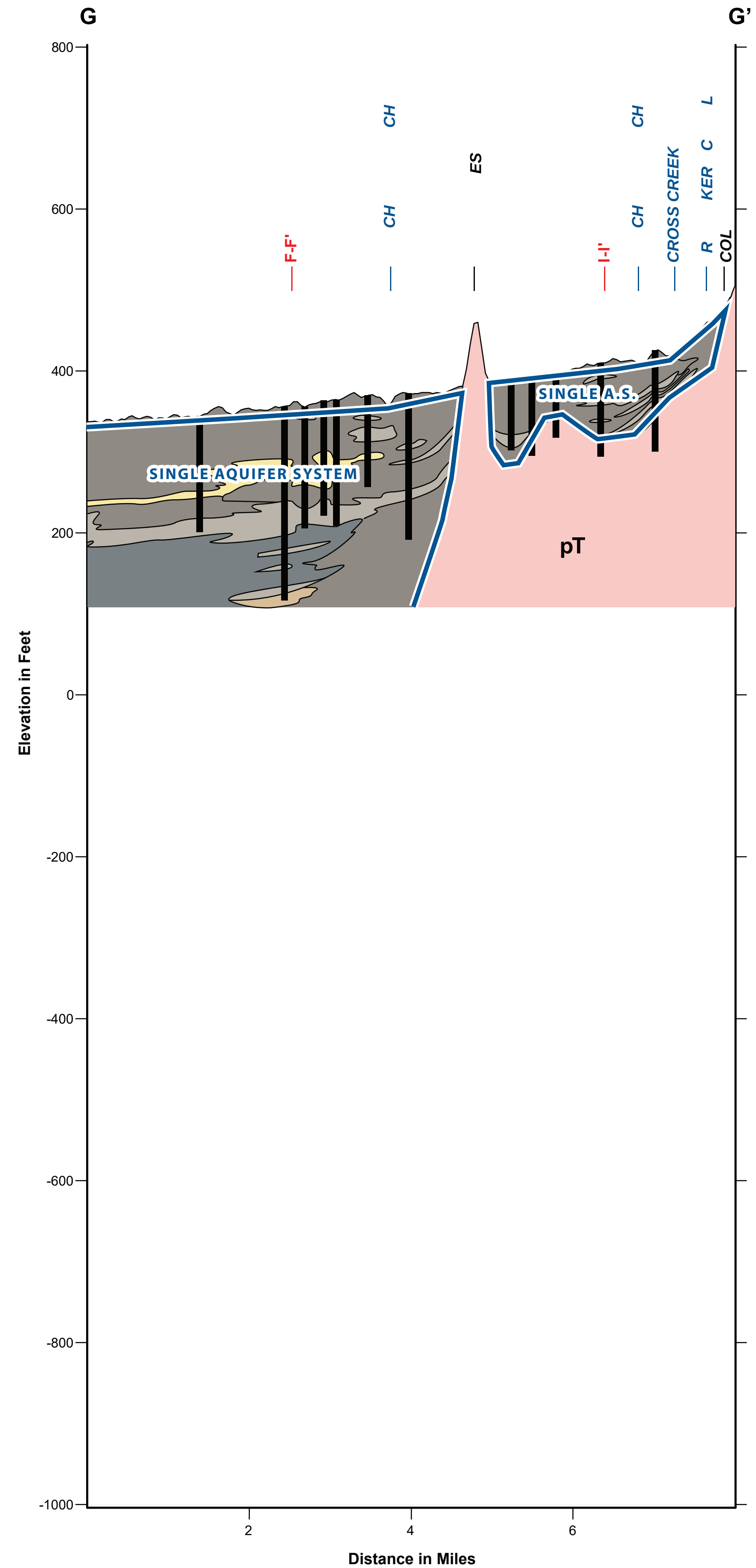


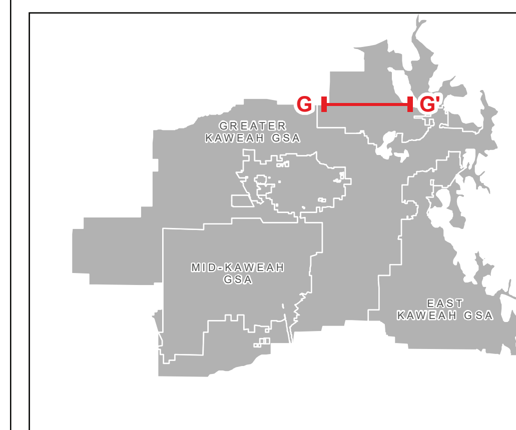
FIGURE 10

Cross Section G

Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Gravel
- Sand
- Silt
- Sandy Clay
- Clay
- pT - Basement Complex
- Generalized Boundaries of Aquifer System



NOTES:

Cross section modified from U.S. Bureau of Rec. (1949), Geologic Cross Section A

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.
4. Effective Base of Aquifer System is base of continental deposits (Tulare Formation)

SCALE

200 ft

0 — 2 mi

VERTICAL EXAGGERATION: 52.8X

GEI Consultants — GSI Water Solutions, Inc.

P:\Portland\634-GEI Consultants\003-Kaweah Subbasin\Figures

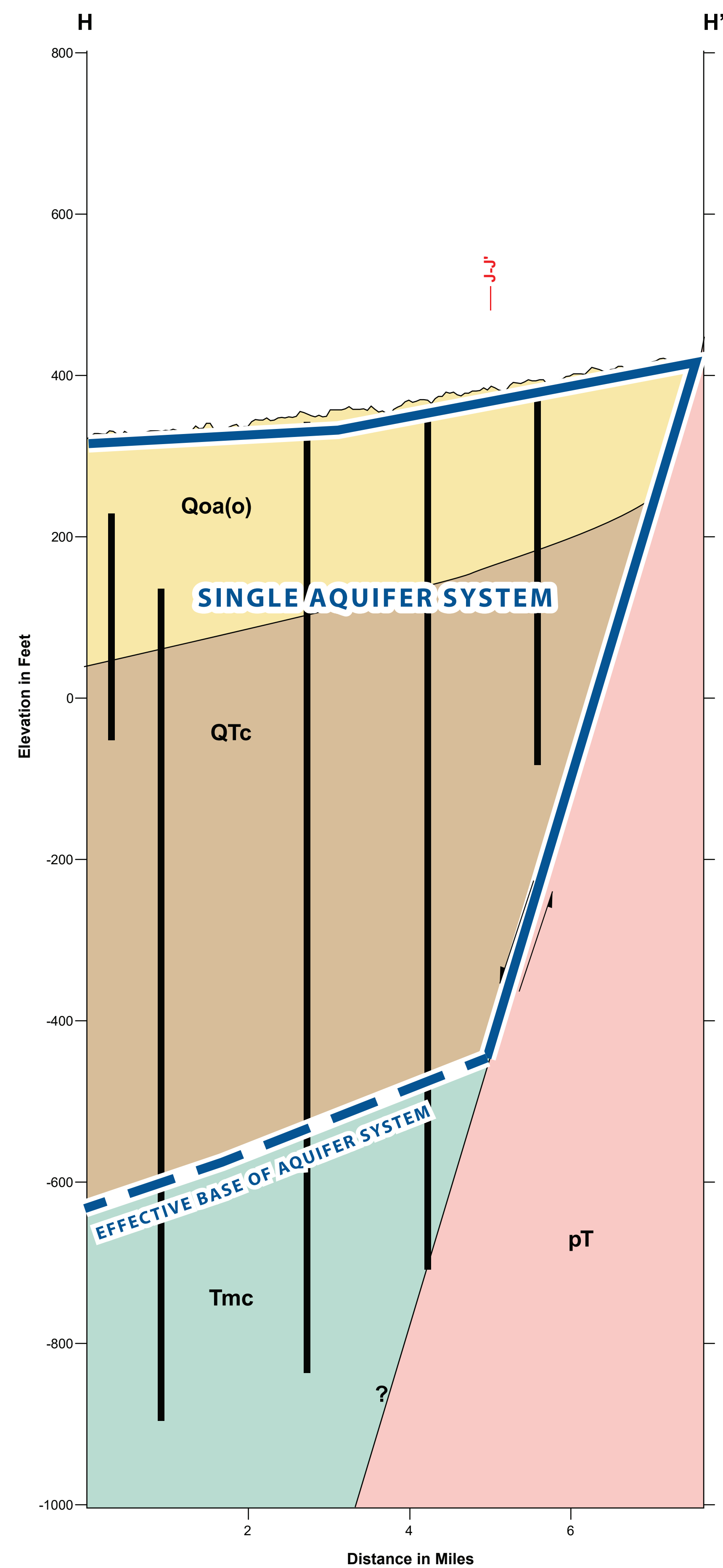


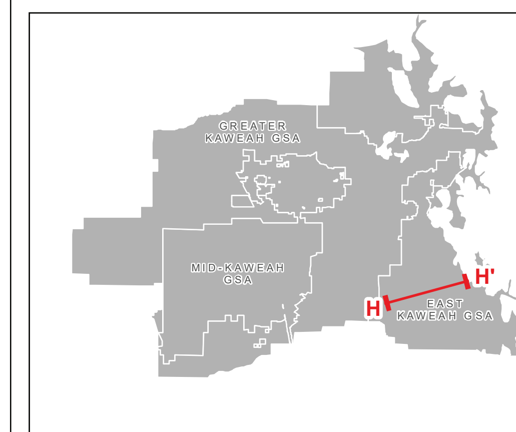
FIGURE 11

Cross Section H

Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System



NOTES:

Cross section modified from Davis et al. (1959), Geologic Cross Section G

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.

SCALE

200 ft

VERTICAL EXAGGERATION: 52.8X

0 — 2 mi

GEI Consultants
GSI Water Solutions, Inc.

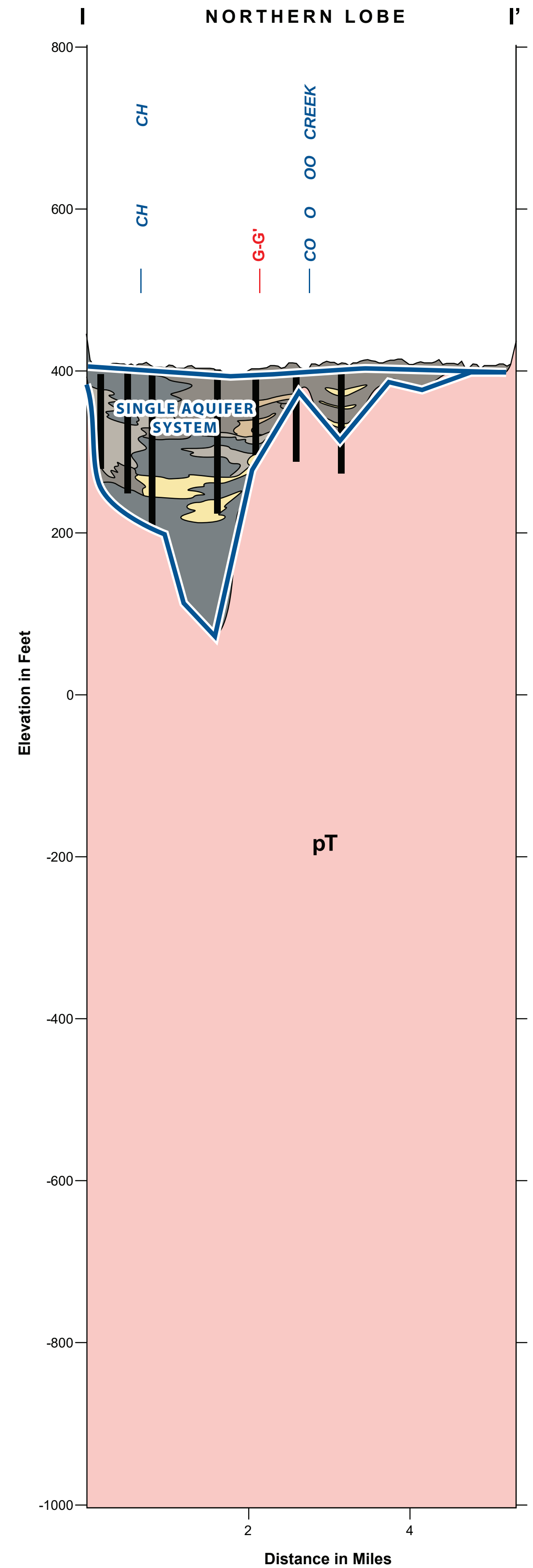


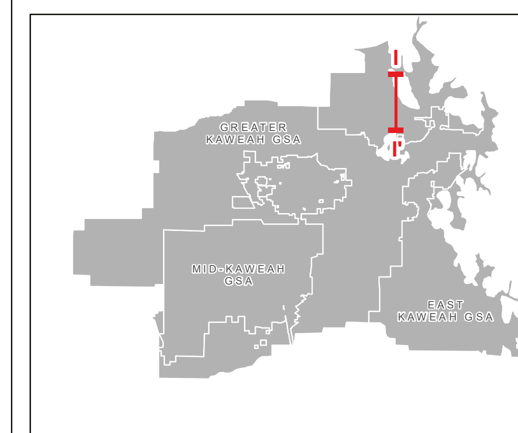
FIGURE 12

Cross Section I

Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Gravel
- Sand
- Silt
- Sandy Clay
- Clay
- pT - Basement Complex
- Generalized Boundaries of Aquifer System



NOTES:

Cross section modified from U.S. Bureau of Rec. (1949), Geologic Cross Section D

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.
4. Effective Base of Aquifer System is base of continental deposits (Tulare Formation)

SCALE

200 ft

VERTICAL EXAGGERATION: 52.8X

0 — 2 mi

GEI Consultants
GSI Water Solutions, Inc.

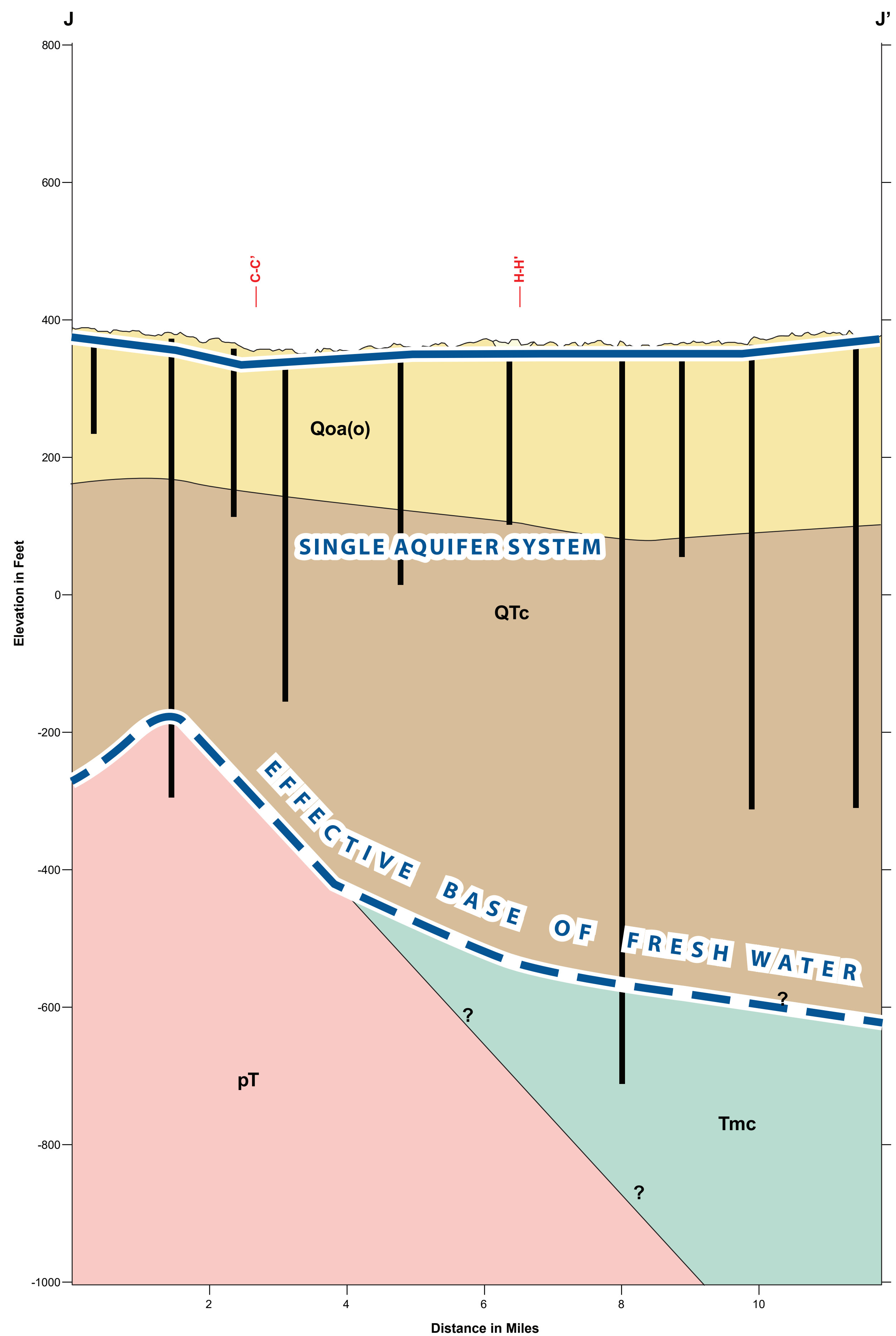


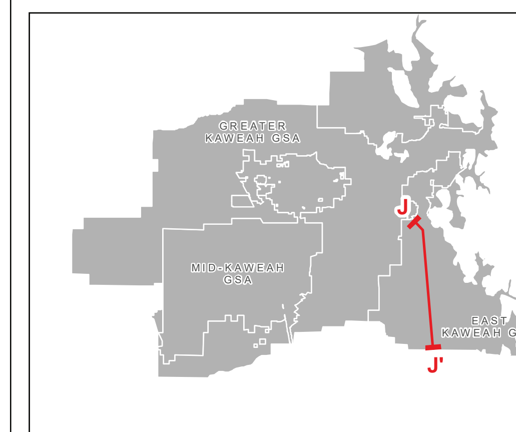
FIGURE 13

Cross Section J

Kaweah Subbasin
Groundwater Sustainability Plan

LEGEND

- Qya - Younger Alluvium
- Qoa(o) - Older Alluvium (oxidized)
- QTl - Corcoran Clay (E-Clay, lacustrine)
- Qoa(r) - Older Alluvium (reduced)
- QTc - Continental Deposits
- Tmc - Marine and Continental Rocks
- pT - Basement Complex
- Generalized Boundaries of Aquifer System



NOTES:

Cross section modified from Croft and Gordon (1968), Geologic Cross Section E

1. Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.
2. Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.
3. Effective base of aquifer system is based on review of recent well logs, professional judgment based on collaboration with adjoining subbasins, and USGS base of fresh water contacts.

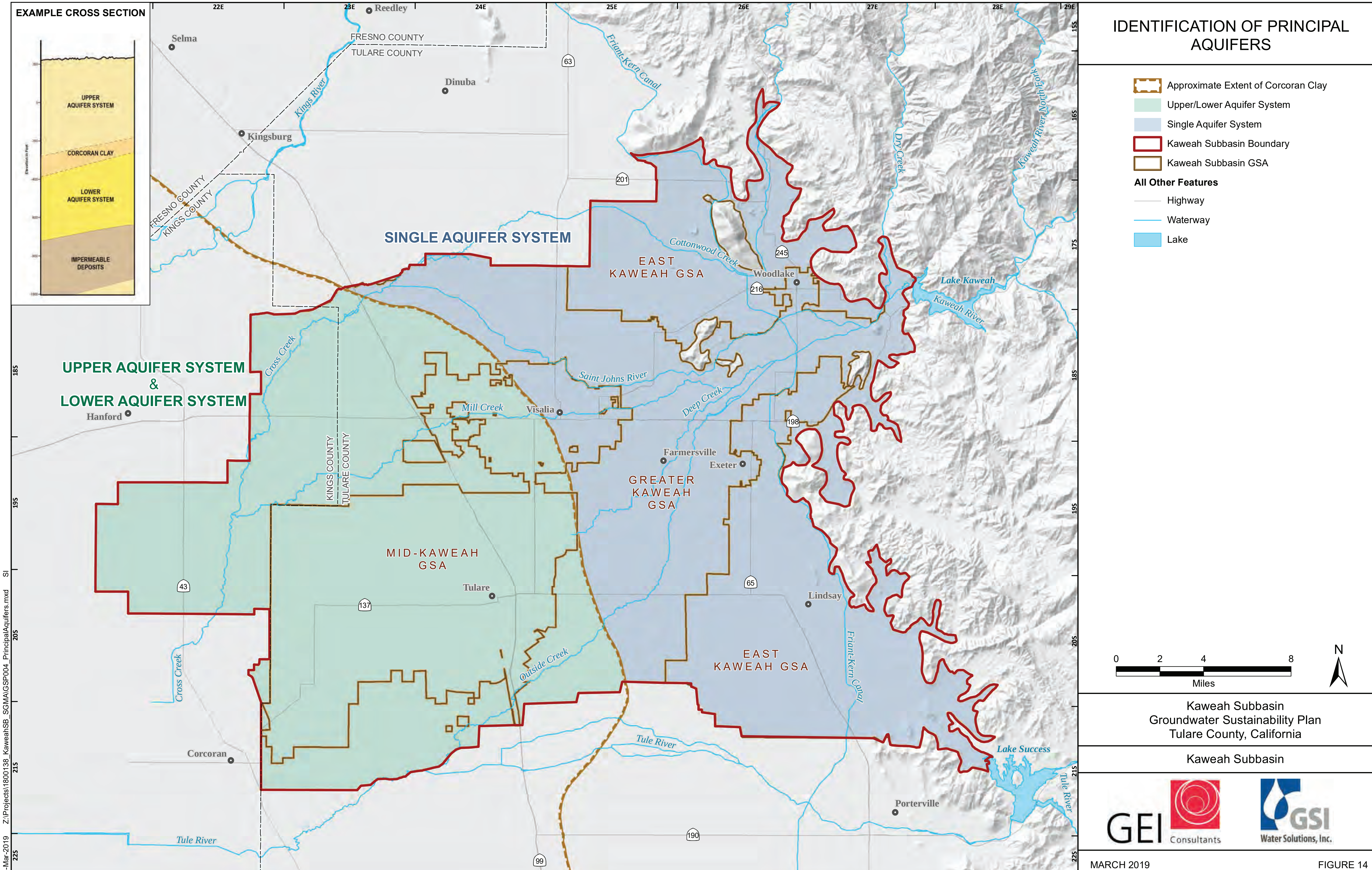
SCALE

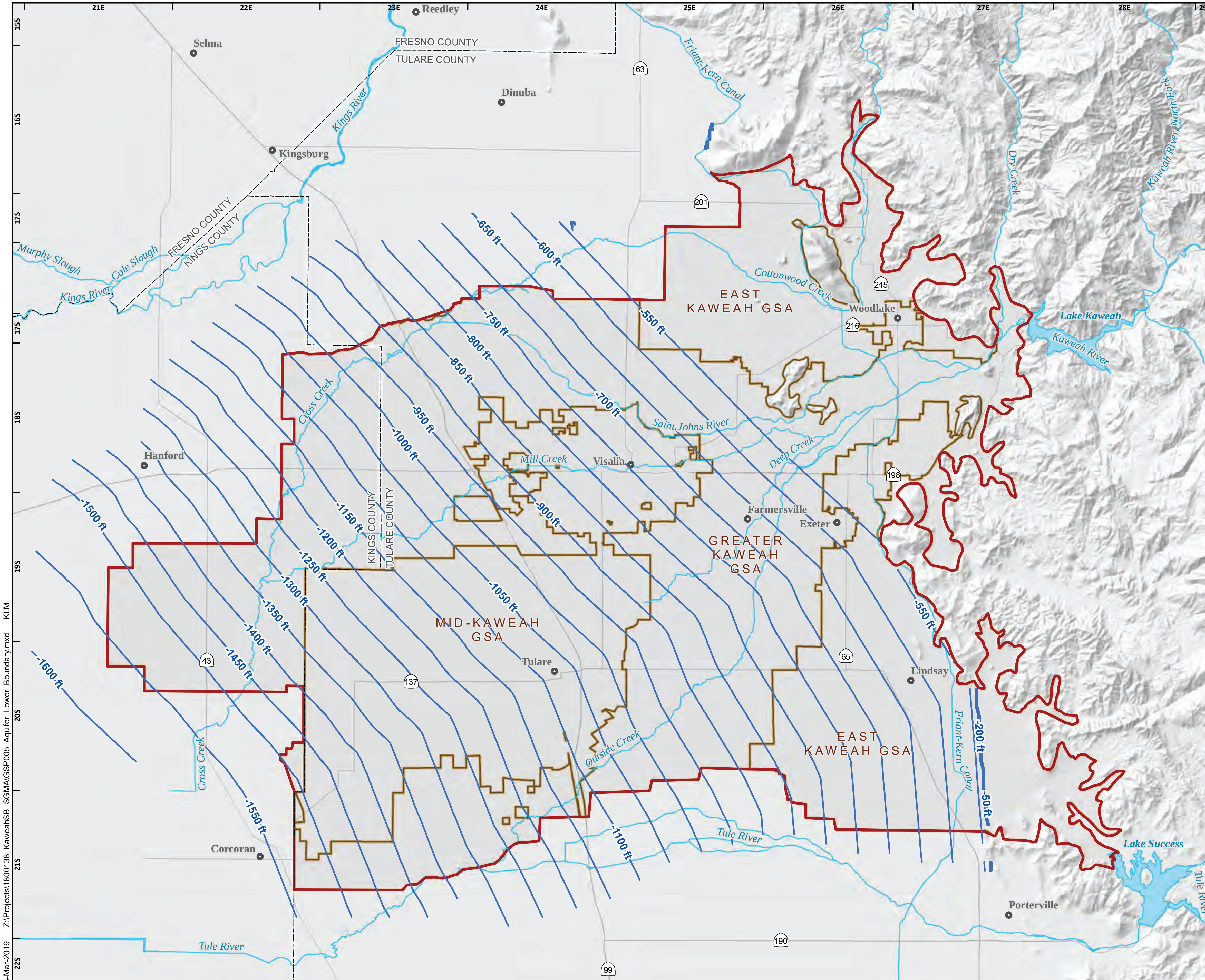
200 ft

VERTICAL EXAGGERATION: 52.8X

0 2 mi

GEI Consultants
GSI Water Solutions, Inc.


IDENTIFICATION OF PRINCIPAL AQUIFERS
Approximate Extent of Corcoran Clay
Upper/Lower Aquifer System
Single Aquifer System
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Lake
EXAMPLE CROSS SECTION
UPPER AQUIFER SYSTEM
CORCORAN CLAY
LOWER AQUIFER SYSTEM
IMPERMEABLE DEPOSITS
SINGLE AQUIFER SYSTEM
UPPER AQUIFER SYSTEM & LOWER AQUIFER SYSTEM
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
EAST KAWEAH GSA
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Reedley
Selma
Dinuba
Kingsburg
Woodlake
Visalia
Hanford
Farmersville
Exeter
Tulare
Lindsay
Corcoran
Porterville
Kings River
Friant-Kern Canal
Cottonwood Creek
Dry Creek
Kaweah River North Fork
Lake Kaweah
Kaweah River
Saint Johns River
Deep Creek
Cross Creek
Mill Creek
Outside Creek
Tule River
Lake Success
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 14
11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP004_PrincipalAquifers.mxd SI



APPROXIMATE ELEVATION OF EFFECTIVE BASE OF FRESHWATER SYSTEM

Approx. Elevation of Effective Base of Freshwater System (ft MSL)
Kaweah Subbasin Boundary
Kaweah Subbasin GSA

All Other Features

Highway
Waterway
Lake

0 2 4 8
Miles

N

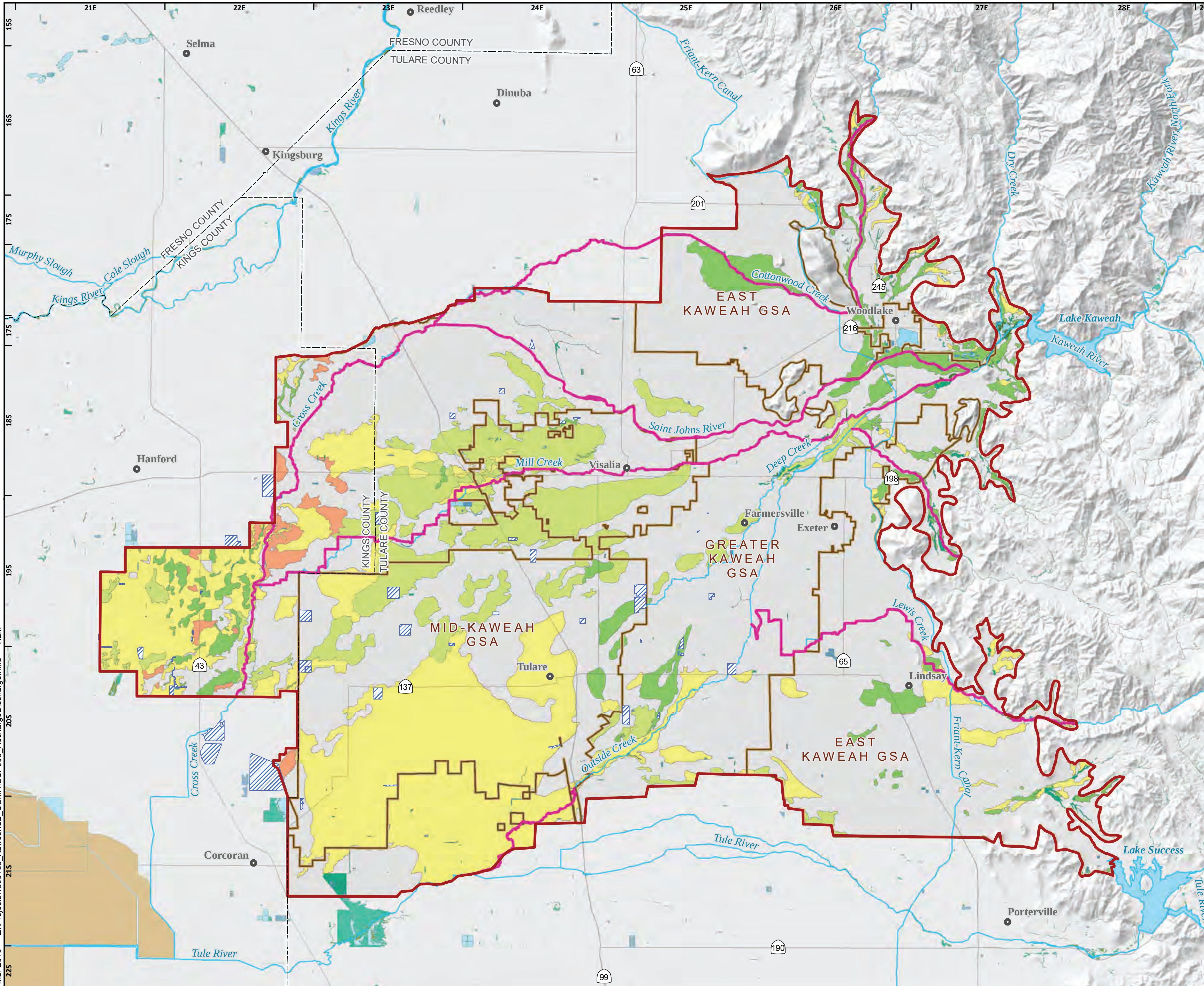
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 15



GROUNDWATER RECHARGE AND DISCHARGE AREAS AND WETLANDS

Wetland Type (National Wetland Inventory, 2018)

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater/Recharge/Irrigation Pond
- Lake
- Farmed Wetland

Soil Agricultural Groundwater Banking Index (2015)

Rating Class

- Excellent
- Good
- Moderately Good
- Moderately Poor
- Recharge Basin
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Losing Stream Reach
- Lake

Note: Data is preliminary and subject to field verification for accuracy.

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

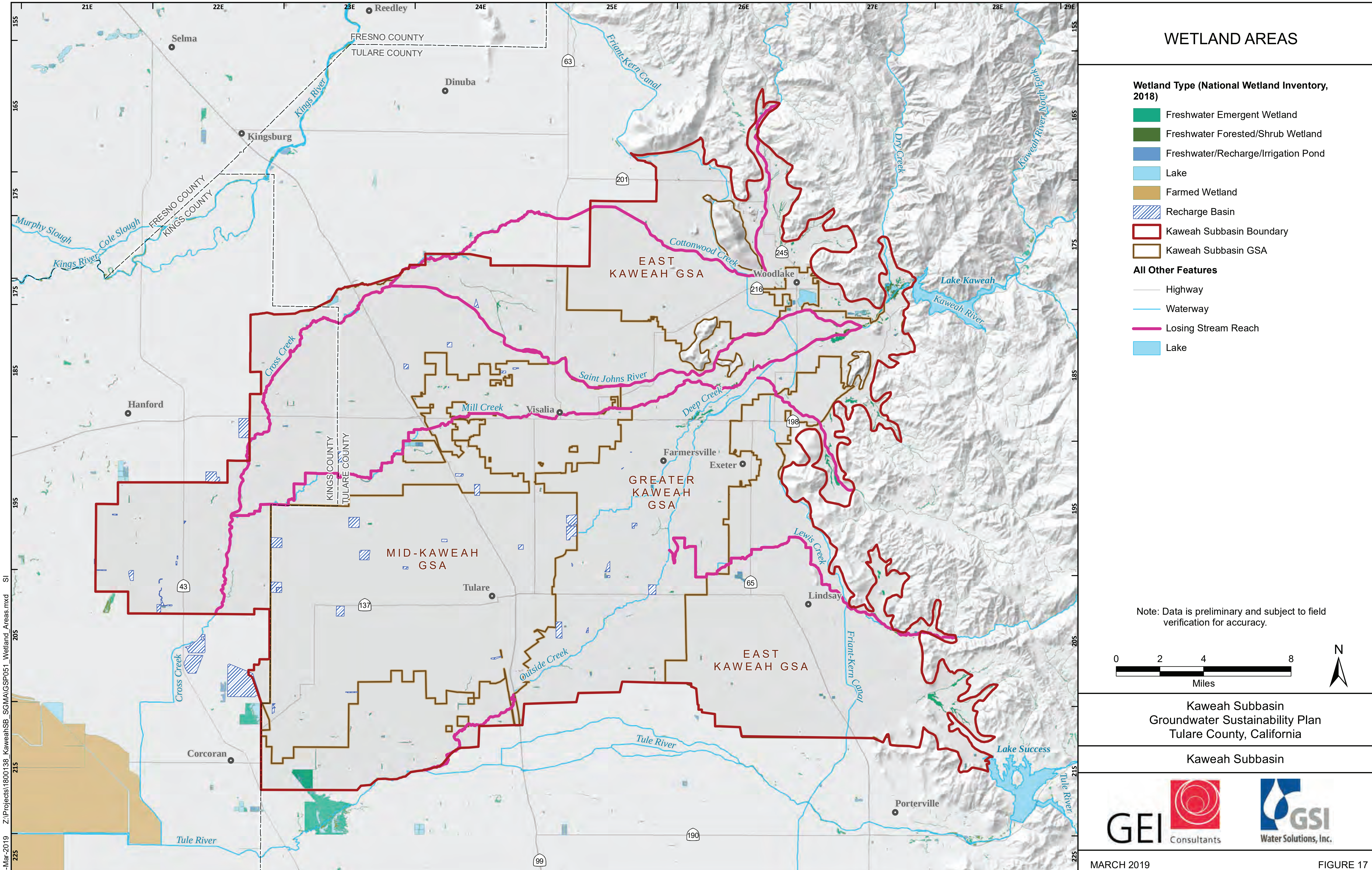
GEI Consultants

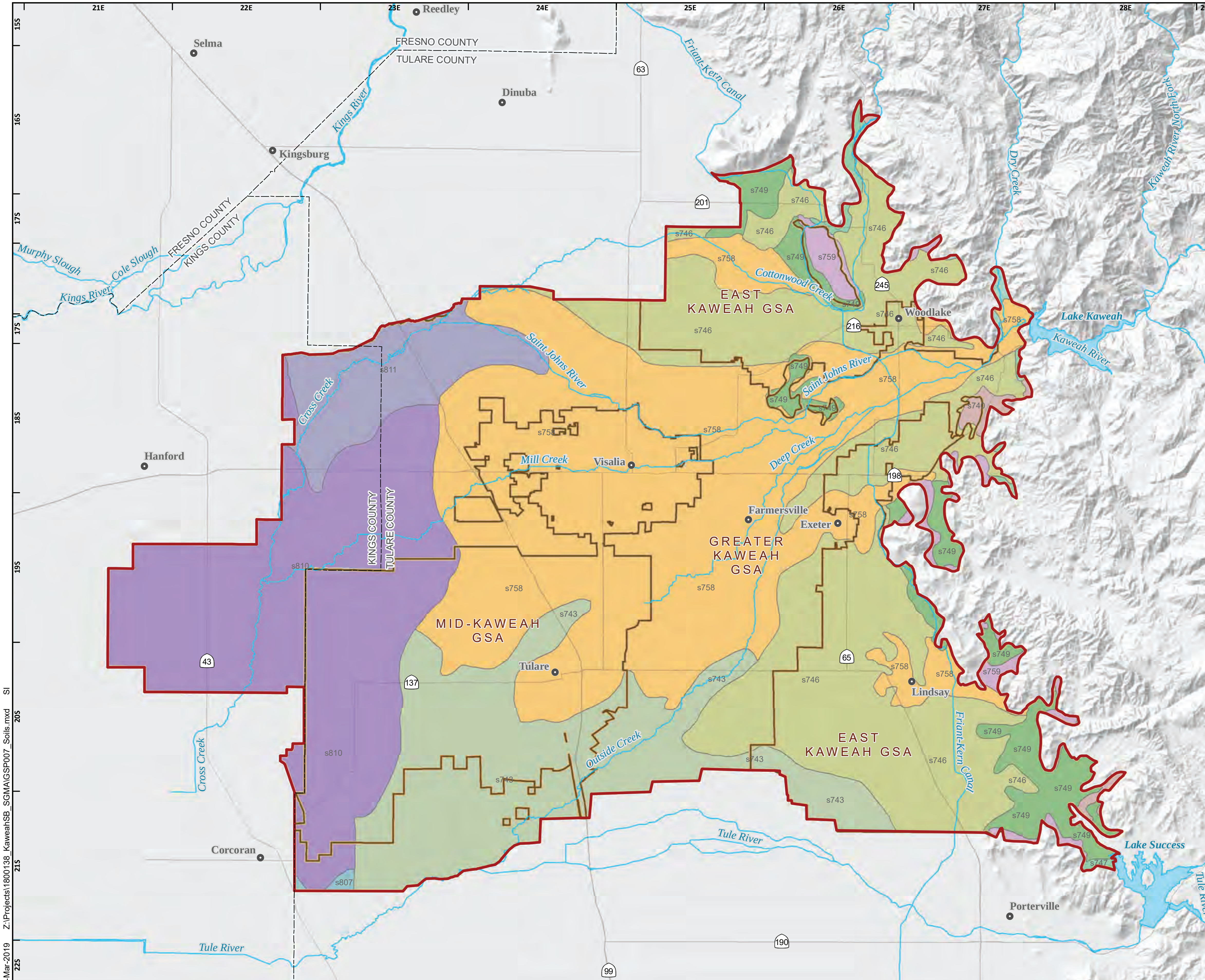
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 16

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP006_RechargeDischarge.mxd KLM


WETLAND AREAS
Wetland Type (National Wetland Inventory, 2018)
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater/Recharge/Irrigation Pond
Lake
Farmed Wetland
Recharge Basin
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Losing Stream Reach
Lake
Note: Data is preliminary and subject to field verification for accuracy.
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 17
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
EAST KAWEAH GSA
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Woodlake
Farmersville
Exeter
Tulare
Lindsay
Corcoran
Porterville
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Kings River
Murphy Slough
Cole Slough
Cross Creek
Friant-Kern Canal
Dry Creek
Kaweah River North Fork
Lake Kaweah
Kaweah River
Cottonwood Creek
Saint Johns River
Mill Creek
Deep Creek
Lewis Creek
Outside Creek
Tule River
Lake Success
11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP051_Wetland_Areas.mxd SI



SOILS MAP

National Resource Conservation Service Soils Categories (STATSGO)

- Hanford-Delhi (s745)
- Lakeside-Kimberlina-Garces (s810)
- Lewis-Fresno-Dinuba (s742)
- Nord-Grangeville-Chino (s744)
- Porterville-Centerville (s749)
- Rock outcrop-Friant-Coarsegold (s751)
- Rock outcrop-Las Posas-Cibo (s759)
- San Joaquin-Madera-Cometa (s746)
- Sheephead-Rock outcrop-Holland-Crouch (s752)
- Tulare (s808)
- Vista-Rock outcrop-Auberry-Ahwahnee (s740)
- Vista-Rock outcrop-Cieneba (s747)
- Water (s8369)
- Waukena-Temple-Pond (s743)
- Westcamp-Houser-Gepford-Armona (s807)
- Woolstalf-Rock outcrop-Jocal-Hotaw-Chaix (s1072)
- Yettem-San Emigdio-Honcut (s758)
- Youd-Remnoy-Melga-Kimberlina (s811)
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

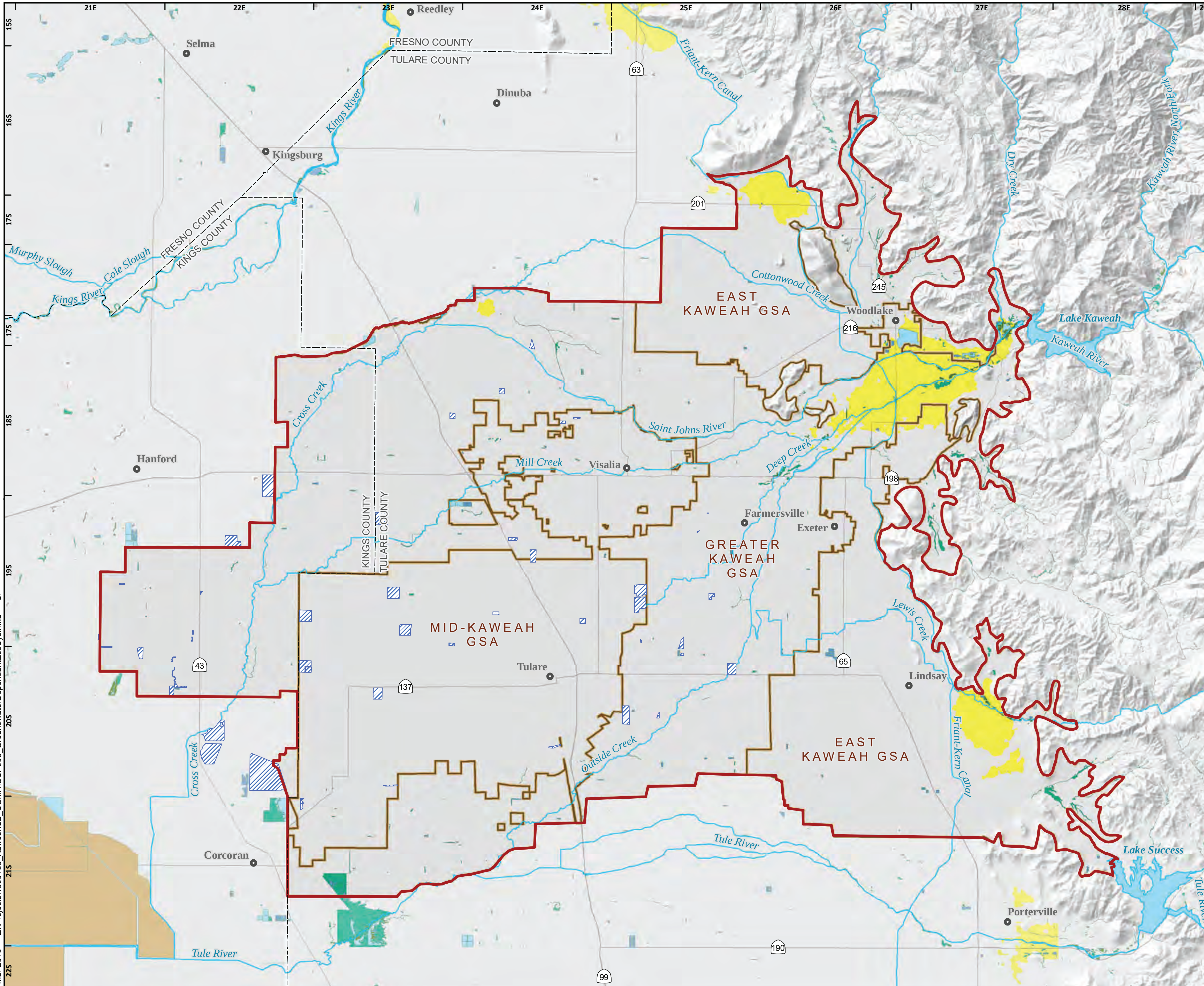
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 18

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP007_Soils.mxd SI



POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS

Potential Groundwater Dependant Ecosystem

- Spring 2015 Groundwater Surface within 50 feet of Ground Surface

Wetland Type (National Wetland Inventory, 2018)

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater/Recharge/Irrigation Pond
- Lake
- Farmed Wetland
- Recharge Basin
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

Note: Data is preliminary and subject to field verification for accuracy.

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

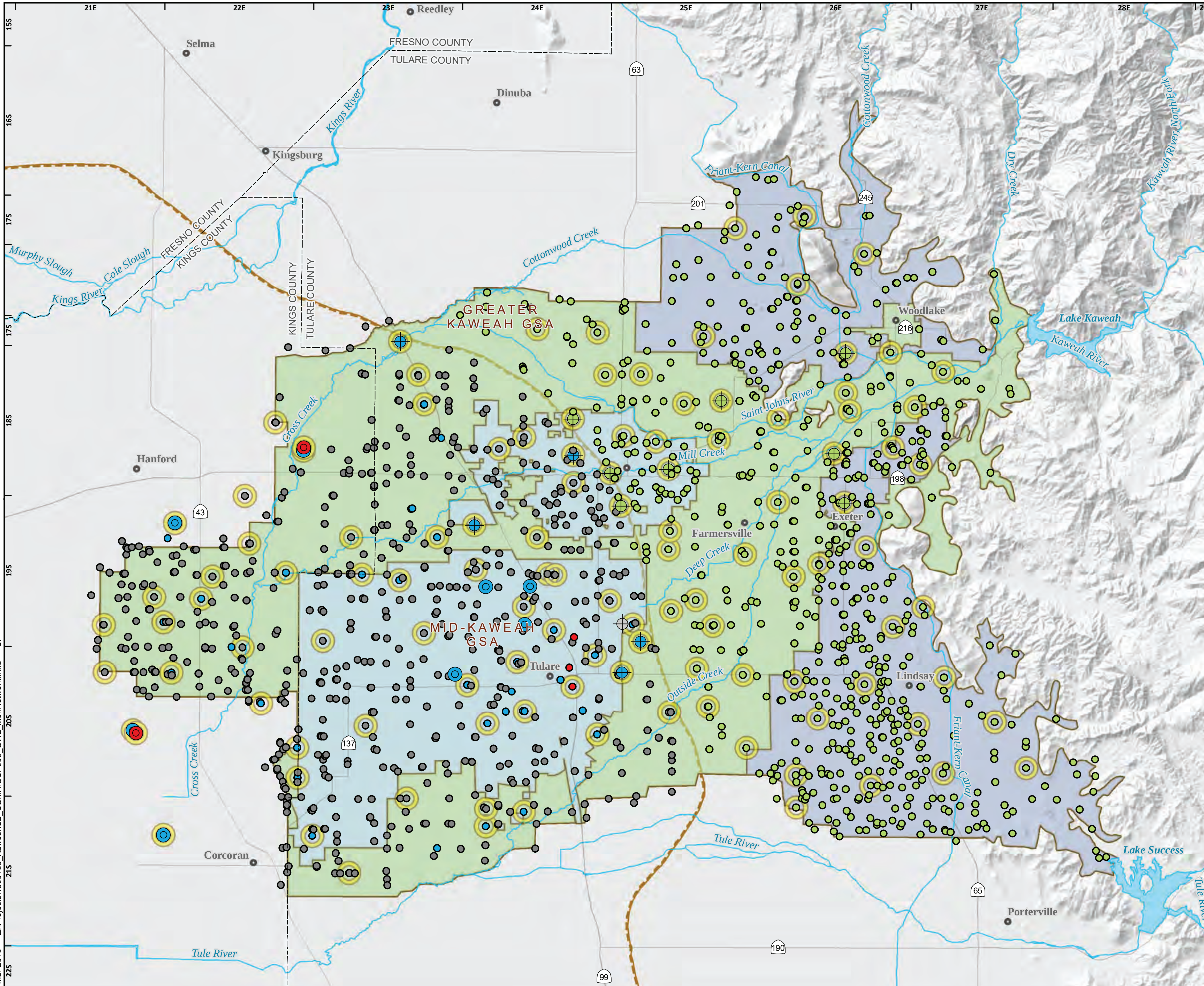
GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 19

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP008_GroundwaterDependantEcoSys.mxd SI



GROUNDWATER LEVEL MONITORING NETWORK

Well Types

- Lower Aquifer
- Upper Aquifer
- Single Aquifer
- Unknown
- Dedicated Monitoring Well
- Dual Completion Well
- Monitoring Well
- Key Well

Approximate Extent of Corcoran Clay

GSA Boundaries

- East Kaweah GSA
- Greater Kaweah GSA
- Mid-Kaweah GSA
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

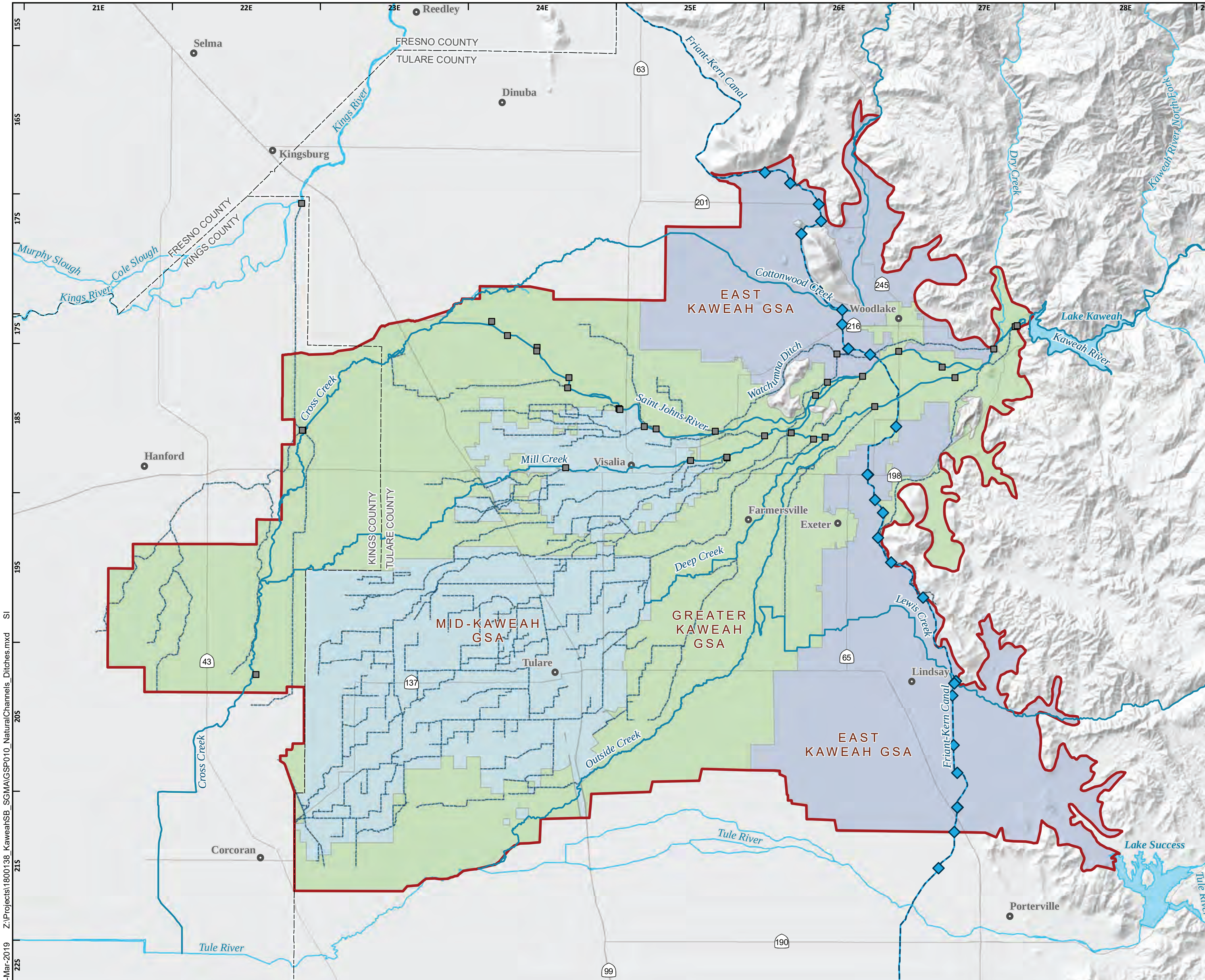
GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 20

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP009_GWL_MonNetwork.mxd SI



NATURAL AND MAN-MADE CHANNELS

Friant-Kern Turnout
Headgate
Principal KSB Natural Channel
Friant-Kern Canal
Other Natural Channel
Man-Made Channel

GSA Boundaries

East Kaweah GSA
Greater Kaweah GSA
Mid-Kaweah GSA
Kaweah Subbasin Boundary

All Other Features

Highway
Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

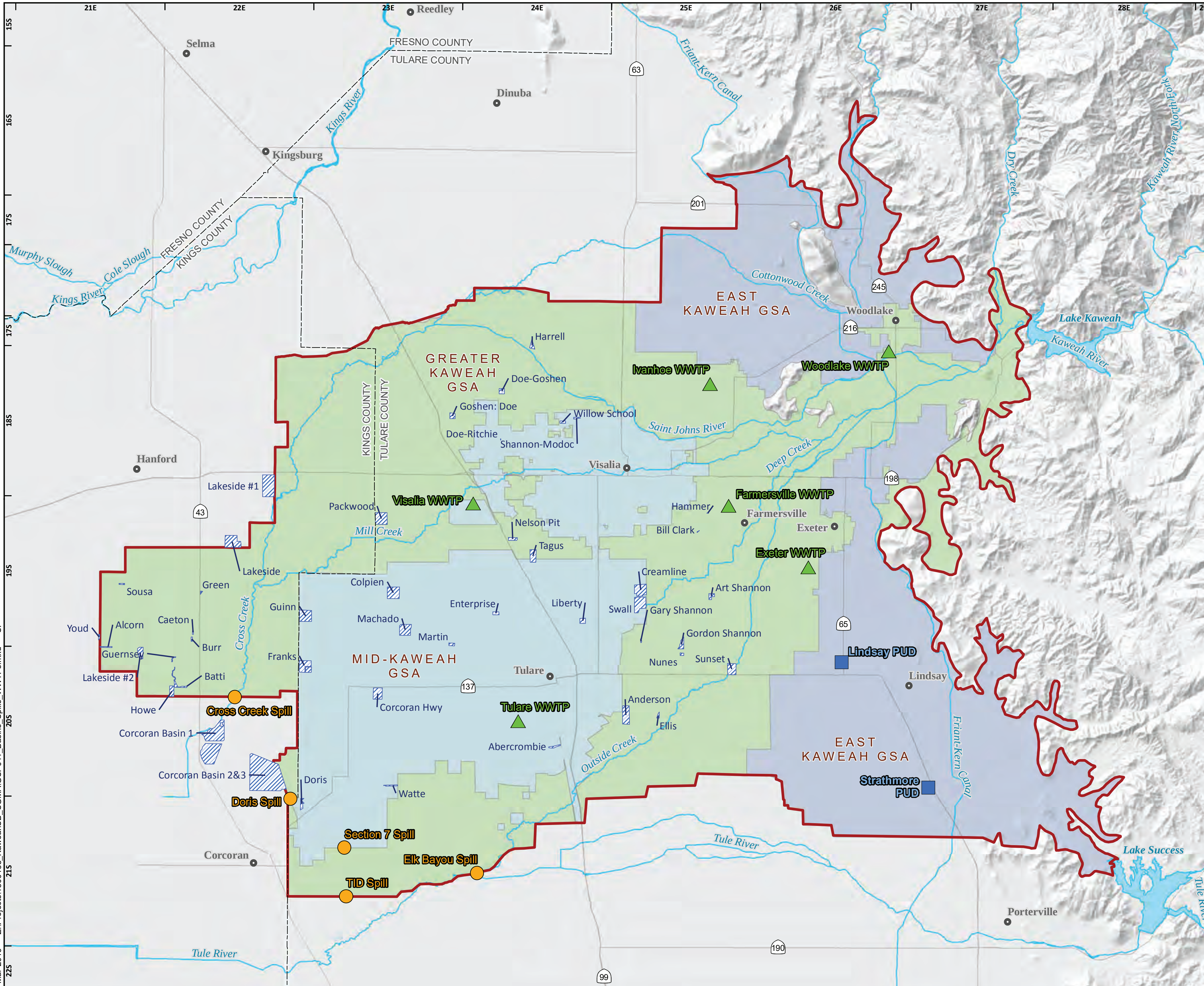
GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 21

18-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP010_NaturalChannels_Ditches.mxd SI

RECHARGE BASINS, SPILLS AND WASTEWATER TREATMENT PLANTS



- Surface Water Spill Point
- Waste Water Treatment Plant (WWTP)
- PUD Treatment Plant
- Recharge Basin

GSA Boundaries

- East Kaweah GSA
- Greater Kaweah GSA
- Mid-Kaweah GSA
- Kaweah Subbasin Boundary

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

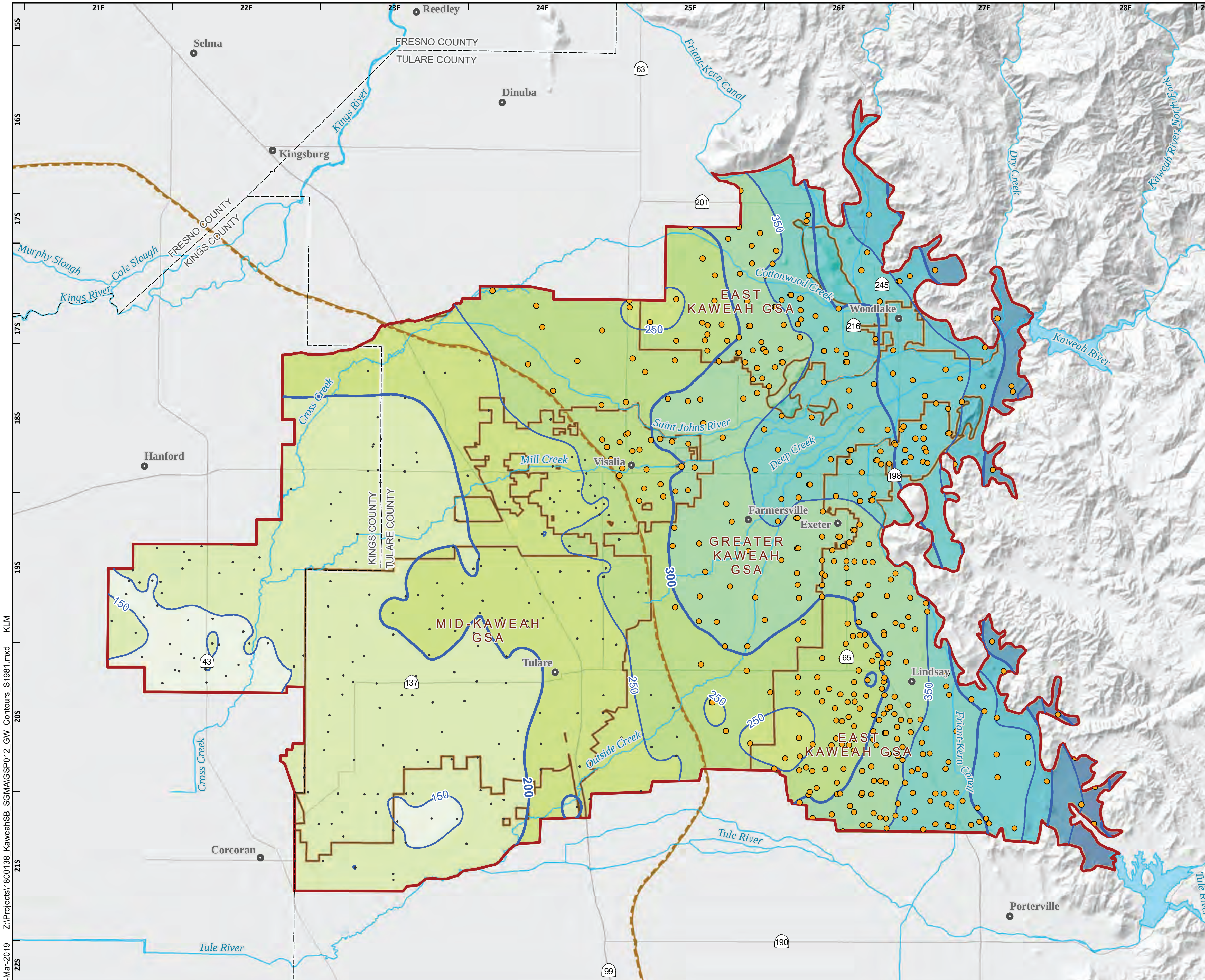
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 22

Z:\Projects\1800138_KaweahSB_SGMA\GSP011_Basins_Spills_WWTPs.mxd SI
18-Mar-2019



SPRING 1981 GROUNDWATER ELEVATION CONTOURS

- Lower Aquifer System, Dedicated Monitoring Well
- Single Aquifer System, Dedicated Monitoring Well
- Lower Aquifer System Well
- Single Aquifer System Well
- Well Construction Details Unknown

Groundwater Elevation Contours, Spring 1981 (GWE ft msl)

- Major (100-foot interval)
- Minor (50-foot interval)
- 123 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 400
- 401 - 450
- 451 - 500
- 501 - 550
- 551 - 600
- 601 - 650
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

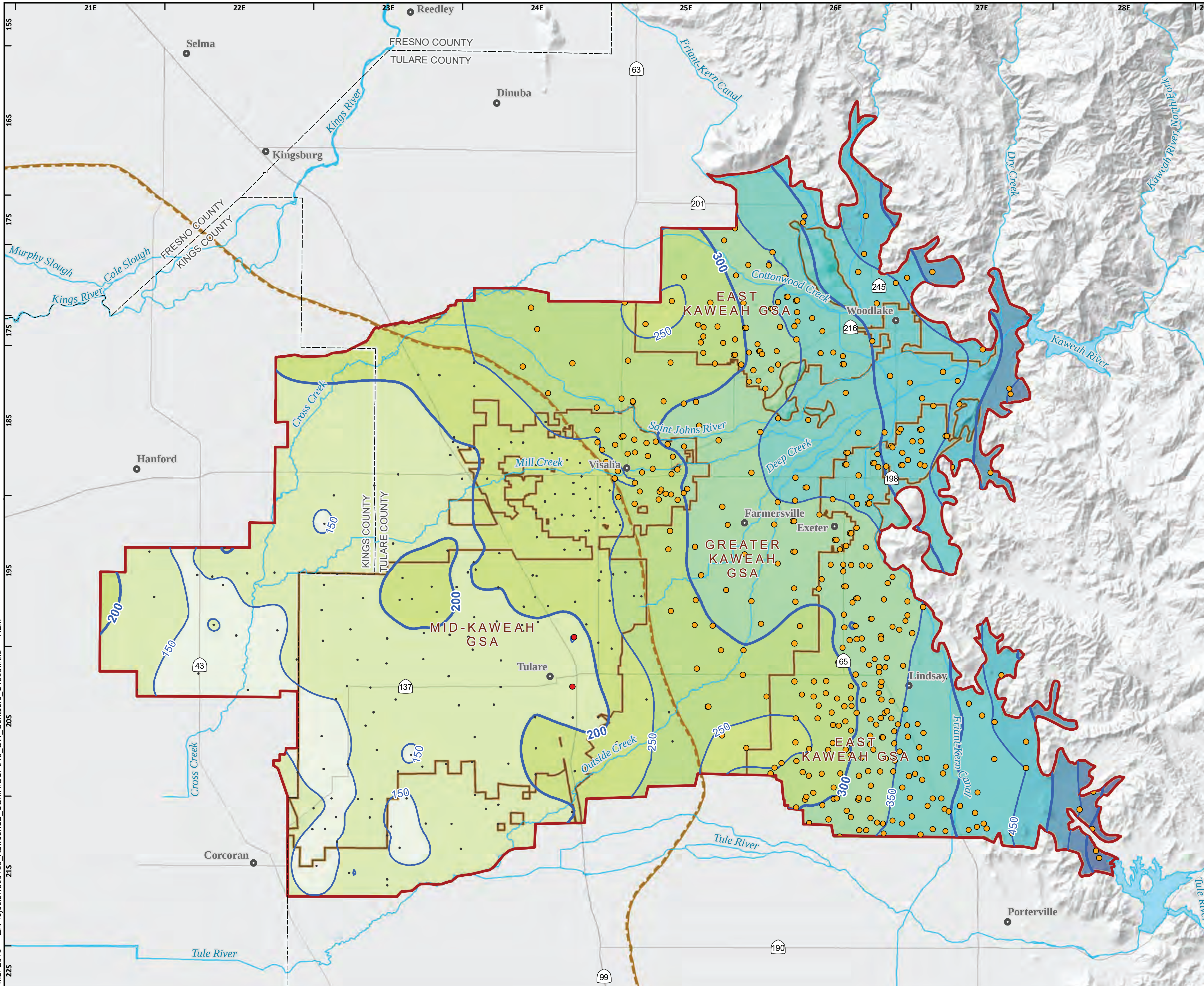
GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 23

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP012_GW_Contours_S1981.mxd KLM



SPRING 1999 GROUNDWATER ELEVATION CONTOURS

- Lower Aquifer System, Dedicated Monitoring Well
- Single Aquifer System, Dedicated Monitoring Well
- Lower Aquifer System Well
- Single Aquifer System Well
- Well Construction Details Unknown

Groundwater Elevation Contours, Spring 1999 (GWE ft msl)

- Major (100-foot interval)
- Minor (50-foot interval)
- 120 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 400
- 401 - 450
- 451 - 500
- 501 - 550
- 551 - 600
- 601 - 650
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

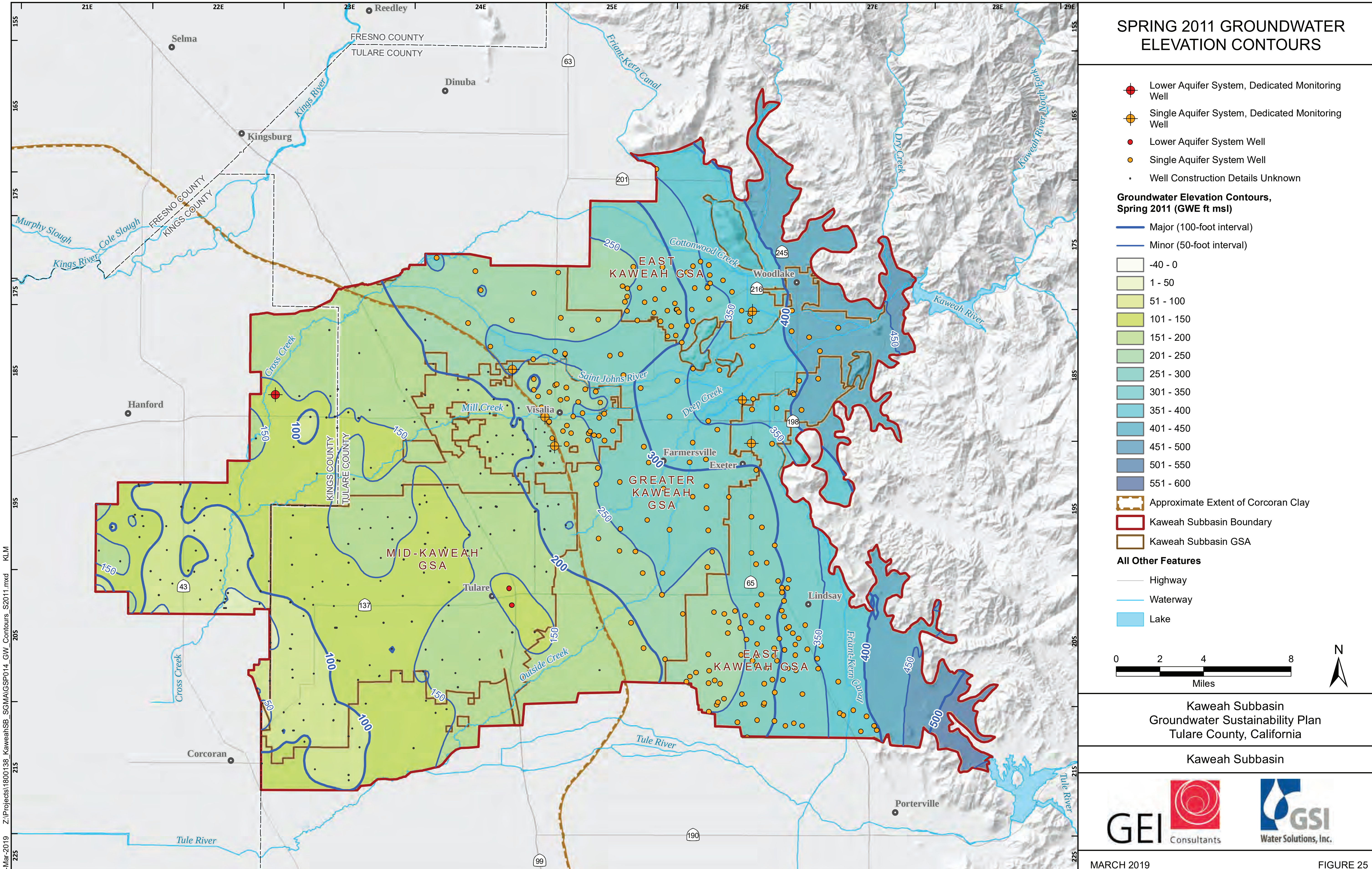
GEI Consultants

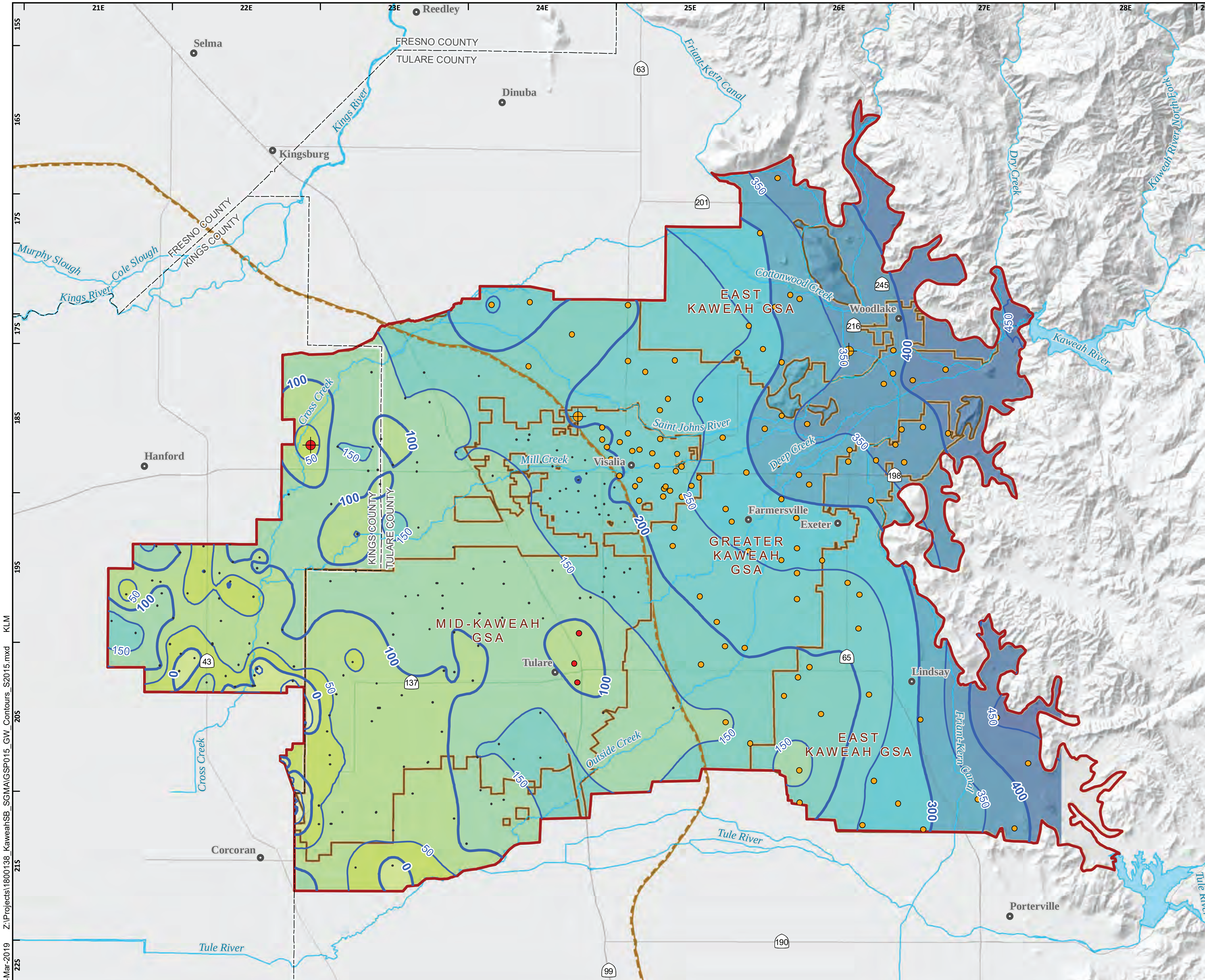
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 24

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP013_GW_Contours_S1999.mxd KLM


SPRING 2011 GROUNDWATER ELEVATION CONTOURS
Lower Aquifer System, Dedicated Monitoring Well
Single Aquifer System, Dedicated Monitoring Well
Lower Aquifer System Well
Single Aquifer System Well
Well Construction Details Unknown
Groundwater Elevation Contours, Spring 2011 (GWE ft msl)
Major (100-foot interval)
Minor (50-foot interval)
-40 - 0
1 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
Approximate Extent of Corcoran Clay
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 25
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Farmersville
Exeter
Woodlake
Tulare
Lindsay
Corcoran
Porterville
Kings River
Cole Slough
Murphy Slough
Cross Creek
Mill Creek
Saint Johns River
Cottonwood Creek
Deep Creek
Outside Creek
Friant-Kern Canal
Kaweah River
Dry Creek
Kaweah River North Fork
Tule River
Z:\Projects\1800138_KaweahSB_SGMA\GSP014_GW_Contours_S2011.mxd KLM
11-Mar-2019



SPRING 2015 GROUNDWATER ELEVATION CONTOURS

- Lower Aquifer System, Dedicated Monitoring Well
- Single Aquifer System, Dedicated Monitoring Well
- Lower Aquifer System Well
- Single Aquifer System Well
- Well Construction Details Unknown

Groundwater Elevation Contours, Spring 2015 (GWE ft msl)

- Major (100-foot interval)
- Minor (50-foot interval)
- -112 - -100
- -99 - -50
- -49 - 0
- 1 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 400
- 401 - 450
- 451 - 500
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

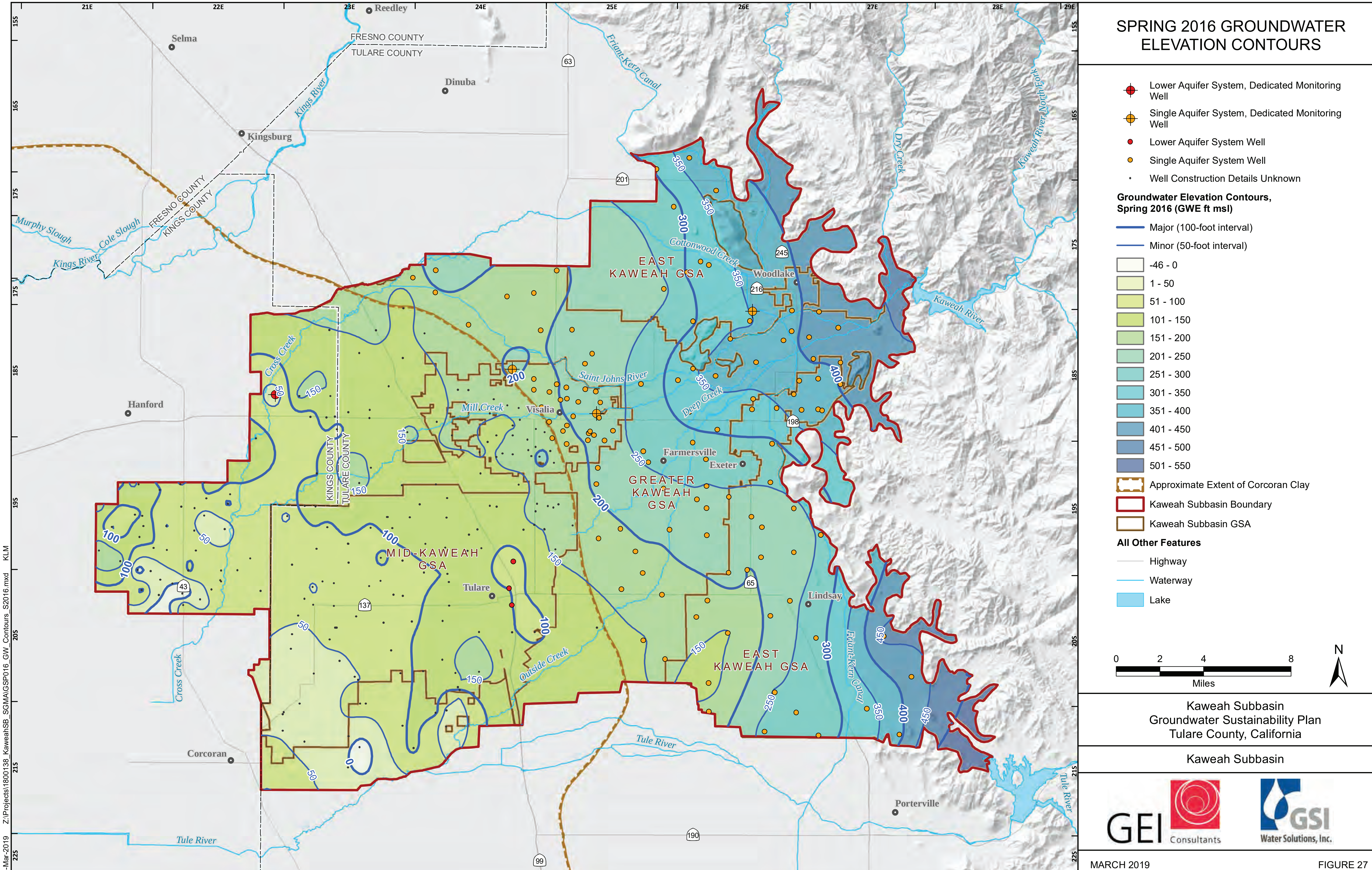
Kaweah Subbasin

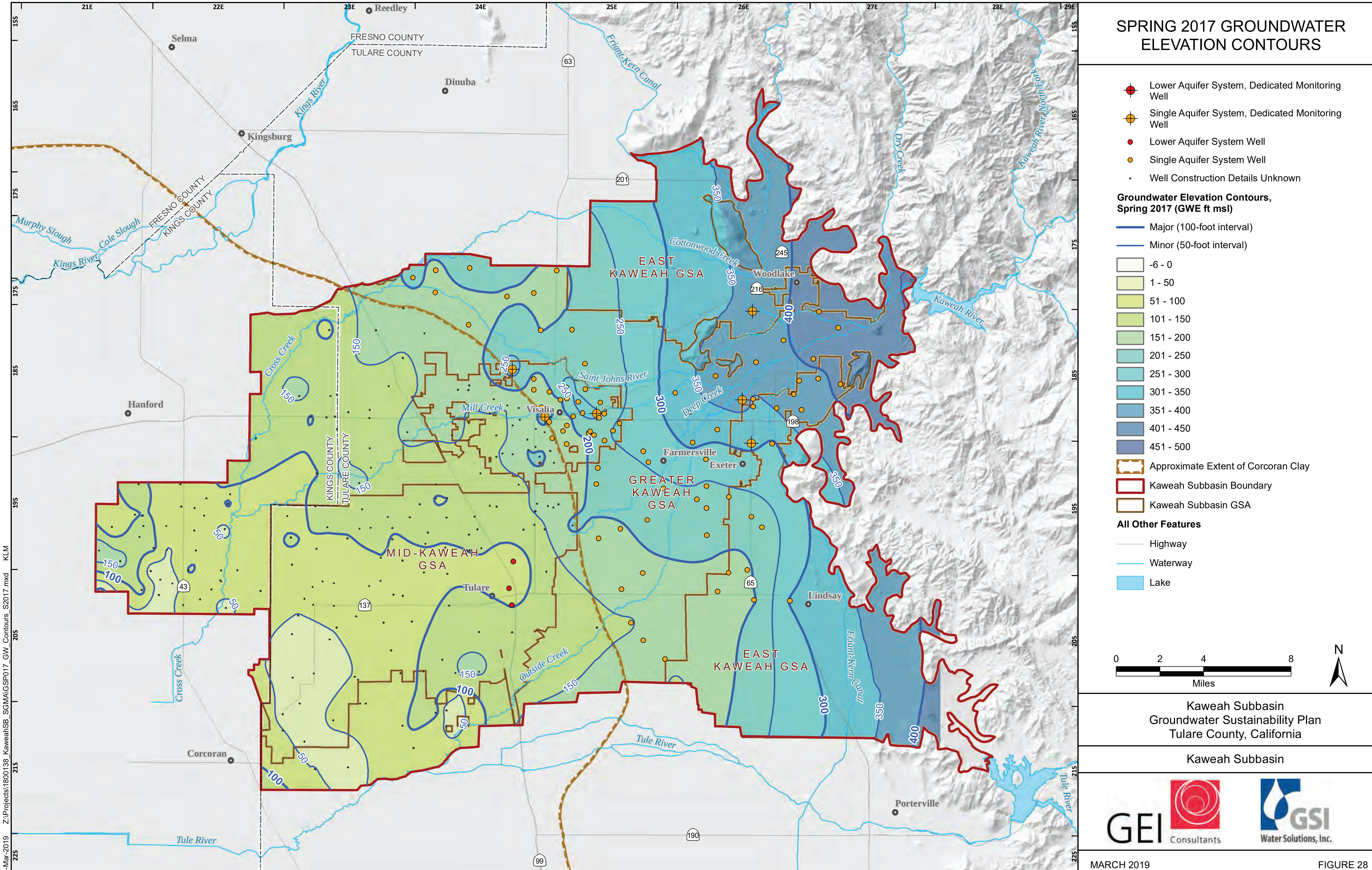
GEI Consultants

GSI Water Solutions, Inc.

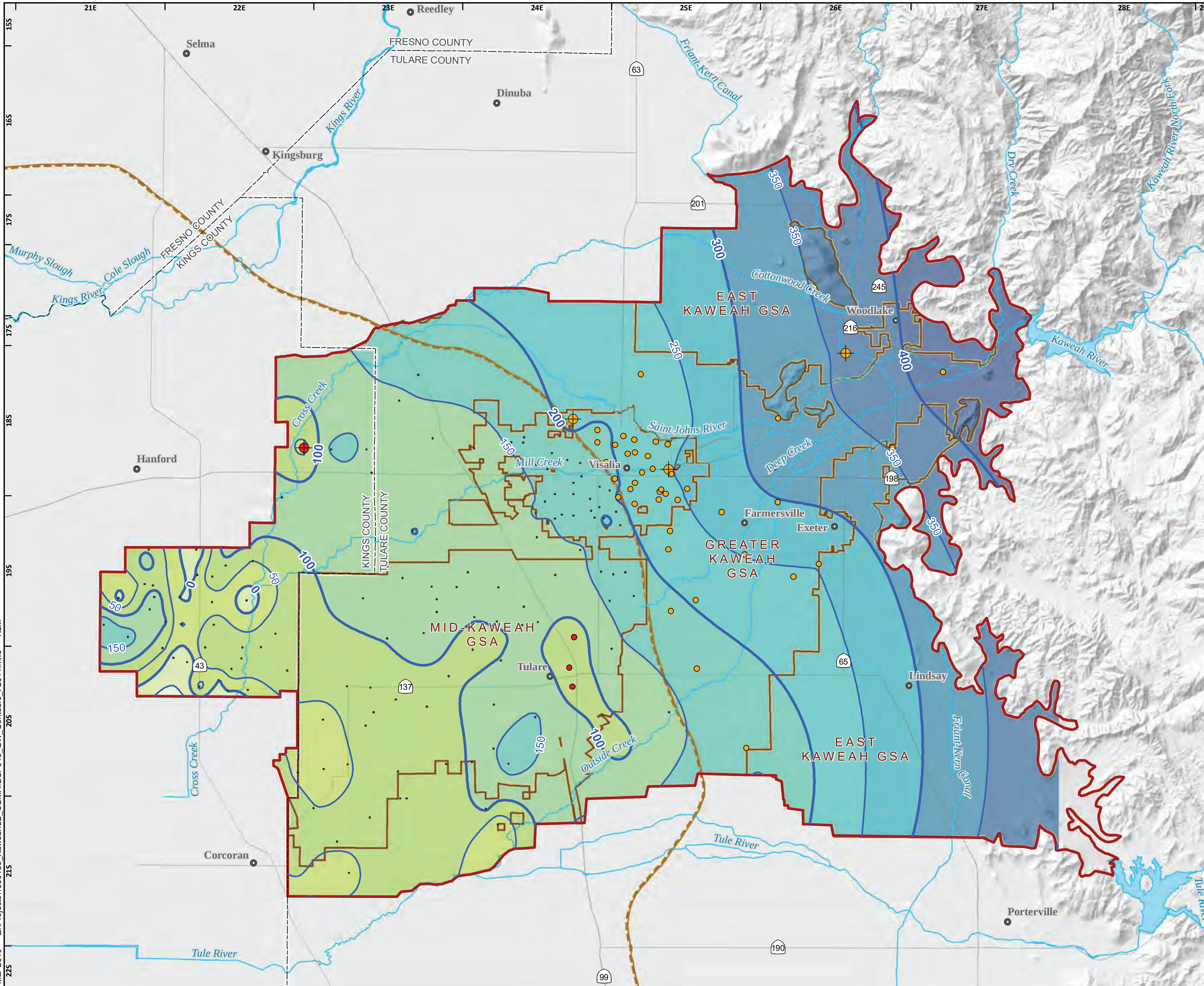
MARCH 2019

FIGURE 26


SPRING 2016 GROUNDWATER ELEVATION CONTOURS
Lower Aquifer System, Dedicated Monitoring Well
Single Aquifer System, Dedicated Monitoring Well
Lower Aquifer System Well
Single Aquifer System Well
Well Construction Details Unknown
Groundwater Elevation Contours, Spring 2016 (GWE ft msl)
Major (100-foot interval)
Minor (50-foot interval)
-46 - 0
1 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
Approximate Extent of Corcoran Clay
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 27
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
EAST KAWEAH GSA
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Woodlake
Farmersville
Exeter
Tulare
Lindsay
Corcoran
Porterville
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Friant-Kern Canal
Kings River
Cole Slough
Murphy Slough
Cross Creek
Cottonwood Creek
Saint Johns River
Deep Creek
Mill Creek
Outside Creek
Kaweah River
Dry Creek
Kaweah River North Fork
Tule River
11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP016_GW_Contours_S2016.mxd KLM


SPRING 2017 GROUNDWATER ELEVATION CONTOURS
Lower Aquifer System, Dedicated Monitoring Well
Single Aquifer System, Dedicated Monitoring Well
Lower Aquifer System Well
Single Aquifer System Well
Well Construction Details Unknown
Groundwater Elevation Contours, Spring 2017 (GWE ft msl)
Major (100-foot interval)
Minor (50-foot interval)
-6 - 0
1 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Approximate Extent of Corcoran Clay
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 28
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
EAST KAWEAH GSA
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Farmersville
Exeter
Woodlake
Tulare
Lindsay
Corcoran
Porterville
Kings River
Friant-Kern Canal
Kaweah River
Tule River
Cross Creek
Outside Creek
Deep Creek
Saint Johns River
Mill Creek
Cottonwood Creek
Dry Creek
Murphy Slough
Cole Slough
11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP017_GW_Contours_S2017.mxd KLM

FALL 2014 GROUNDWATER ELEVATION CONTOURS



- Lower Aquifer System, Dedicated Monitoring Well
- Single Aquifer System, Dedicated Monitoring Well
- Lower Aquifer System Well
- Single Aquifer System Well
- Well Construction Details Unknown

Groundwater Elevation Contours, Fall 2014 (GWE ft msl)

- Major (100-foot interval)
- Minor (50-foot interval)
- -75 - -50
- -49 - 0
- 1 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 400
- 401 - 450
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

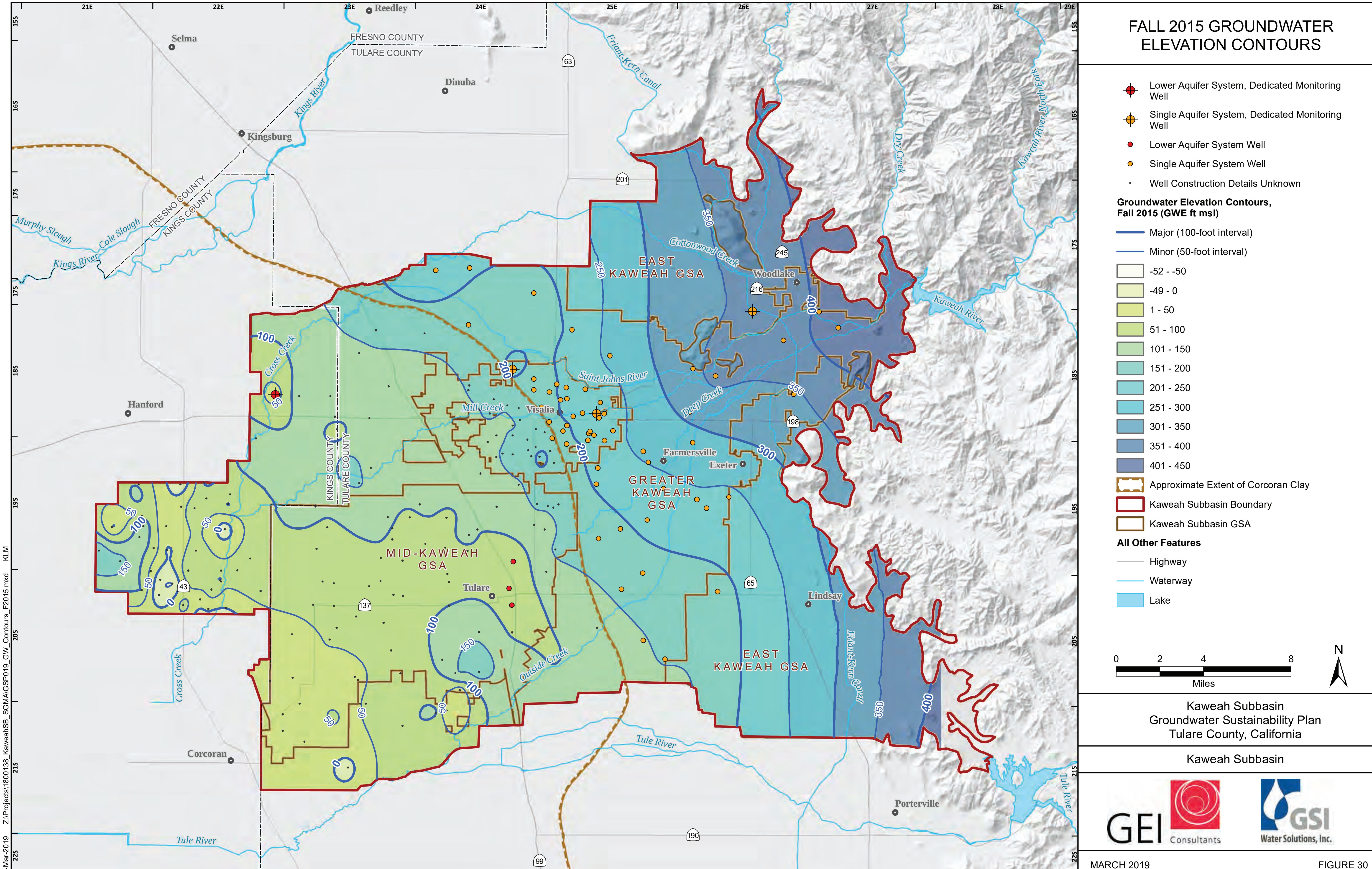
GEI Consultants

GSI Water Solutions, Inc.

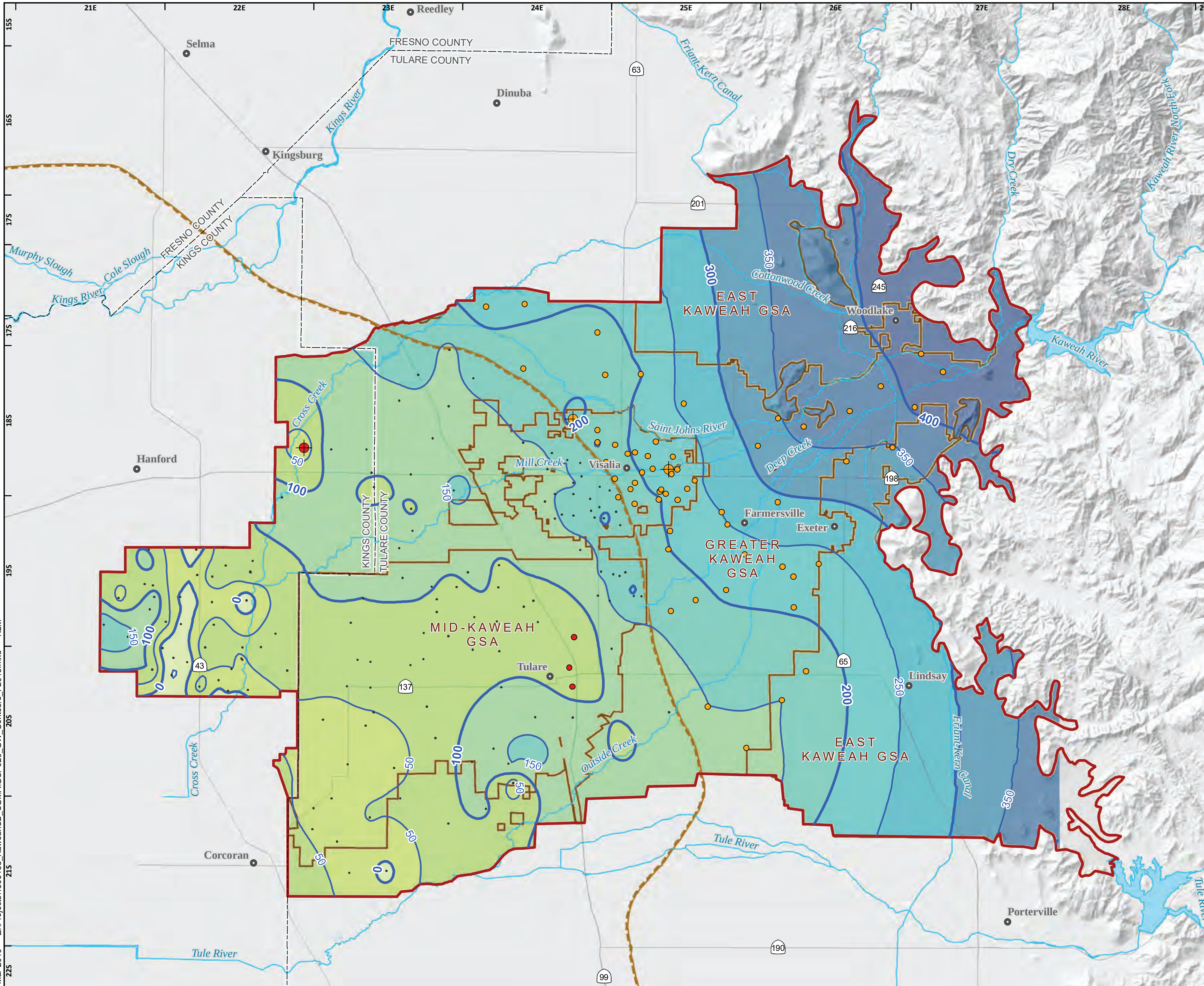
MARCH 2019

FIGURE 29

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP018_GW_Contours_F2014.mxd KLM


FALL 2015 GROUNDWATER ELEVATION CONTOURS
Lower Aquifer System, Dedicated Monitoring Well
Single Aquifer System, Dedicated Monitoring Well
Lower Aquifer System Well
Single Aquifer System Well
Well Construction Details Unknown
Groundwater Elevation Contours, Fall 2015 (GWE ft msl)
Major (100-foot interval)
Minor (50-foot interval)
-52 - -50
-49 - 0
1 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
Approximate Extent of Corcoran Clay
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 30
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
EAST KAWEAH GSA
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Farmersville
Exeter
Woodlake
Tulare
Lindsay
Corcoran
Porterville
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Kings River
Murphy Slough
Cole Slough
Cross Creek
Friant-Kern Canal
Cottonwood Creek
Saint Johns River
Mill Creek
Deep Creek
Kaweah River
Dry Creek
Kaweah River North Fork
Outside Creek
Tule River
11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP019_GW_Contours_F2015.mxd KLM

FALL 2016 GROUNDWATER ELEVATION CONTOURS



- Lower Aquifer System, Dedicated Monitoring Well
- Single Aquifer System, Dedicated Monitoring Well
- Lower Aquifer System Well
- Single Aquifer System Well
- Well Construction Details Unknown

Groundwater Elevation Contours, Fall 2016 (GWE ft msl)

- Major (100-foot interval)
- Minor (50-foot interval)
- -56 - -50
- -49 - 0
- 1 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 400
- 401 - 450
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

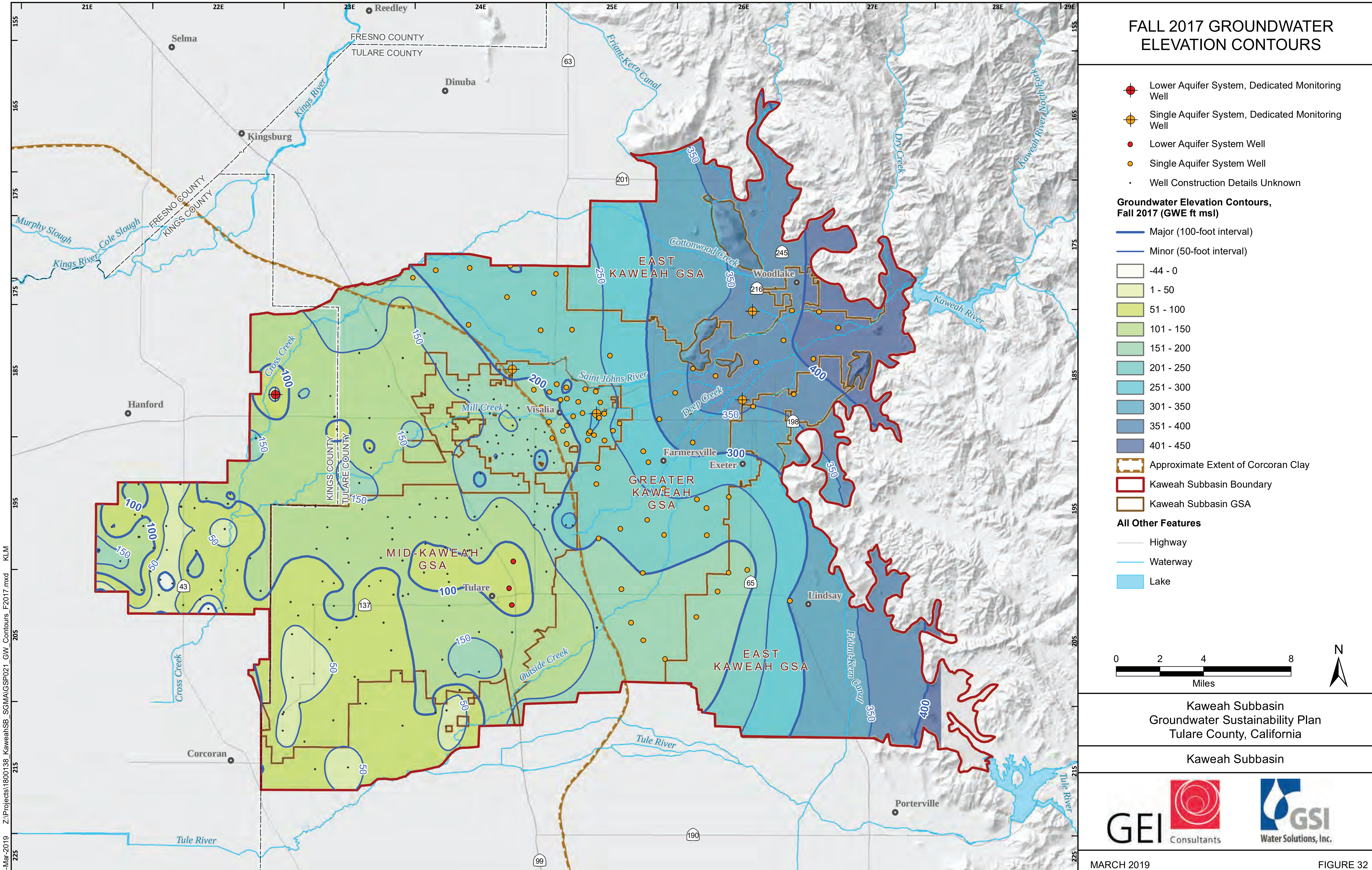
N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

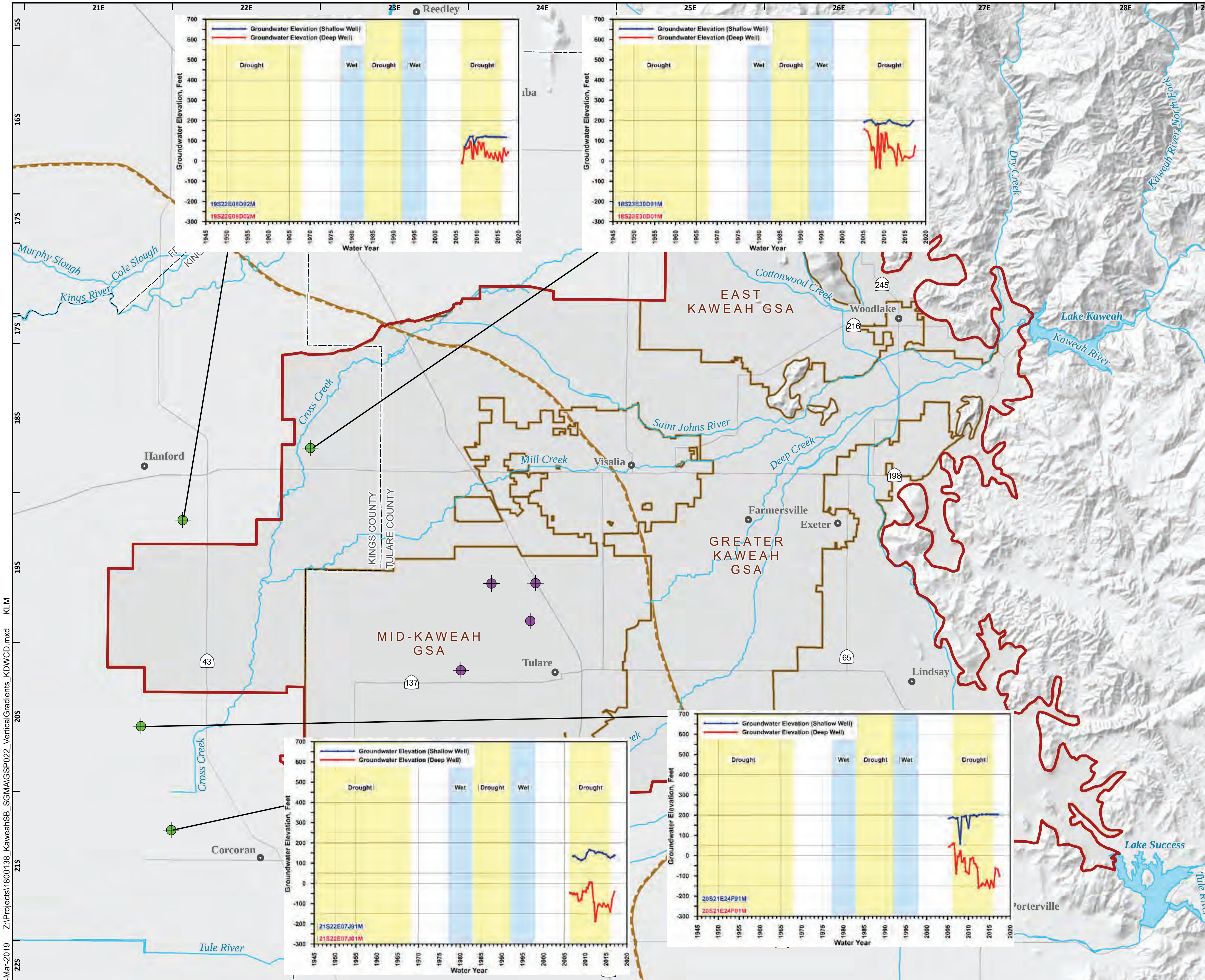
Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 31


FALL 2017 GROUNDWATER ELEVATION CONTOURS
Lower Aquifer System, Dedicated Monitoring Well
Single Aquifer System, Dedicated Monitoring Well
Lower Aquifer System Well
Single Aquifer System Well
Well Construction Details Unknown
Groundwater Elevation Contours, Fall 2017 (GWE ft msl)
Major (100-foot interval)
Minor (50-foot interval)
-44 - 0
1 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
Approximate Extent of Corcoran Clay
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 32
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Farmersville
Exeter
Woodlake
Tulare
Lindsay
Corcoran
Porterville
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Kings River
Murphy Slough
Cole Slough
Cross Creek
Mill Creek
Saint Johns River
Cottonwood Creek
Deep Creek
Kaweah River
Dry Creek
Kaweah River North Fork
Friant-Kern Canal
Outside Creek
Tule River
11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP021_GW_Contours_F2017.mxd KLM

VERTICAL GRADIENTS
KAWEAH DELTA WATER CONSERVATION DISTRICT WELLS



Dual Completion Monitoring Wells

- KDWCD Dual Completion Wells
- TID Dual Completion Wells
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

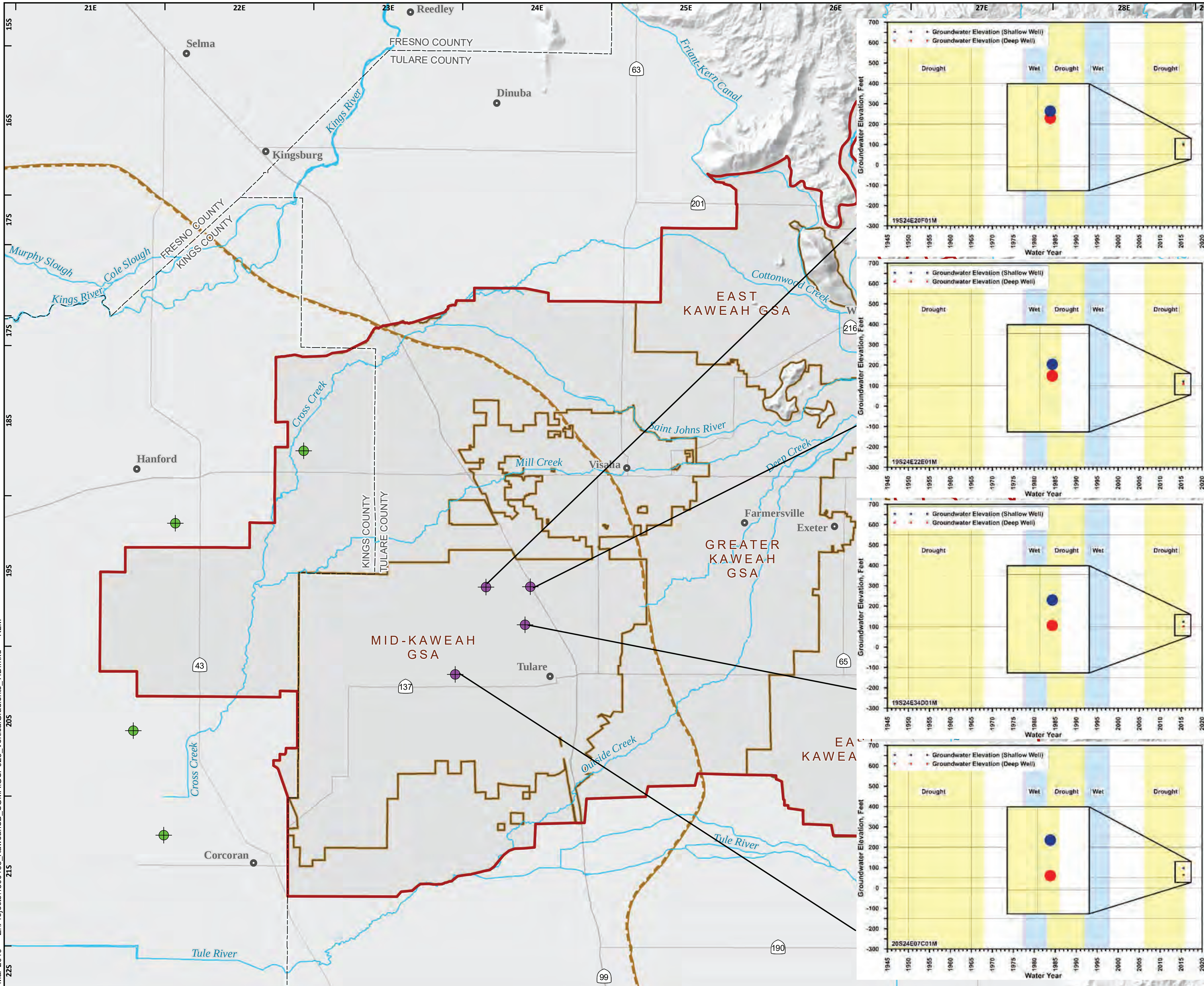
Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 33

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP022_VerticalGradients_KDWCD.mxd KLM

VERTICAL GRADIENTS TULARE IRRIGATION DISTRICTWELLS



Dual Completion Monitoring Wells

- KDWCD Dual Completion Wells
- TID Dual Completion Wells
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

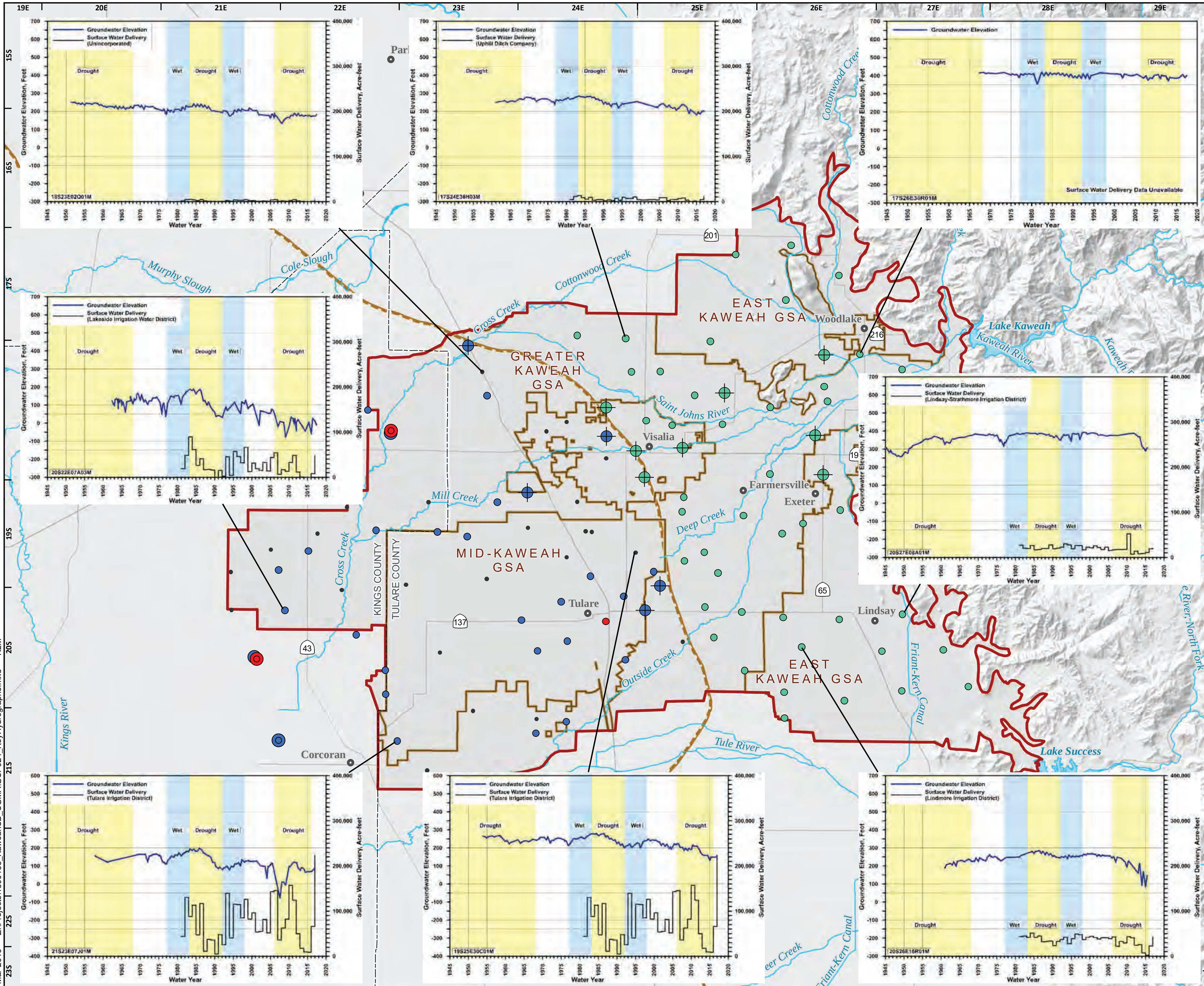
GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 34

Z:\Projects\1800138_KaweahSB_SGMA\GSP023_VerticalGradients_TID.mxd KLM
11-Mar-2019



SELECT KEY WELL HYDROGRAPHS

- Lower Aquifer System Dual Completion Well
- Lower Aquifer System Well
- Single Aquifer System Dedicated Monitoring Well
- Single Aquifer System Well
- Upper Aquifer System Dedicated Monitoring Well
- Upper Aquifer System Dual Completion Well
- Upper Aquifer System Well
- Well Construction Details Unknown
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

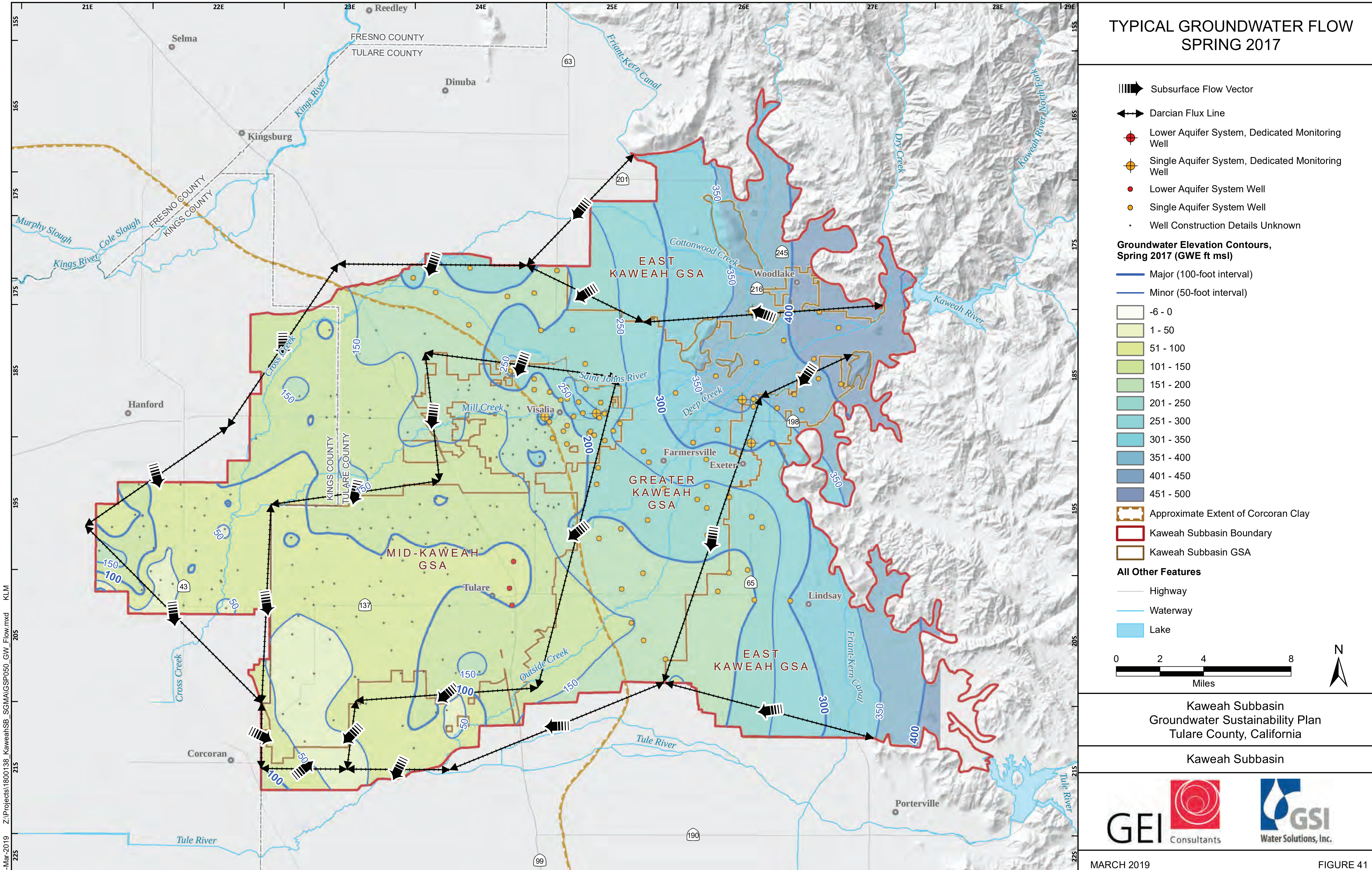
Kaweah Subbasin

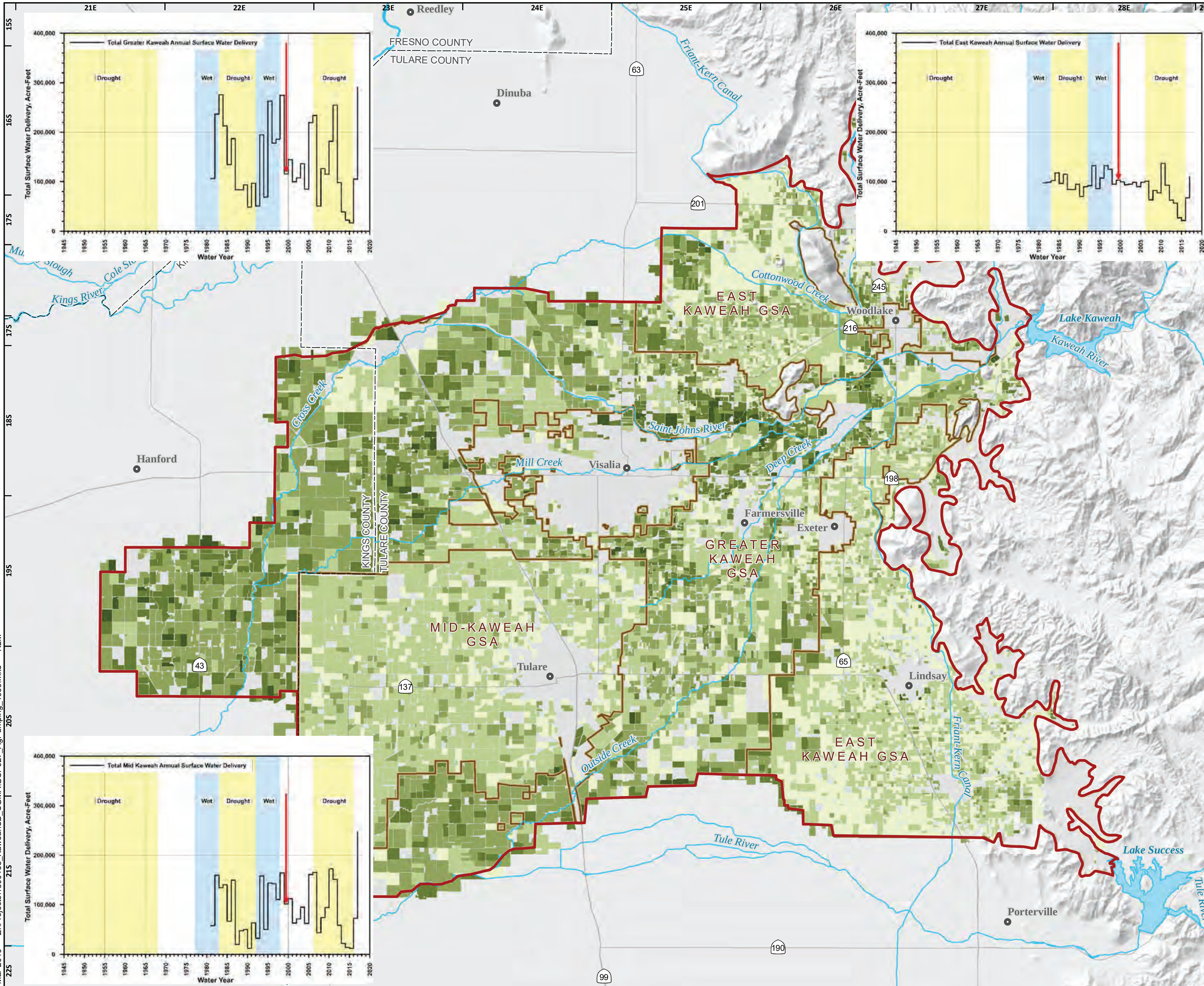
GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 35

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP024_KeyHydrographs.mxd KLM


TYPICAL GROUNDWATER FLOW
SPRING 2017
Subsurface Flow Vector
Darcian Flux Line
Lower Aquifer System, Dedicated Monitoring Well
Single Aquifer System, Dedicated Monitoring Well
Lower Aquifer System Well
Single Aquifer System Well
Well Construction Details Unknown
Groundwater Elevation Contours, Spring 2017 (GWE ft msl)
Major (100-foot interval)
Minor (50-foot interval)
-6 - 0
1 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Approximate Extent of Corcoran Clay
Kaweah Subbasin Boundary
Kaweah Subbasin GSA
All Other Features
Highway
Waterway
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 41
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Farmersville
Exeter
Woodlake
Tulare
Lindsay
Corcoran
Porterville
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Kings River
Friant-Kern Canal
Murphy Slough
Cole Slough
Cross Creek
Mill Creek
Saint Johns River
Cottonwood Creek
Deep Creek
Outside Creek
Tule River
Kaweah River
Dry Creek
Kaweah River North Fork
11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP050_GW_Flow.mxd KLM



ANNUAL AGRICULTURAL PUMPING WATER YEAR 1999

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

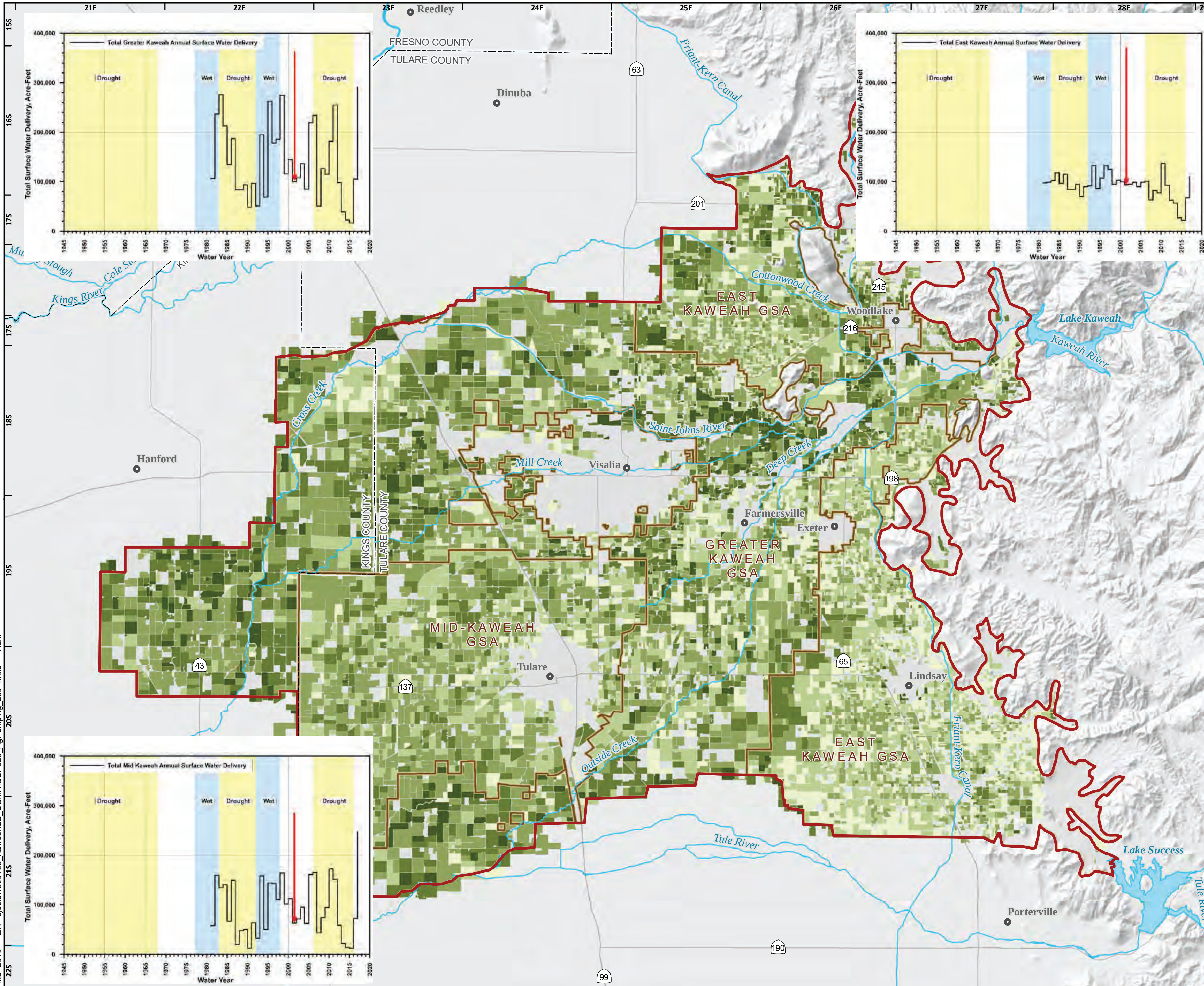
Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 42



ANNUAL AGRICULTURAL PUMPING WATER YEAR 2001

Agricultural Pumping, acre-feet/acre

- 0.0 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8 Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

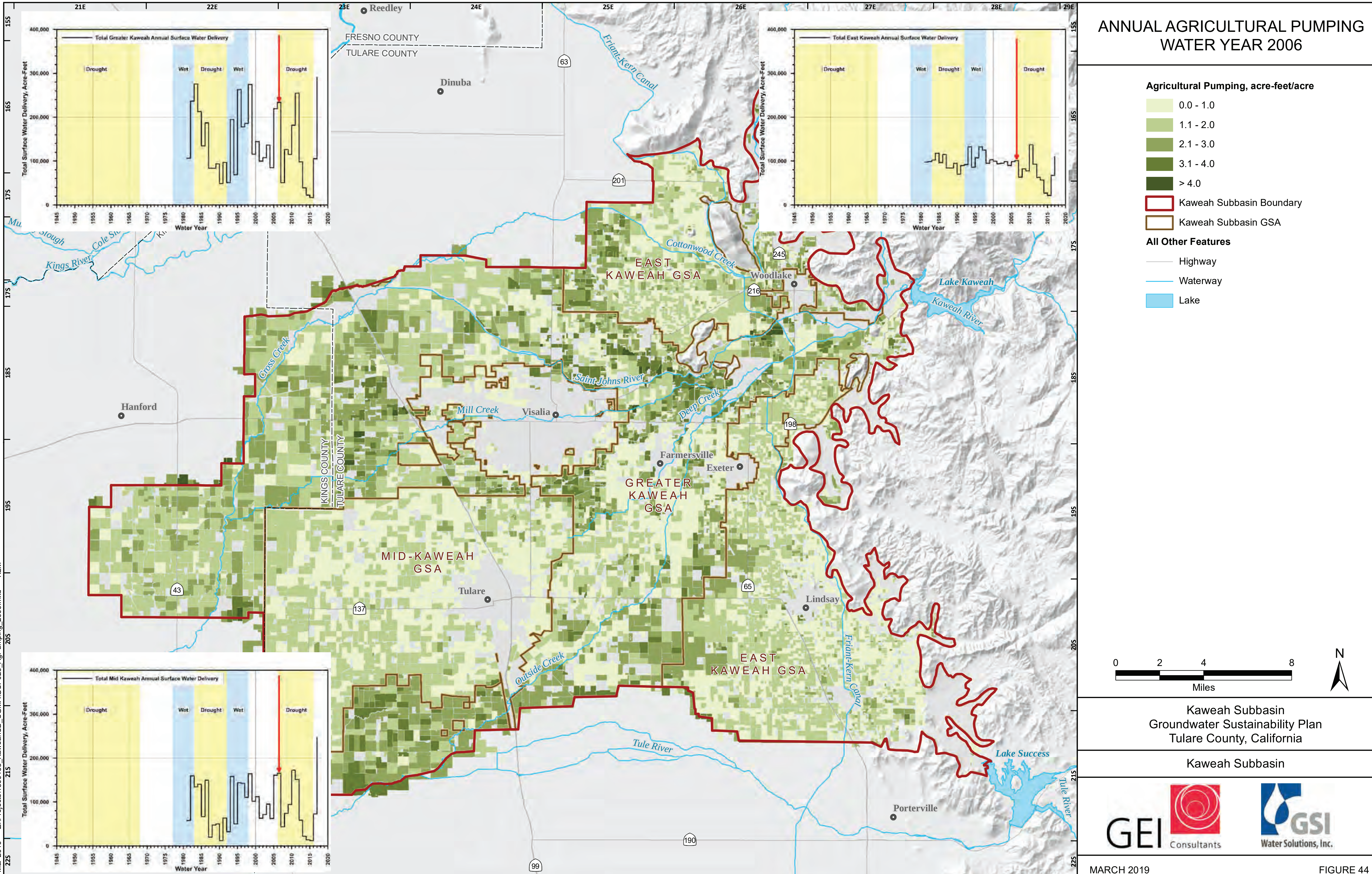
GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 43

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP028_AgPumping_2001.mxd KLM



ANNUAL AGRICULTURAL PUMPING WATER YEAR 2006

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

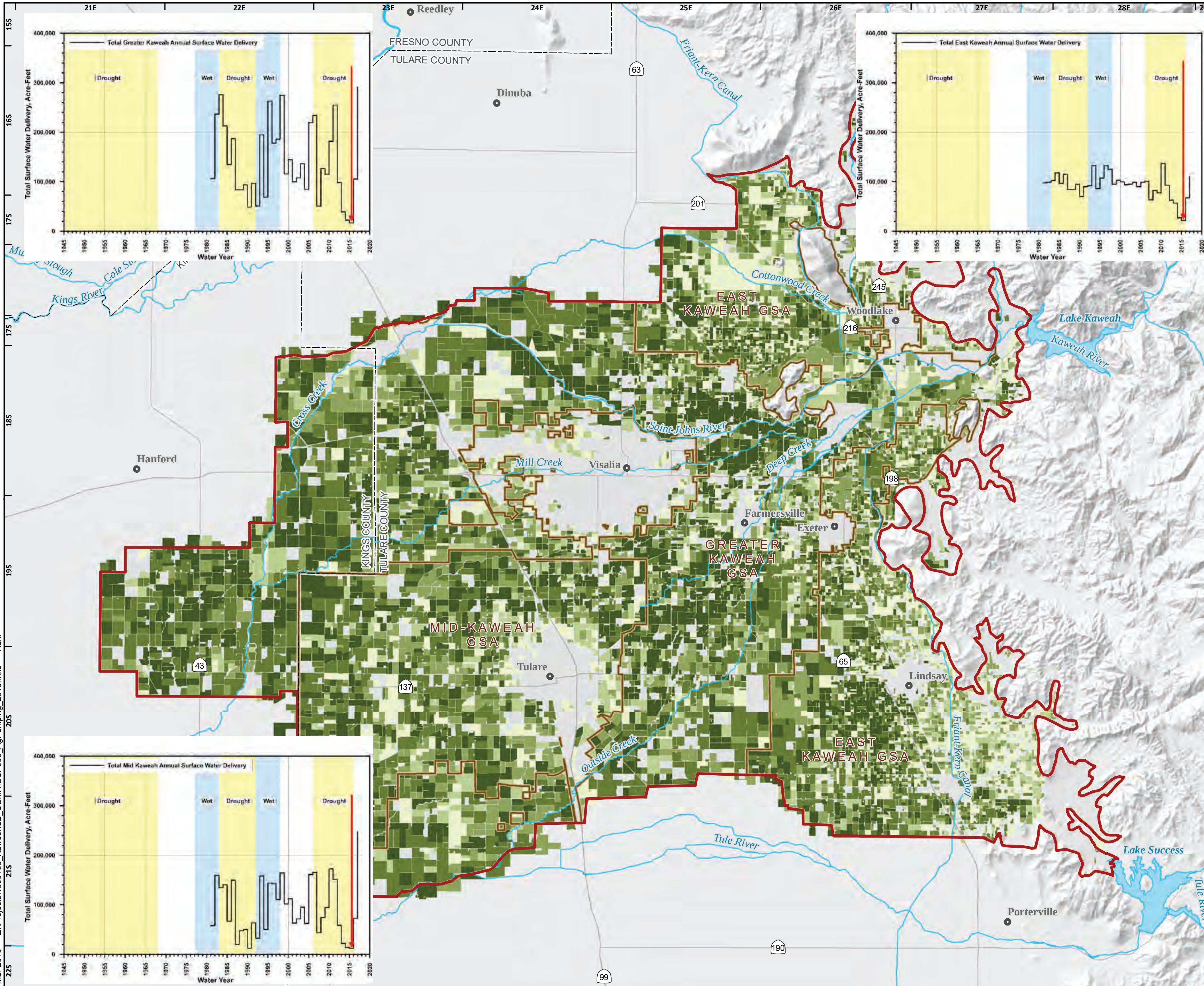
MARCH 2019

FIGURE 44

Z:\Projects\1800138_KaweahSB_SGMA\GSP029_AgPumping_2006.mxd KLM

11-Mar-2019

ANNUAL AGRICULTURAL PUMPING WATER YEAR 2015



Agricultural Pumping, acre-feet/acre

- 0.0 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

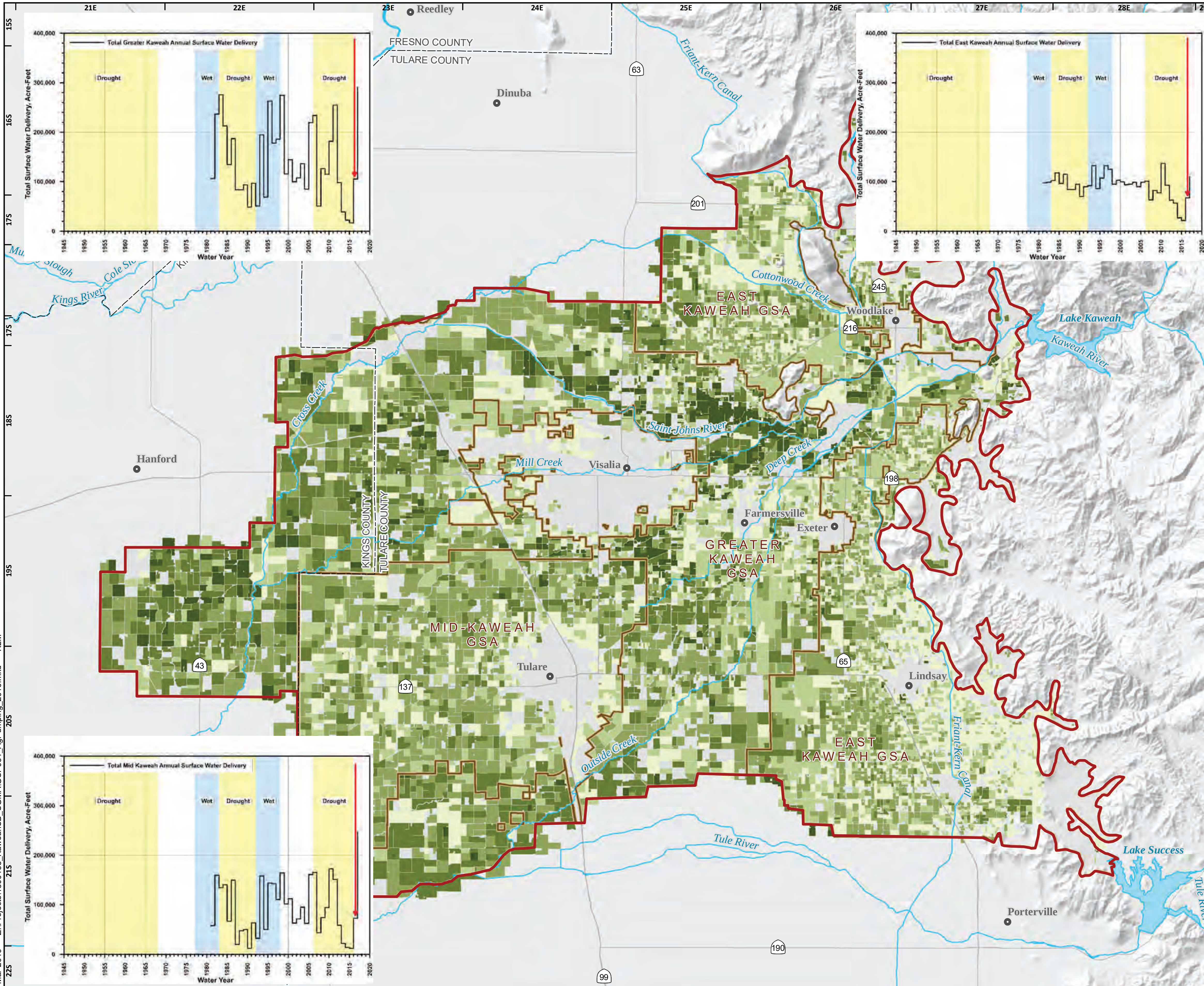
GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 45

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP030_AgPumping_2015.mxd KLM

ANNUAL AGRICULTURAL PUMPING WATER YEAR 2016



Agricultural Pumping, acre-feet/acre

- 0.0 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

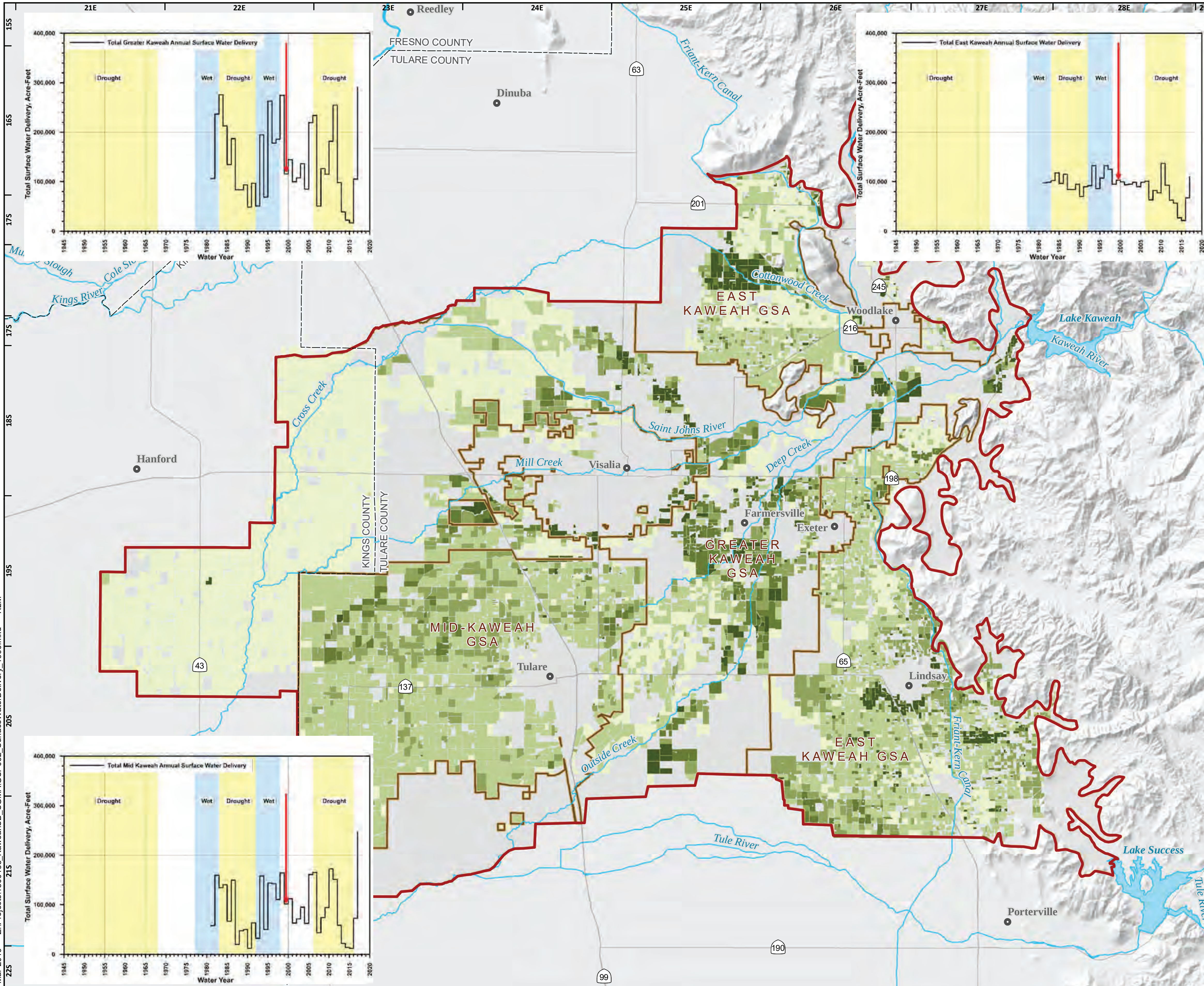
Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 46

11-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP031_AgPumping_2016.mxd KLM

ANNUAL SURFACE WATER DELIVERY
WATER YEAR 1999



Surface Water Delivery, acre-feet/acre

- < 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

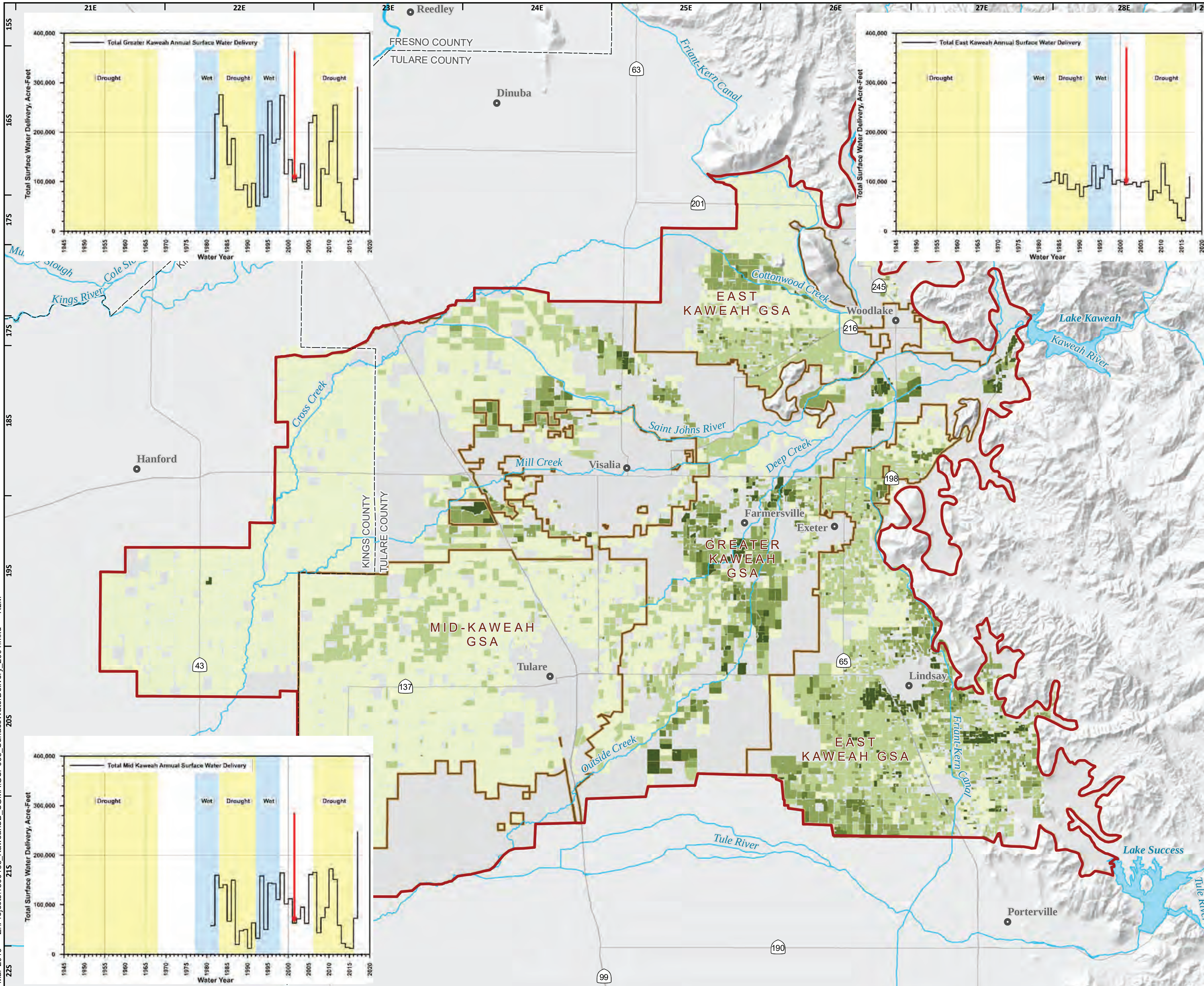
MARCH 2019

FIGURE 47

Z:\Projects\1800138_KaweahSB_SGMA\GSP032_SurfaceWaterDelivery_1999.mxd KLM

12-Mar-2019

ANNUAL SURFACE WATER DELIVERY WATER YEAR 2001



Surface Water Delivery, acre-feet/acre

- < 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

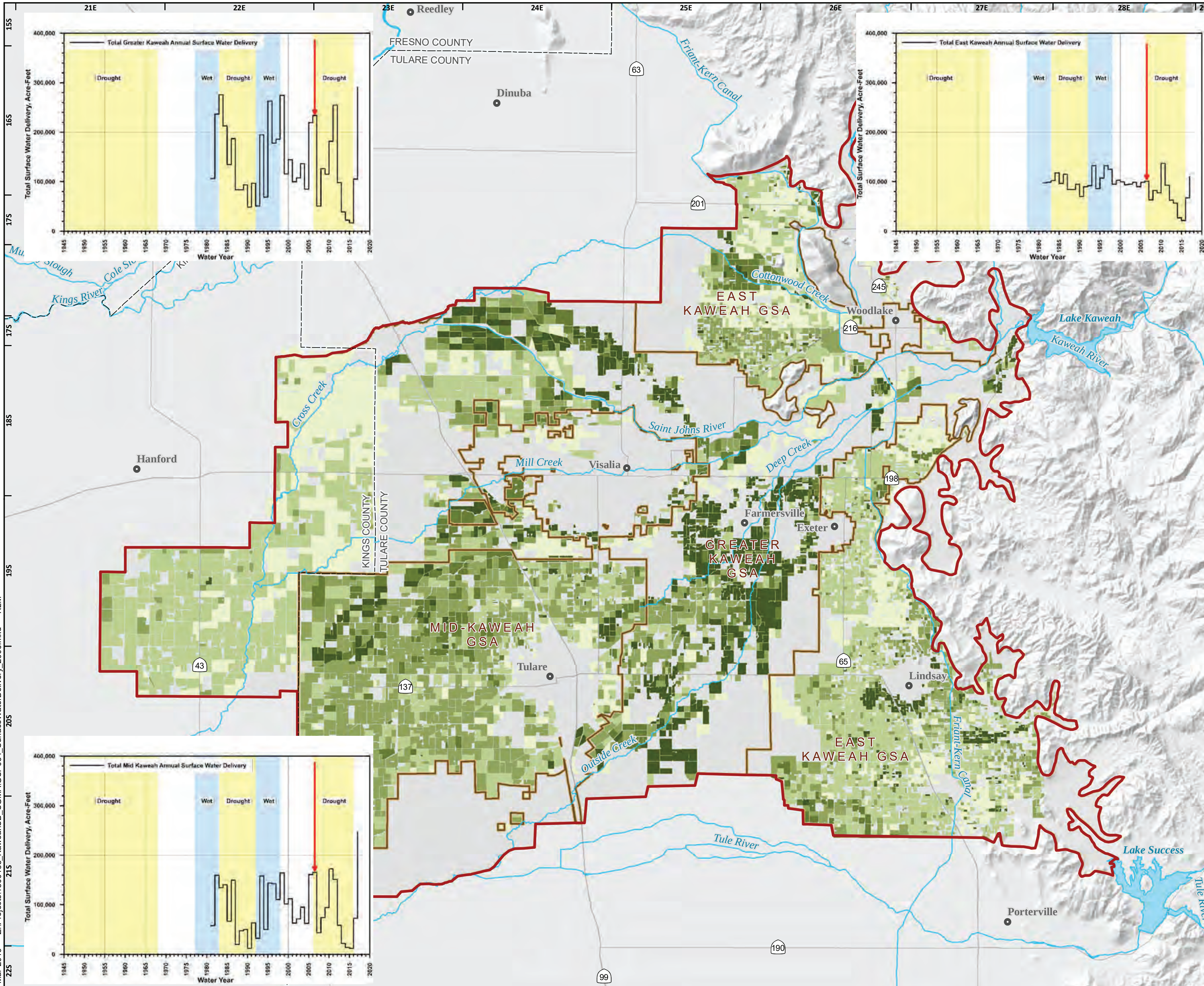
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 48

12-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP033_SurfaceWaterDelivery_2001.mxd KLM



ANNUAL SURFACE WATER DELIVERY WATER YEAR 2006

Surface Water Delivery, acre-feet/acre

- < 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

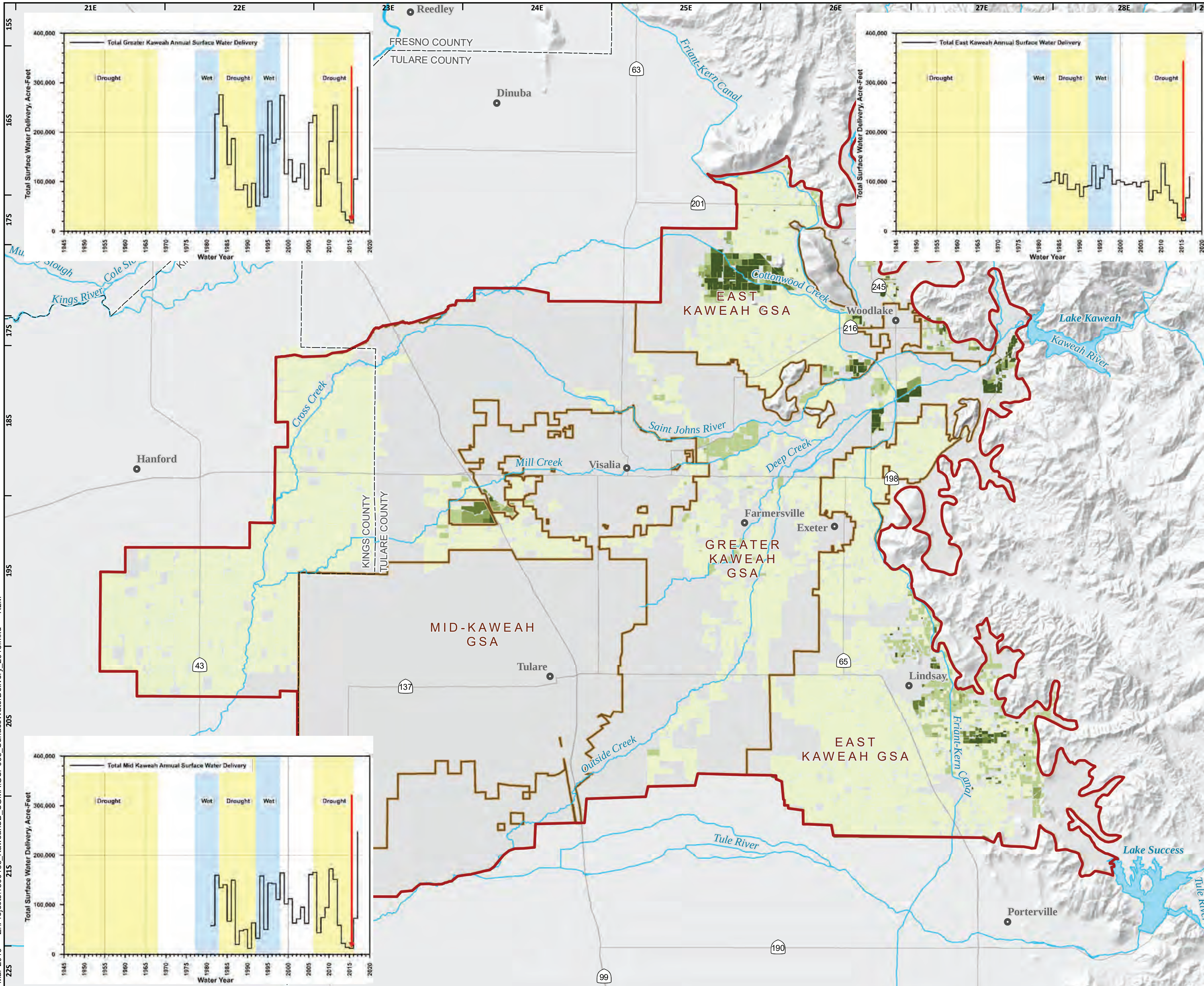
GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 49

12-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP034_SurfaceWaterDelivery_2006.mxd KLM

ANNUAL SURFACE WATER DELIVERY WATER YEAR 2015



Surface Water Delivery, acre-feet/acre

- < 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8 Miles

N

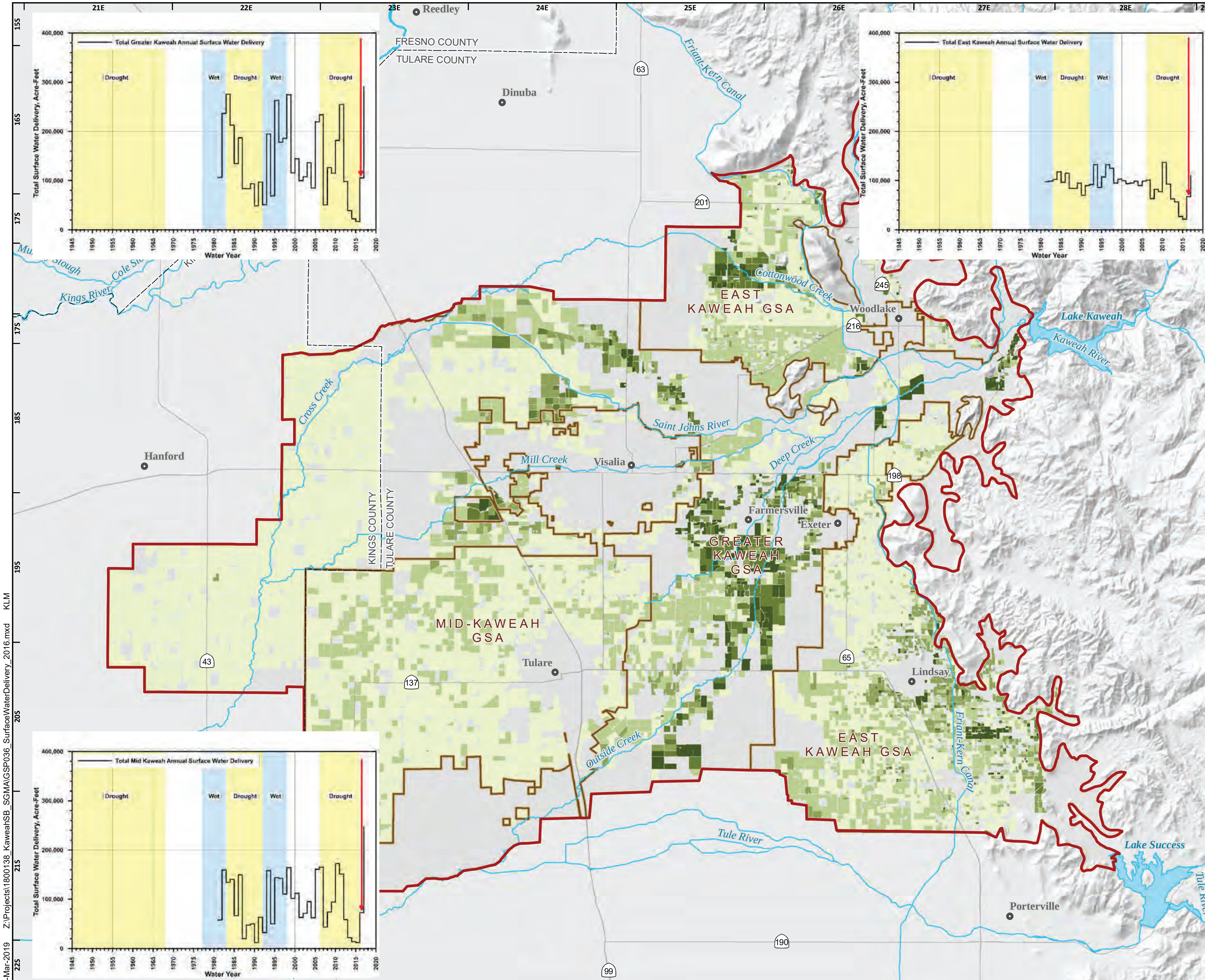
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 50

Z:\Projects\1800138_KaweahSB_SGMA\GSP035_SurfaceWaterDelivery_2015.mxd KLM 12-Mar-2019



ANNUAL SURFACE WATER DELIVERY WATER YEAR 2016

Surface Water Delivery, acre-feet/acre

- < 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- > 4.0
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8 Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

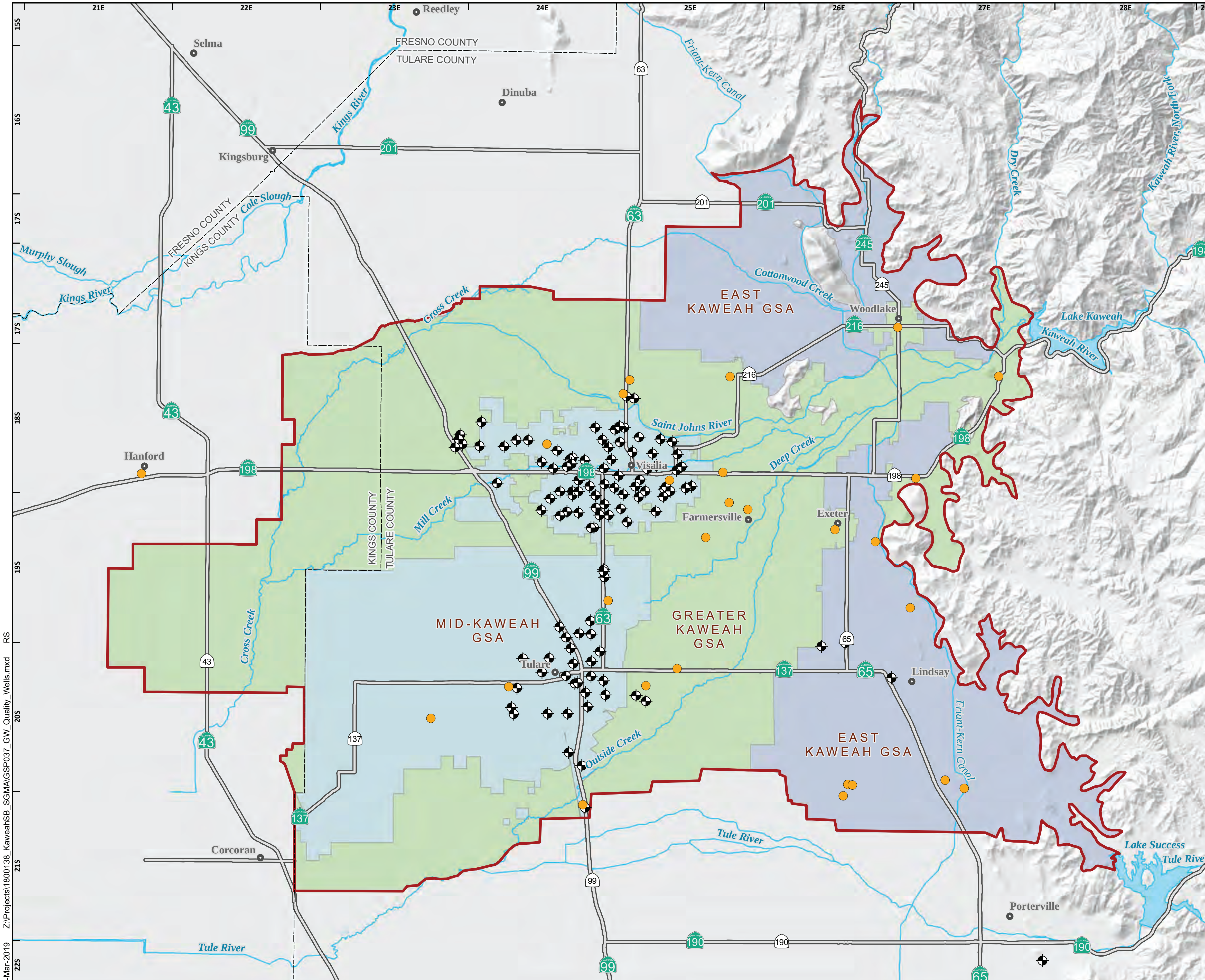
Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 51

Z:\Projects\1800138_KaweahSB_SGMA\GSP036_SurfaceWaterDelivery_2016.mxd KLM
12-Mar-2019



KAWEAH SUBBASIN GROUNDWATER QUALITY WELL LOCATIONS

- Representation of PWS with unknown Well Locations
- Approximate Well Location

GSA Boundaries

- East Kaweah GSA
- Greater Kaweah GSA
- Mid-Kaweah GSA
- Kaweah Subbasin Boundary

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8 Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

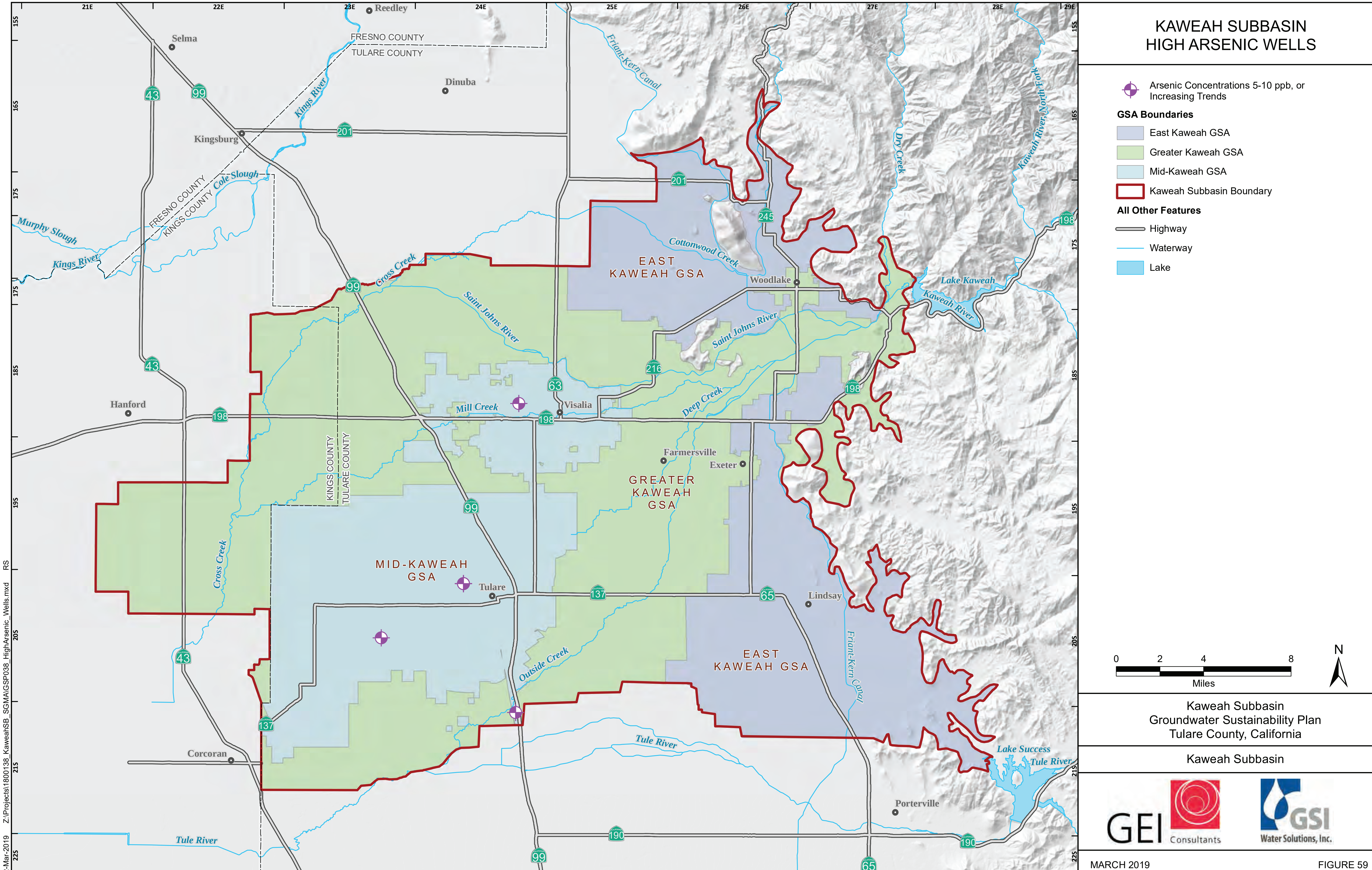
Kaweah Subbasin

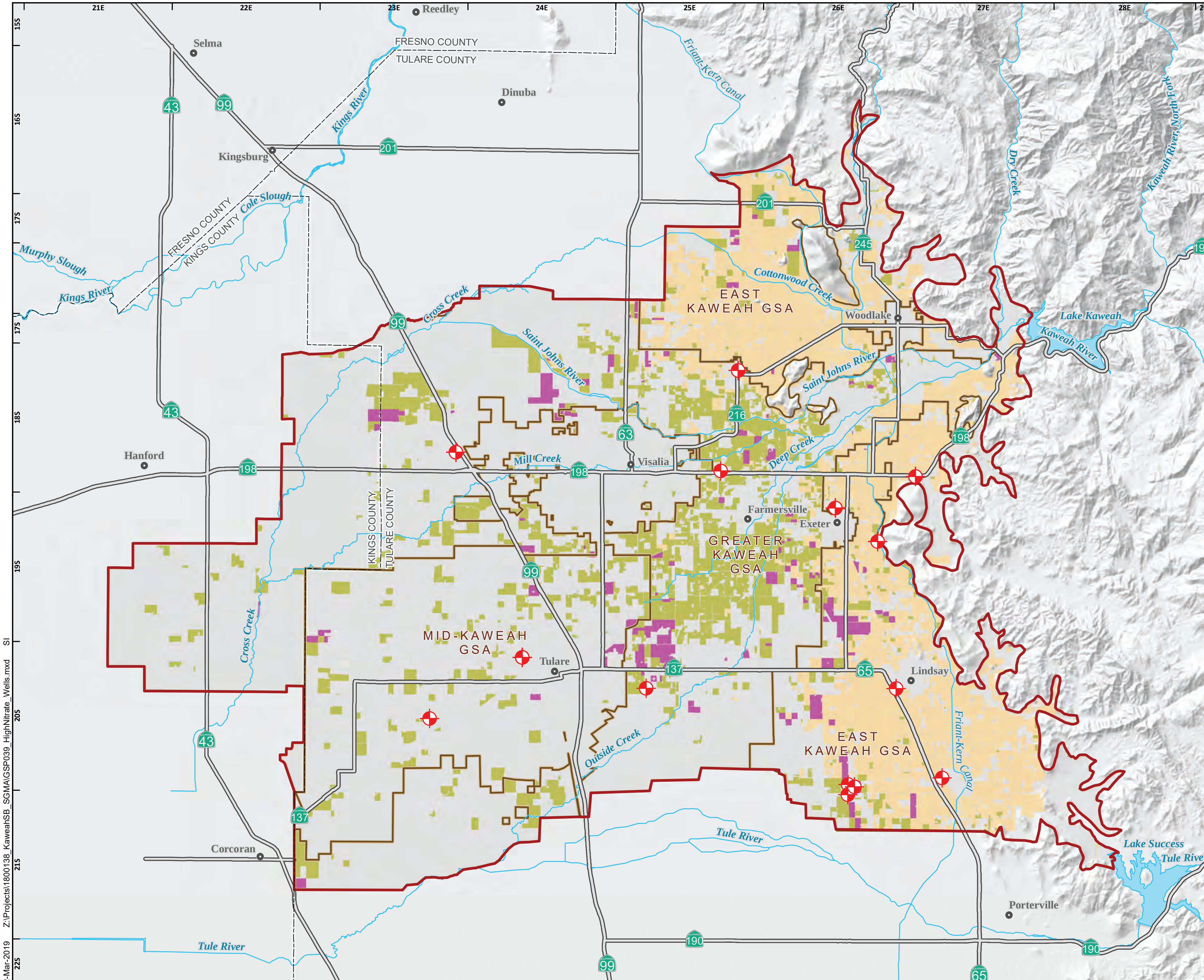
GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 58


KAWEAH SUBBASIN
HIGH ARSENIC WELLS
Arsenic Concentrations 5-10 ppb, or Increasing Trends
GSA Boundaries
East Kaweah GSA
Greater Kaweah GSA
Mid-Kaweah GSA
Kaweah Subbasin Boundary
All Other Features
Highway
Waterway
Lake
0
2
4
8
Miles
N
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
EAST KAWEAH GSA
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Selma
Reedley
Dinuba
Kingsburg
Hanford
Visalia
Woodlake
Farmersville
Exeter
Tulare
Lindsay
Corcoran
Porterville
Kings River
Cole Slough
Murphy Slough
Cross Creek
Saint Johns River
Cottonwood Creek
Friant-Kern Canal
Dry Creek
Kaweah River, North Fork
Lake Kaweah
Kaweah River
Mill Creek
Deep Creek
Outside Creek
Tule River
Lake Success
43
99
201
245
198
63
216
137
65
190
Z:\Projects\1800138_KaweahSB_SGMA\GSP038_HighArsenic_Wells.mxd RS
12-Mar-2019
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 59



KAWEAH SUBBASIN HIGH NITRATE WELLS

Nitrate Concentrations 5-10 ppm, or Increasing Trends

Kaweah Subbasin GSA

Kaweah Subbasin Boundary

Land Use

Citrus and Subtropical

Deciduous Fruits and Nuts

Vineyard

All Other Features

Highway

Waterway

Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

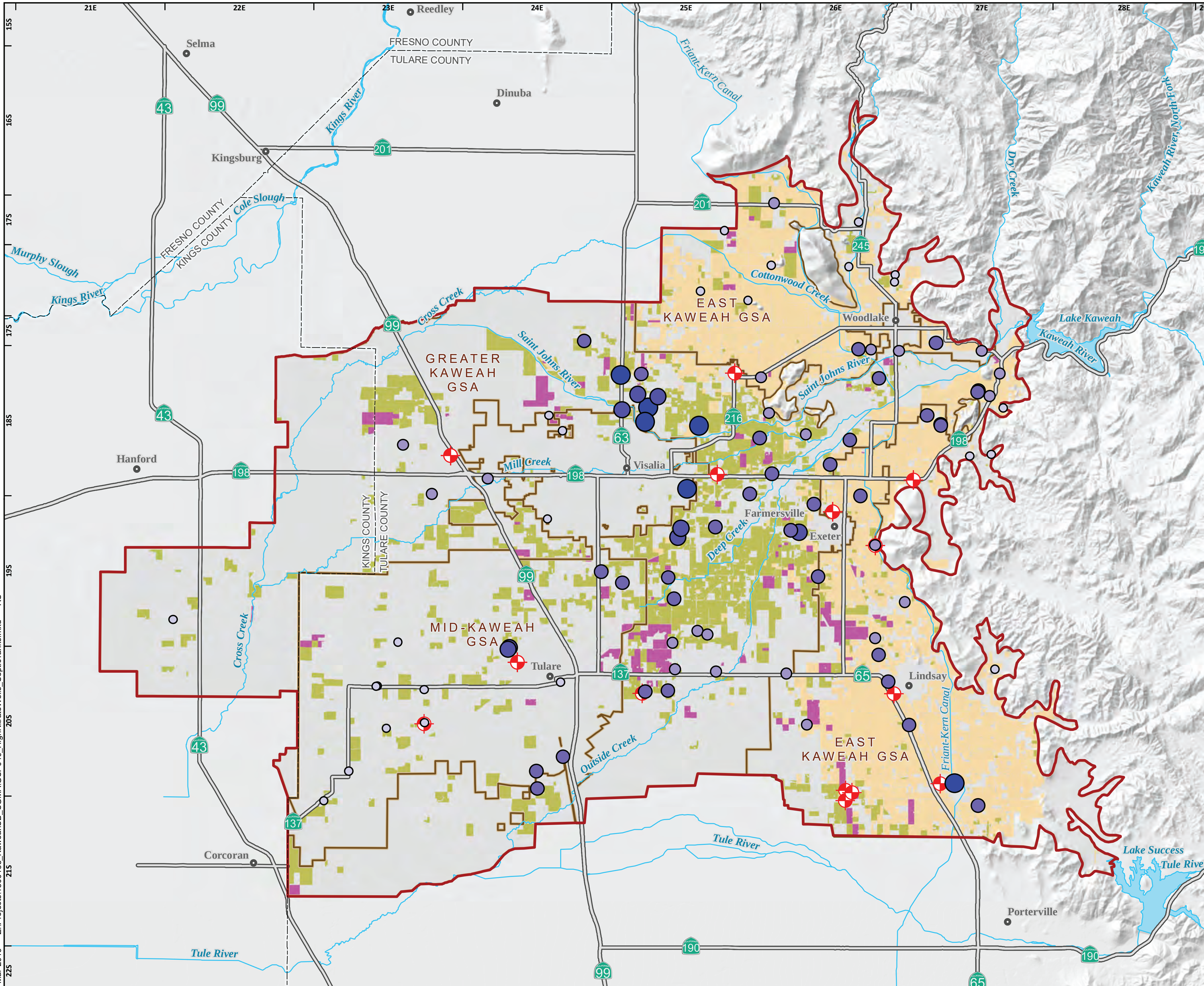
Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 61



KAWEAH SUBBASIN HIGH NITRATE WELLS AND SEPTIC TANKS

Nitrate Concentrations 5-10 ppm, or Increasing Trends

Kaweah Subbasin GSA

Kaweah Subbasin Boundary

USGS Study Septic Tank Density per 500 meters

- 0.9 to 3.7
- >3.7 to 6.4
- > 6.4 to 10.6
- >10.6 to 15.4
- >15.4 to 35.9

Land Use

- Citrus and Subtropical
- Deciduous Fruits and Nuts
- Vineyard

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8

Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

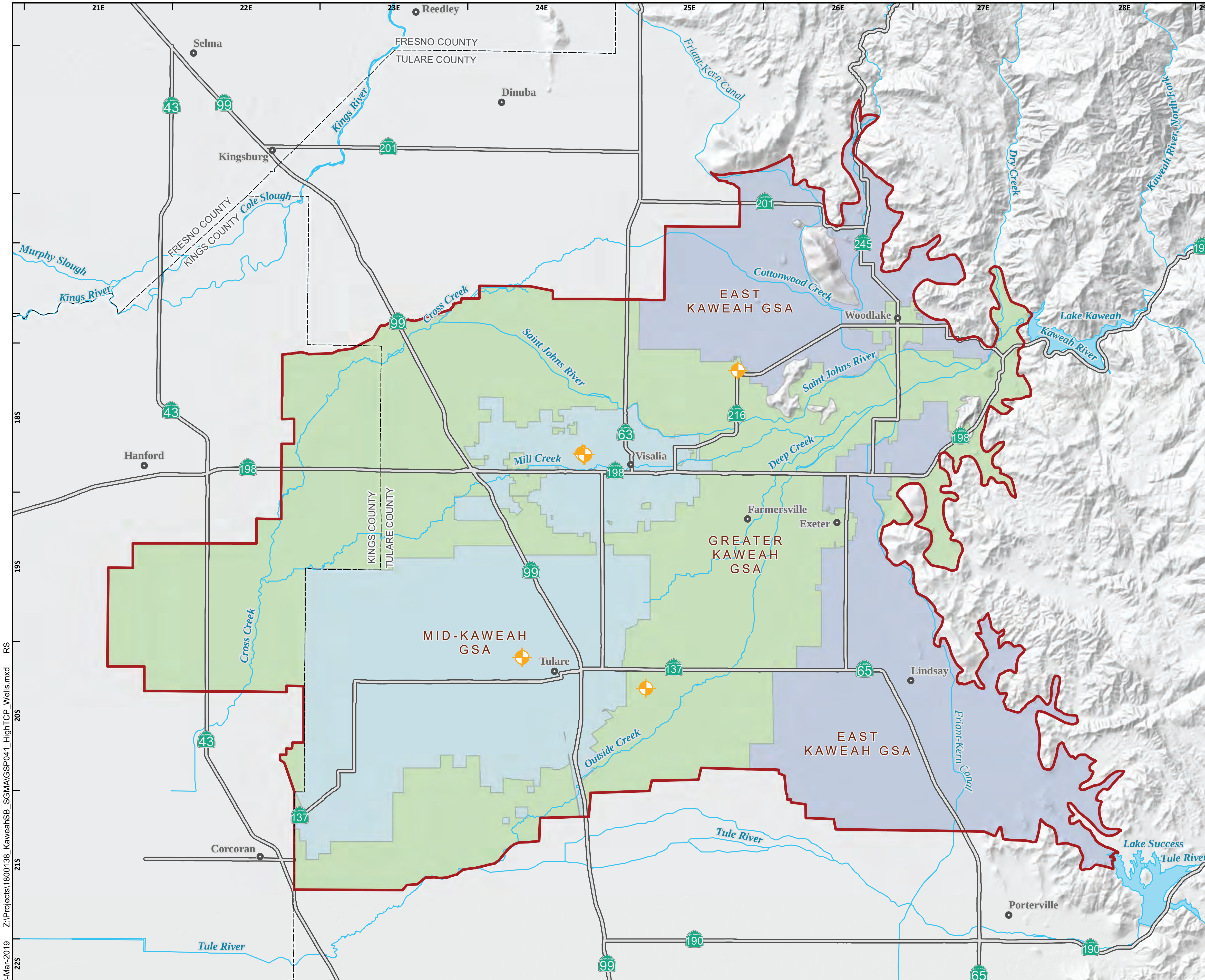
Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 62



KAWEAH SUBBASIN HIGH TCP WELLS

Areas of TCP Levels Greater Than 5 ppt

GSA Boundaries

East Kaweah GSA

Greater Kaweah GSA

Mid-Kaweah GSA

Kaweah Subbasin Boundary

All Other Features

Highway

Waterway

Lake

0 2 4 8
Miles

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

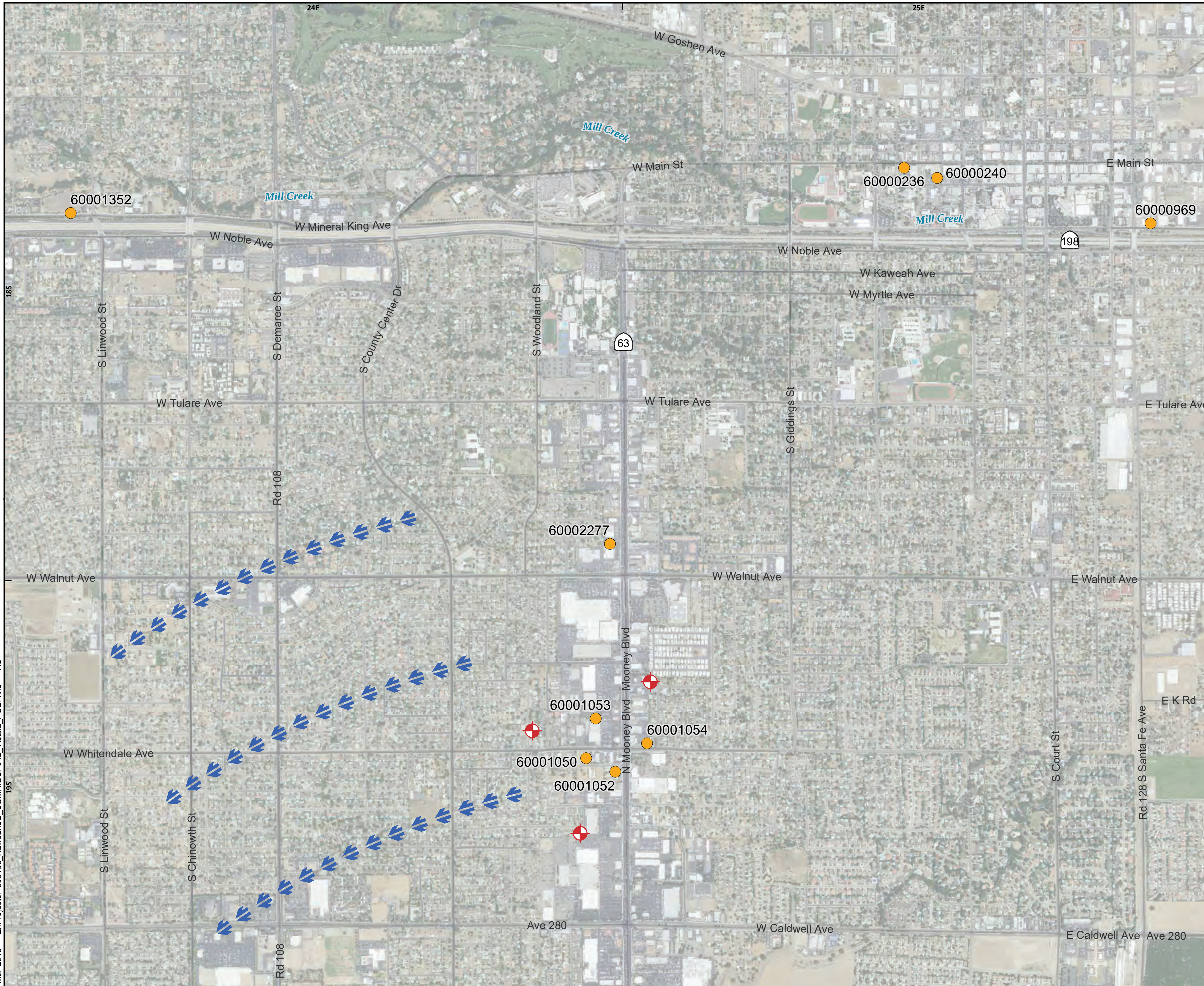
GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 78

12-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP041_HighTCP_Wells.mxd RS

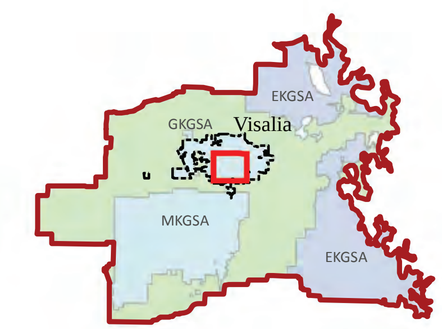


KAWEAH SUBBASIN
VISALIA CITYWIDE PCE PLUME

PCE Contamination Site

Municipal Well

General GW Flow Direction



0 1,500 3,000

Feet

N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

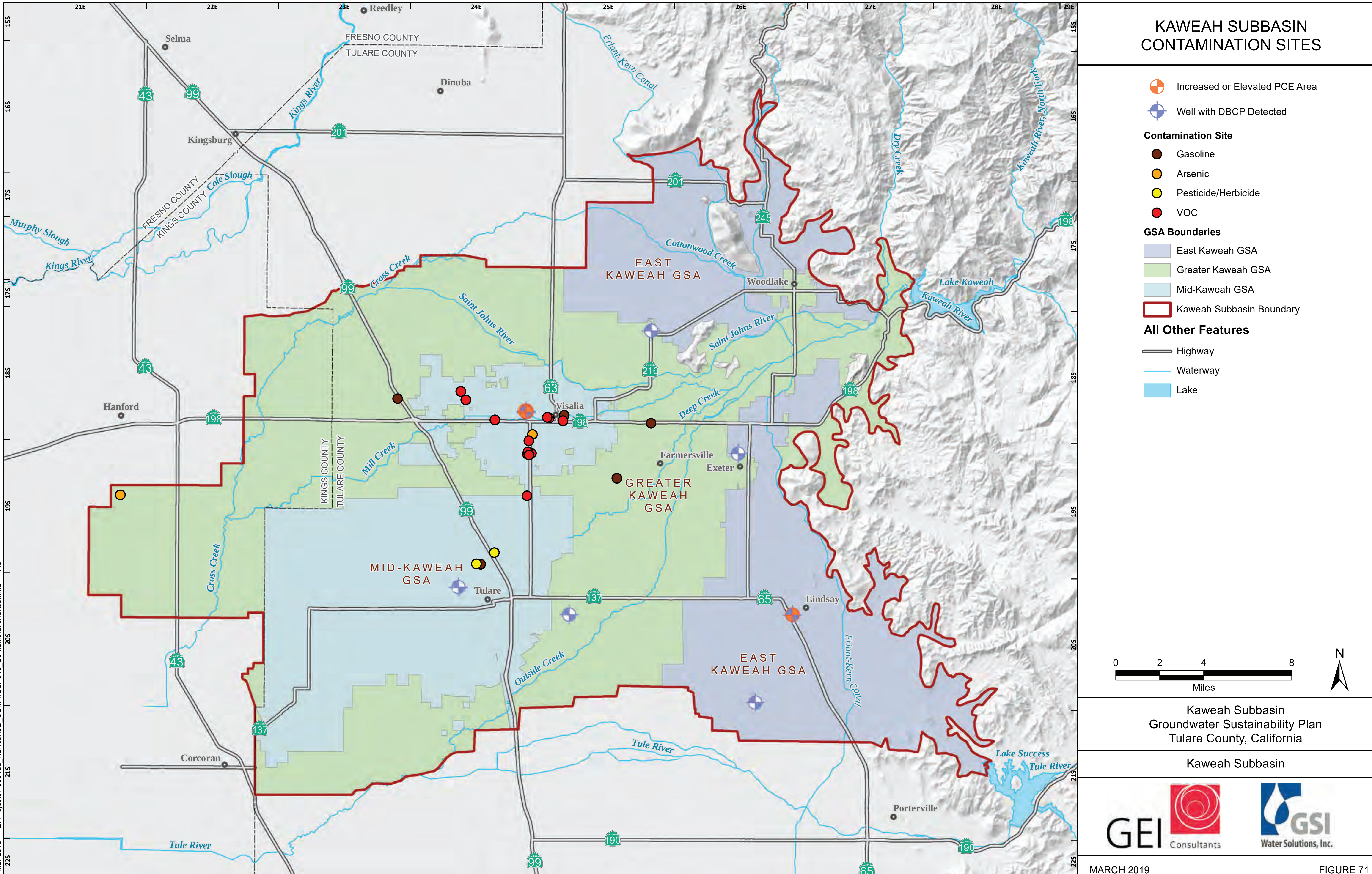
Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 70



KAWEAH SUBBASIN
CONTAMINATION SITES
Increased or Elevated PCE Area
Well with DBCP Detected
Contamination Site
Gasoline
Arsenic
Pesticide/Herbicide
VOC
GSA Boundaries
East Kaweah GSA
Greater Kaweah GSA
Mid-Kaweah GSA
Kaweah Subbasin Boundary
All Other Features
Highway
Waterway
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 71
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
EAST KAWEAH GSA
Reedley
Selma
Dinuba
Kingsburg
Hanford
Visalia
Farmersville
Exeter
Woodlake
Tulare
Lindsay
Corcoran
Porterville
FRESNO COUNTY
TULARE COUNTY
KINGS COUNTY
Kings River
Cole Slough
Murphy Slough
Cross Creek
Mill Creek
Saint Johns River
Cottonwood Creek
Deep Creek
Outside Creek
Tule River
Friant-Kern Canal
Dry Creek
Kaweah River, North Fork
Lake Kaweah
Kaweah River
Lake Success
12-Mar-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP043_ContaminationSites.mxd RS

KAWEAH SUBBASIN
HIGH SODIUM AND CHLORIDE WELLS

Increasing or Elevated Chloride Area

Increasing or Elevated Sodium Area

GSA Boundaries

East Kaweah GSA

Greater Kaweah GSA

Mid-Kaweah GSA

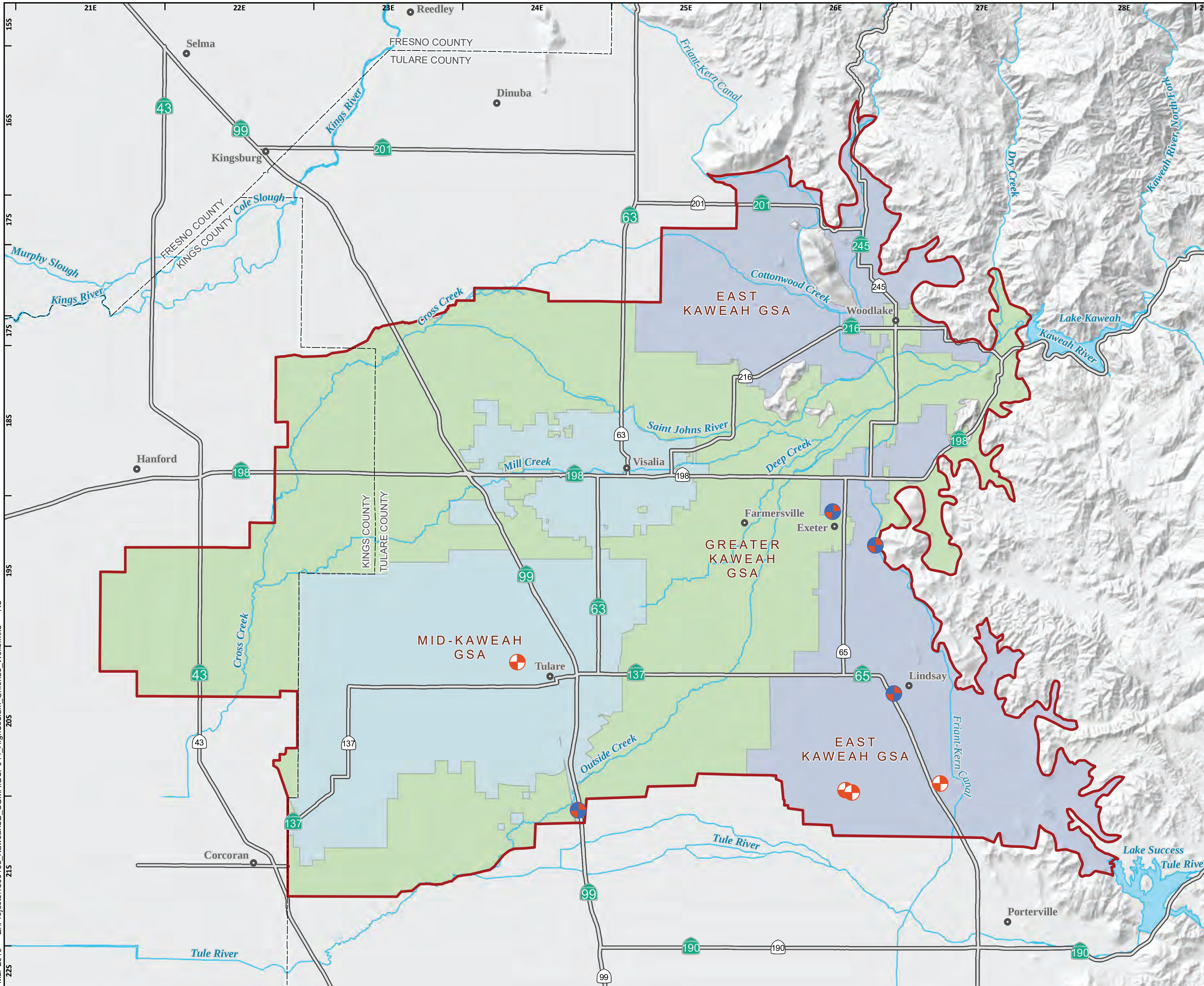
Kaweah Subbasin Boundary

All Other Features

Highway

Waterway

Lake



Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

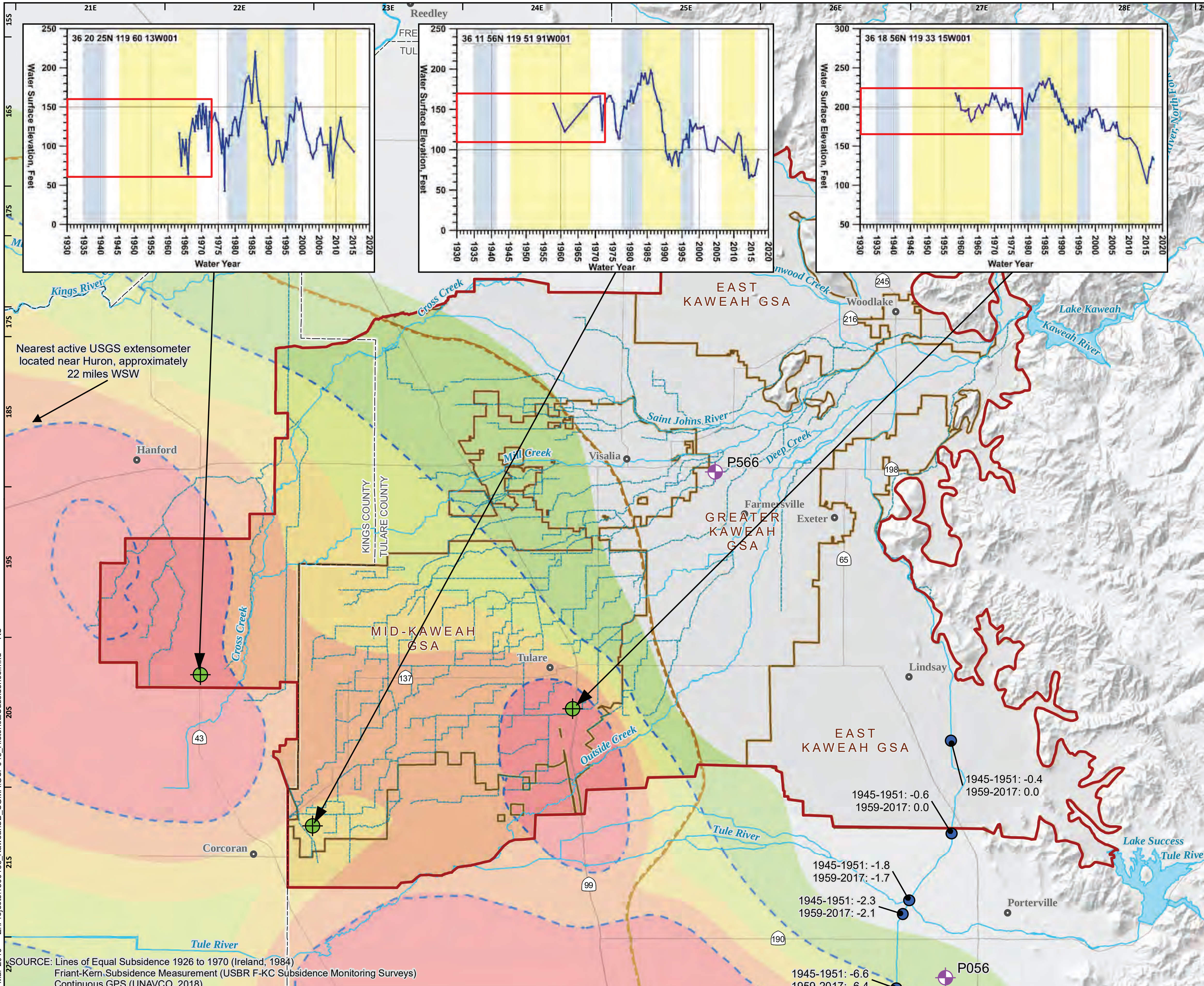
Kaweah Subbasin

GEI Consultants

GSI Water Solutions, Inc.

MARCH 2019

FIGURE 72



Z:\Projects\1800138_KaweahSB_SGMA\GSP045_HistoricalSubsidence.mxd RS 12-Mar-2019

HISTORICAL CUMULATIVE SUBSIDENCE (1926 TO 1970)

- Continuous GPS Station
- Casgem Well with Plotted Hydrograph
- Friant Kern Subsidence Measurement Location
- Line of Equal Subsidence 1926 to 1970 (Feet)
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin GSA
- Kaweah Subbasin Boundary

Interprolated Values of Subsidence in Feet (1926 to 1970 Contours)

- Out Of Extent
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- > 4

All Other Features

- Highway
- Waterway
- Minor Canal
- Lake

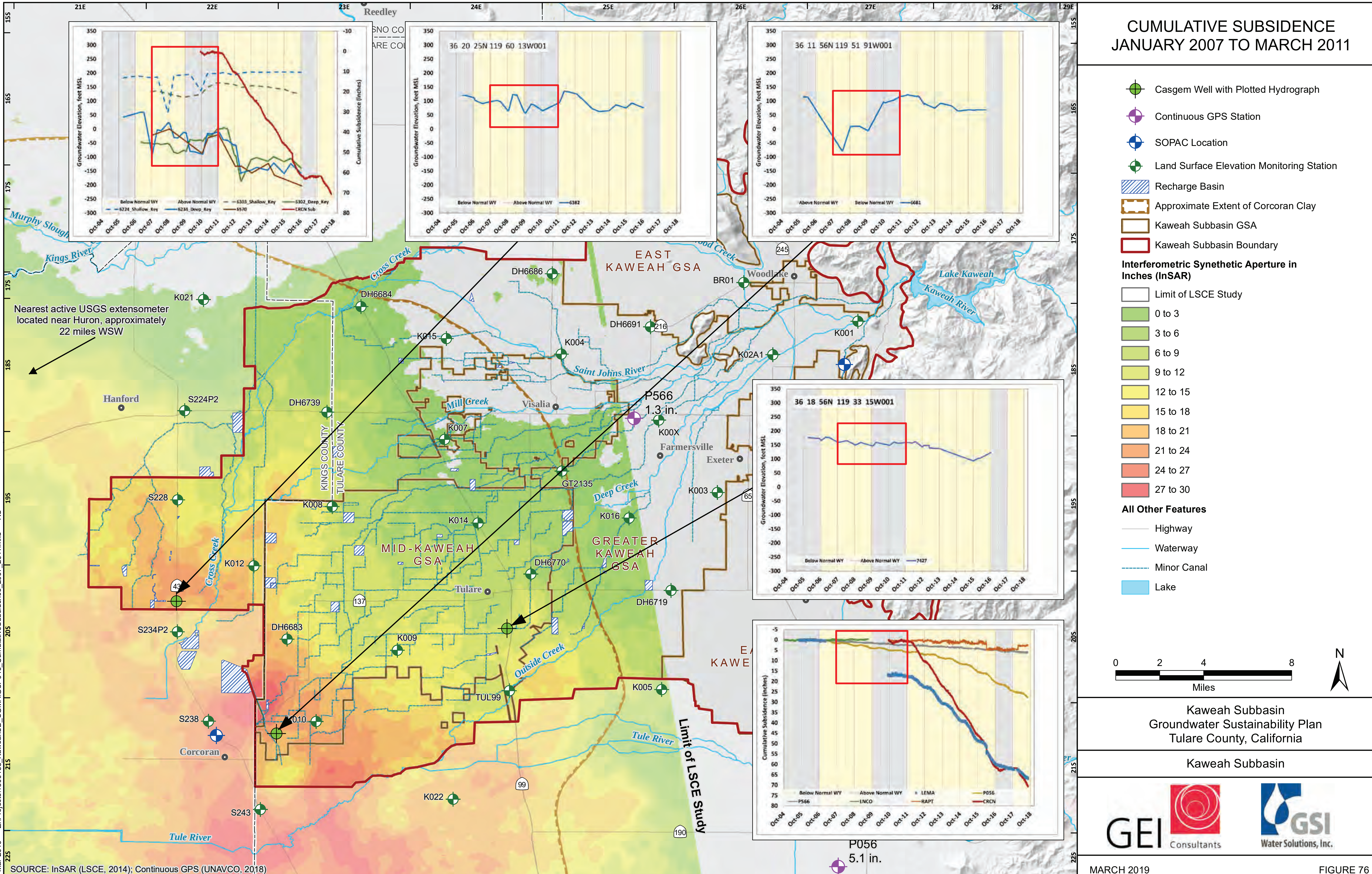
0 2 4 8
Miles
N

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

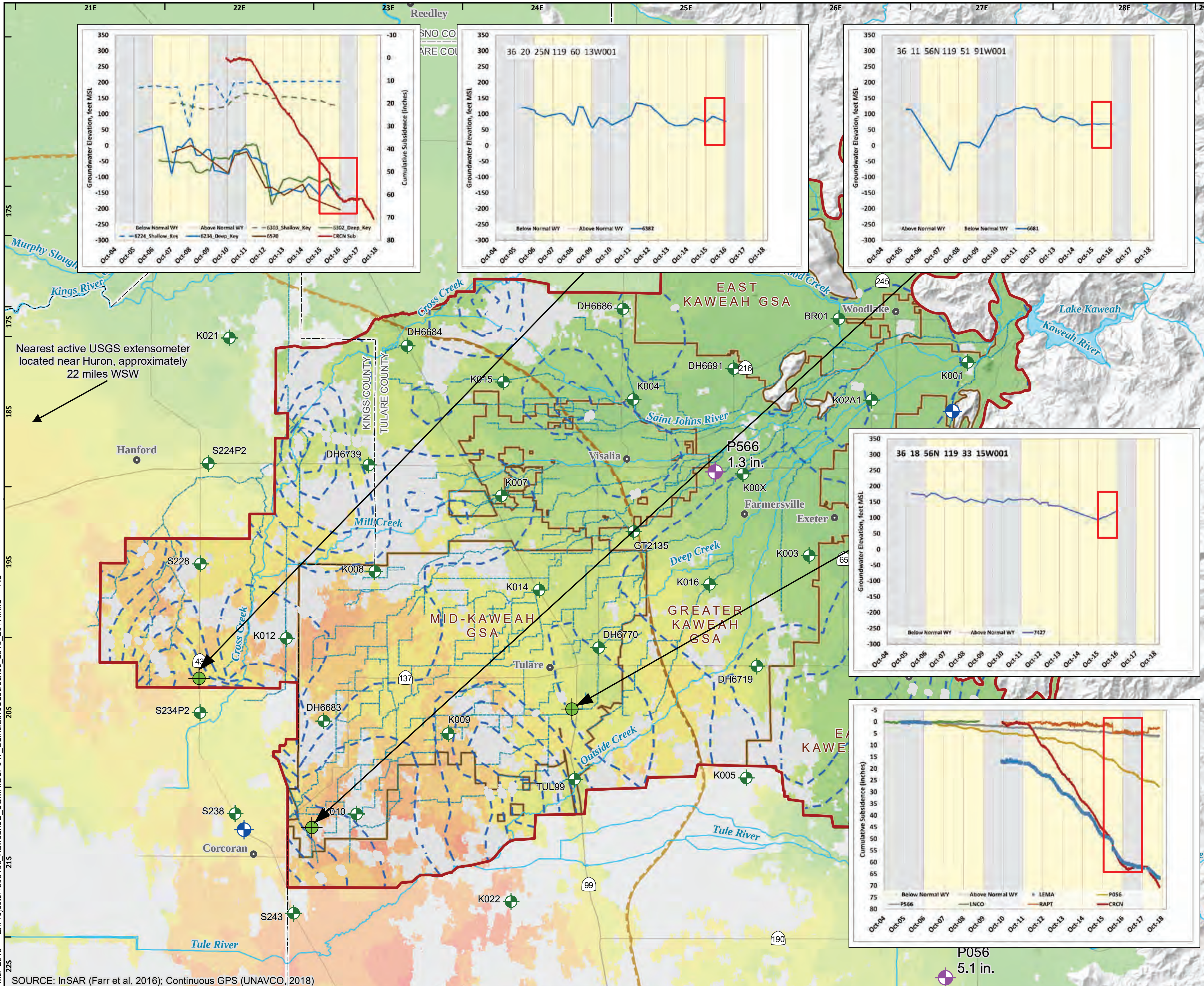
Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019 FIGURE 75


CUMULATIVE SUBSIDENCE
JANUARY 2007 TO MARCH 2011
Casgem Well with Plotted Hydrograph
Continuous GPS Station
SOPAC Location
Land Surface Elevation Monitoring Station
Recharge Basin
Approximate Extent of Corcoran Clay
Kaweah Subbasin GSA
Kaweah Subbasin Boundary
Interferometric Synthetic Aperture in Inches (InSAR)
Limit of LSCE Study
0 to 3
3 to 6
6 to 9
9 to 12
12 to 15
15 to 18
18 to 21
21 to 24
24 to 27
27 to 30
All Other Features
Highway
Waterway
Minor Canal
Lake
0 2 4 8
Miles
N
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 76
EAST KAWEAH GSA
MID-KAWEAH GSA
GREATER KAWEAH GSA
KINGS COUNTY
TULARE COUNTY
Nearest active USGS extensometer located near Huron, approximately 22 miles WSW
P566
1.3 in.
P056
5.1 in.
Limit of LSCE Study
Reedley
Hanford
Visalia
Farmersville
Exeter
Woodlake
Tulare
Corcoran
Kings River
Murphy Slough
Cross Creek
Saint Johns River
Mill Creek
Deep Creek
Outside Creek
Tule River
Lake Kaweah
Kaweah River
36 20 25N 119 60 13W001
36 11 56N 119 51 91W001
36 18 56N 119 33 15W001
Groundwater Elevation, feet MSL
Cumulative Subsidence (inches)
Below Normal WY
Above Normal WY
SOURCE: InSAR (LSCE, 2014); Continuous GPS (UNAVCO, 2018)
Z:\Projects\1800138_KaweahSB_SGMA\GSP046_CumulativeSubsidence_2007_2011.mxd
12-Mar-2019
RS

CUMULATIVE SUBSIDENCE GROUNDWATER LEVEL DECLINE SPRING 2015 TO SPRING 2017



SOURCE: InSAR (Farr et al, 2016); Continuous GPS (UNAVCO, 2018)

- Casgem Well with Plotted Hydrograph
- Continuous GPS Station
- Land Surface Elevation Monitoring Station
- SOPAC Location
- Groundwater Elevation Decline Contour (20-foot Interval)
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin GSA
- Kaweah Subbasin Boundary

Subsidence in Inches (NASA JPL InSAR Dataset)

- 0 to 3
- 3 to 6
- 6 to 9
- 9 to 12
- 12 to 15
- 15 to 18
- 18 to 21
- 21 to 24
- 24 to 27
- 27 to 30

All Other Features

- Highway
- Waterway
- Minor Canal
- Lake

0 2 4 8
Miles

Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

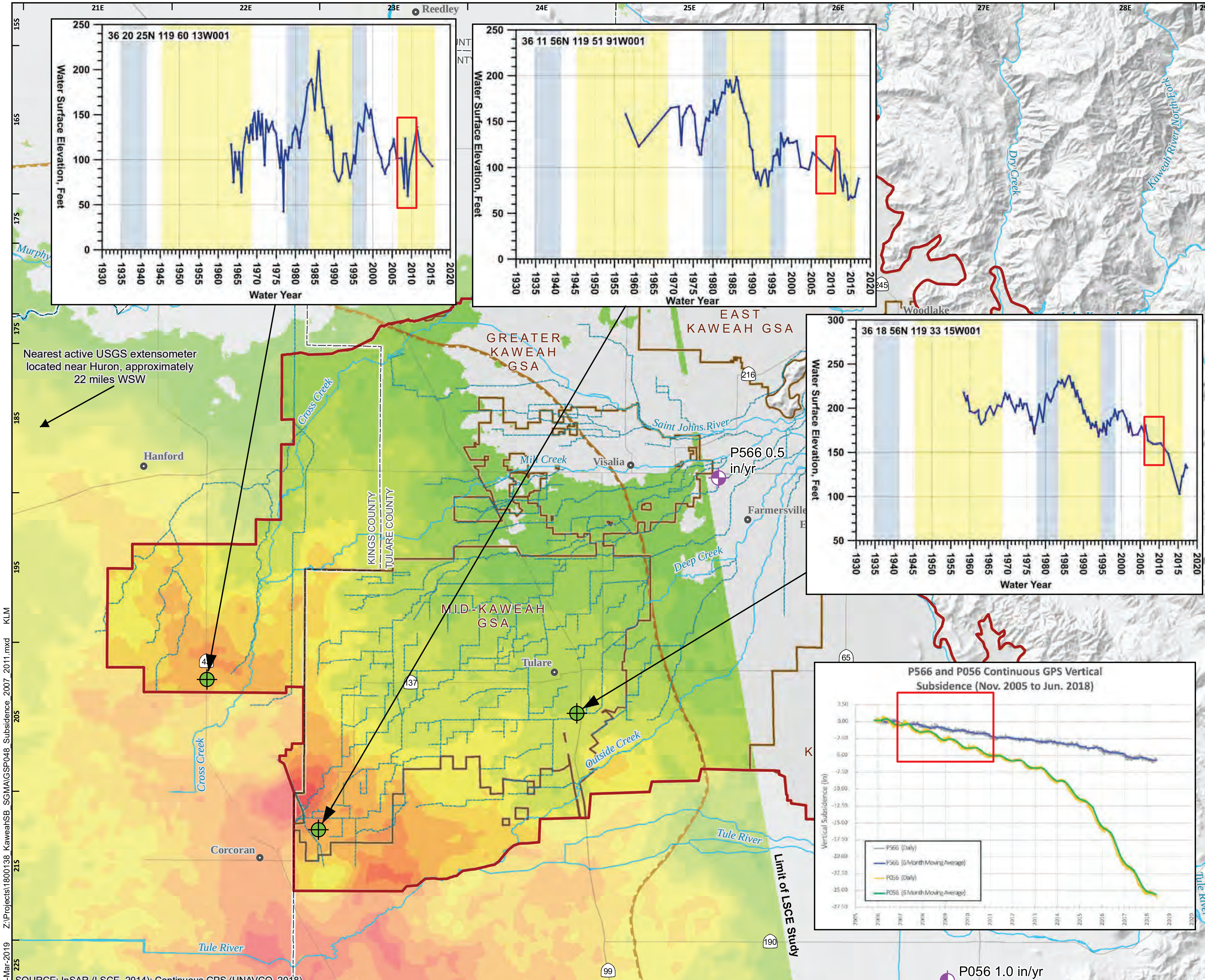
Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 77

Z:\Projects\1800138_KaweahSB_SGMA\GSP047_CumulativeSubsidence_2015_2017.mxd RS
12-Mar-2019



ANNUAL RATE OF SUBSIDENCE (JANUARY 2007 TO MARCH 2011)

- Continuous GPS Station
- Casgem Wells with Plotted Hydrograph
- Approximate Extent of Corcoran Clay
- Kaweah Subbasin Boundary
- Kaweah Subbasin GSA

Interferometric Synthetic Aperture in Inches per Year (InSAR)

- Limit of LSCE Study
- 0 to 0.75
- .75 to 1.5
- 1.5 to 2.25
- 2.25 to 3
- 3 to 3.75
- 3.75 to 4.5
- 4.5 to 5.25
- 5.25 to 6
- 6 to 6.75
- 6.75 to 7.5

All Other Features

- Highway
- Waterway
- Minor Canals
- Lake

0 2 4 8
Miles
N

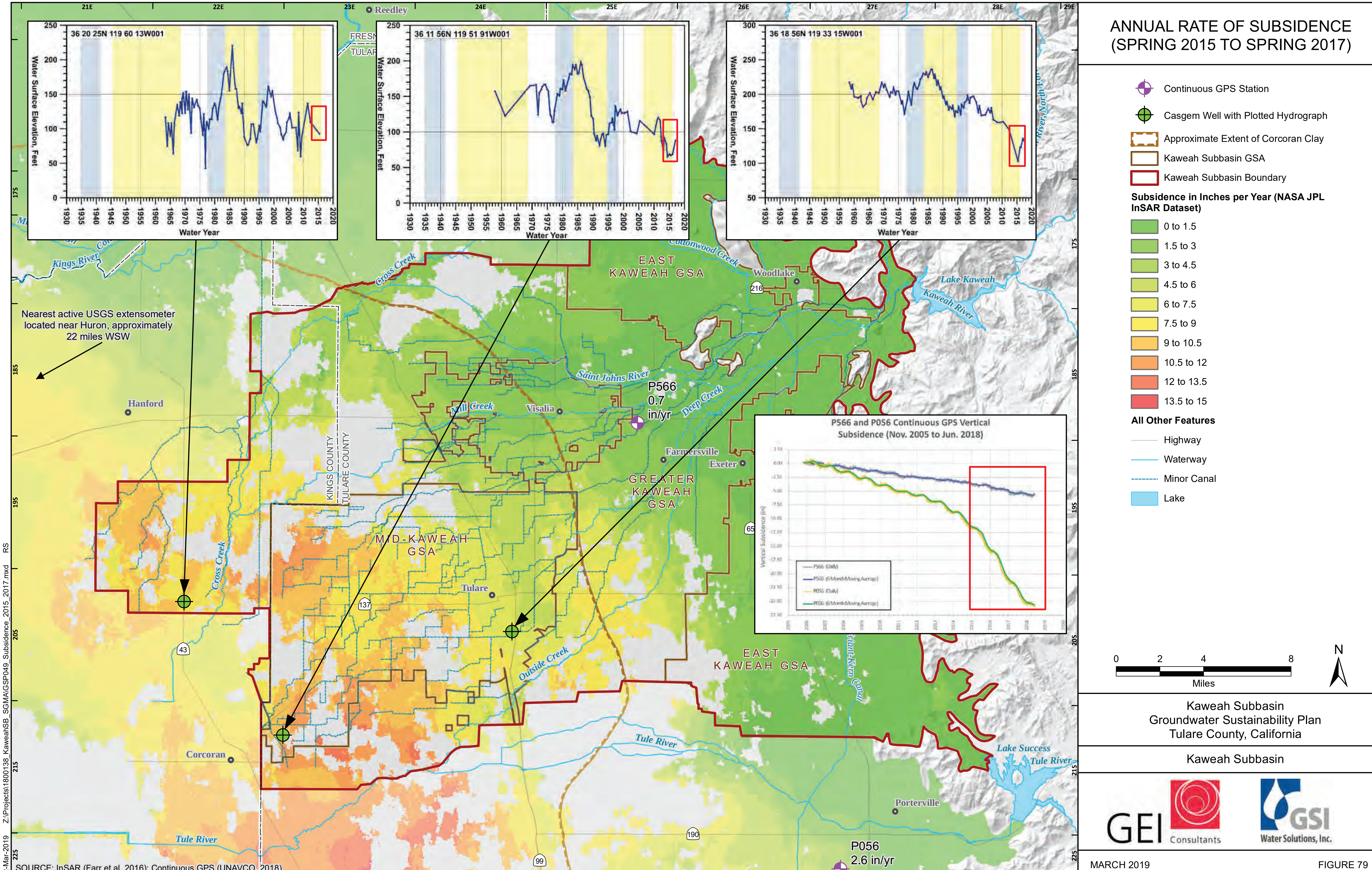
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

MARCH 2019

FIGURE 78


ANNUAL RATE OF SUBSIDENCE
(SPRING 2015 TO SPRING 2017)
Continuous GPS Station
Casgem Well with Plotted Hydrograph
Approximate Extent of Corcoran Clay
Kaweah Subbasin GSA
Kaweah Subbasin Boundary
Subsidence in Inches per Year (NASA JPL InSAR Dataset)
0 to 1.5
1.5 to 3
3 to 4.5
4.5 to 6
6 to 7.5
7.5 to 9
9 to 10.5
10.5 to 12
12 to 13.5
13.5 to 15
All Other Features
Highway
Waterway
Minor Canal
Lake
0 2 4 8
Miles
N
36 20 25N 119 60 13W001
36 11 56N 119 51 91W001
36 18 56N 119 33 15W001
Water Surface Elevation, Feet
Water Year
P566 and P056 Continuous GPS Vertical Subsidence (Nov. 2005 to Jun. 2018)
P566
0.7
in/yr
P056
2.6 in/yr
Nearest active USGS extensometer located near Huron, approximately 22 miles WSW
EAST KAWEAH GSA
GREATER KAWEAH GSA
MID-KAWEAH GSA
KINGS COUNTY
TULARE COUNTY
Hanford
Visalia
Tulare
Corcoran
Farmersville
Exeter
Woodlake
Porterville
Reedley
Kings River
Cross Creek
Mill Creek
Saint Johns River
Deep Creek
Cottonwood Creek
Outside Creek
Tule River
Lake Kaweah
Kaweah River
Lake Success
Friant-Kern Canal
SOURCE: InSAR (Farr et al, 2016); Continuous GPS (UNAVCO, 2018)
Z:\Projects\1800138_KaweahSB_SGMA\GSP049_Subsidence_2015_2017.mxd RS
12-Mar-2019
Kaweah Subbasin
Groundwater Sustainability Plan
Tulare County, California
Kaweah Subbasin
GEI Consultants
GSI Water Solutions, Inc.
MARCH 2019
FIGURE 79

Appendix A

Groundwater Modeling Technical Memorandum

Consulting Engineers and Scientists

D R A F T

T E C H N I C A L   M E M O R A N D U M

TO: Kaweah Sub-Basin Management Team

FROM: GEI Consultants, Inc.; GSI Water Solutions, Inc.

DATE: August 24, 2018

RE: TASK 1 – REVIEW OF EXISTING KAWEAH SUB-BASIN GROUNDWATER MODELS AND APPROACH FOR MODEL DEVELOPMENT TO SUPPORT GSPs

Introduction

Early in 2017, the GEI Consultants, Inc. (GEI) and GSI Water Solutions, Inc. (GSI) teams prepared a Technical Memorandum (TM) to evaluate the groundwater models available for use in development of the Groundwater Sustainability Plans (GSP) for the three Groundwater Sustainability Agencies (GSA) in the Kaweah Sub-Basin (Sub-Basin). That TM, dated March 8, 2017, presented the significant comparative details of three numerical groundwater flow models that cover the Sub-Basin, including:

- Kaweah Delta Water Conservation District (KDWCD) Groundwater Model,
- Central Valley Hydrologic Model (CVHM), and
- California Central Valley Groundwater-Surface Water Simulation Model (C2VSim) coarse grid and fine grid variants.

The March 2107 TM identified the water budget from the most recent update of the KDWCD Water Resources Investigation (WRI) as an accounting "model", but it is essentially a water accounting analysis that uses water consumption and soil moisture models. It is not a three-dimensional, numerical groundwater flow model, but is a valuable analysis that will be used as primary inputs to the groundwater model. The March 2017 TM recommended use of the KDWCD Groundwater Model as the preferred tool for Sustainable Groundwater Management Act (SGMA) applications based upon its relative ability to address the potential model needs cited in SGMA regulations. Model selection criteria used in the TM included: model availability; cost of development and implementation; regulatory acceptance; suitability for GSP-specific analyses; and relative abilities to assess Sub-Basin water budget components, future undesirable results, and impacts of future management actions and projects.

GEI Consultants, Inc.
5001 California Ave., Suite 120, Bakersfield, CA 93309
661.327.7601 F: 661.327.0173

More recently, the Kaweah Management Team, consisting of the East Kaweah, Greater Kaweah, and Mid-Kaweah Groundwater Sustainability Agencies (EKGSA, GKGSA, and MKGSA) approved a scope of work to develop a Sub-Basin wide numerical groundwater model to support GSP development and implementation. Efforts related to groundwater model development and use of the calibrated tool were generally defined within three tasks, as follows:

1. Task 1 – Perform a technical assessment of existing groundwater models that cover the Kaweah Sub-Basin, with emphasis on the KDWCD Model, and develop an approach to update and revise the selected source model as required to support the objectives of the GSP.
2. Task 2 – Perform model revisions and updates for the selected groundwater model as documented in Task 1, with a focus on supporting GSP objectives.
3. Task 3 – Apply the updated model predictively for each GSA and cumulatively for the entire Sub-Basin to simulate future conditions, with and without potential management actions and projects proposed to support GSP implementation.

This TM documents the results of Task 1. GEI and GSI (the Modeling Team), as part of supporting Sub-Basin SGMA compliance, have evaluated the existing KDWCD Groundwater Model for update to simulate the entire Sub-Basin and relevant adjacent areas. The following presents technical details and performance aspects of the KDWCD Model and proposes a general approach for utilizing the model to support development of the GSP. Specifics of this approach may change over the course of model development as dictated by data constraints and improved conceptualization provided by the updated Sub-Basin Basin Setting developed through the Management Team. This TM and associated analyses satisfies Task 1 requirements, including:

- Perform a detailed evaluation of the existing KDWCD groundwater model inputs and outputs, including test runs and simulations, comparisons with water budget data, and a general comparison with regional C2VSim and CVHM models.
- Develop a plan to move forward with the model update, including assessment of status of required hydrogeologic data, updates to model area, parameters, fluxes, spatial framework, stress periods, validation periods, and calibration periods and general approach for the model domain.
- Prepare a TM summarizing the path forward for modeling support of the GSP, including technical coordination with adjacent basin GSA representatives regarding groundwater modeling methods and assumptions.

Additionally, the Modeling Team will present the key findings of this TM in a workshop for representatives of the Sub-Basin GSAs. This working session will allow GSA representatives to better understand the model design and capabilities as well as provide a forum for discussion of current, future, and outstanding data as well as planning needs for model development and predictive simulations.

After submittal of this proposed modeling approach and path forward, the Modeling Team will execute the recommended actions described in this document. Once updated, the Modeling Team is recommending adoption of the name Kaweah Sub-Basin Hydrologic Model (KSHM) for this new SGMA tool to differentiate it from the previous modeling efforts and to reflect the fact that it includes complex hydrologic analyses in addition to groundwater flow.

Comparison with Regional Modeling Tools

The Modeling Team previously performed a cursory review of pertinent aspects affecting the efficient use of the three major groundwater modeling tools that cover the Sub-Basin. This TM is built upon that analysis and includes a more in-depth assessment of the newly released beta version of the C2VSim model provided by the California Department of Water Resources (DWR). Although the results of the March 2017 analysis were reinforced with findings from this review, the Modeling Team also looked at the datasets contained within these valuable, regional modeling tools to see if they may be of use in the development of the KSHM.

Central Valley Hydrologic Model

CVHM is an 11-layer model that covers the entire Central Valley. It has a spatial resolution of one square mile and includes both a coupled lithologic model and Farm Process module (model) that are used to estimate hydraulic parameters and agricultural groundwater demand and recharge, respectively. The CVHM was previously deemed not to be a viable modeling alternative for the Sub-Basin analyses by the Modeling Team due to several factors. Most significant of these is the fact that the model data is only current to 2009, well before the SGMA-specified accountability date of 2015. The model resolution is also not suitable to reflect all water budget components at the precision required to assess past and current groundwater responses to water management within each GSA. The CVHM is also not suitably calibrated nor reflective of the hydrostratigraphy in the Sub-Basin and does not match the higher resolution and more accurate crop and related groundwater pumping estimates produced by Davids Engineering, Inc. (Davids Engineering) time-series analysis of evaporation and applied water estimates for the KDWCD; soon to be provided for the entire Sub-Basin through water year 2017. Lastly, the use of the Farm Process is cost prohibitive, given the fact that it would have to be rigorously calibrated to the evapotranspiration and deep percolation estimates already provided by the Davids Engineering analysis.

California Central Valley Groundwater-Surface Water Simulation Model (C2VSim)

The DWR-supported C2VSim Fine Mesh Beta Version was assessed in greater detail as part of the development of this modeling approach. Like CVHM, the C2VSim fine mesh does not include the high resolution of crop demands and surface water deliveries that are in the existing KDWCD model and can be easily updated with the KSHM. It also does not have the element resolution, flexibility to change fluxes, cost savings, and GSA-level accuracy of a sub-regional model designed to incorporate the highest resolution and locally accurate consumptive use and recharge information available. The Modeling Team assessed model layering, significant water budget components, storage change, and groundwater level elevation changes used in C2VSim relative to KDWCD monitoring well locations. The previous KDWCD model produced a better match for the data and estimates from the WRI, and at a significantly higher resolution. Simulated storage change within the Sub-Basin was greater than that estimated by C2VSim by over 20,000 acre-feet per year (AFY); without documentation of how the quantification of water budget components was performed. Calibration of regional flow directions and gradients were reasonable but not as accurate nor locally refined as that observed with the KDWCD modeling efforts.

The beta version of the C2VSim model is not currently considered to be calibrated in a quantitative sense, and no documentation is publicly available to assess the resolution or accuracy of the model inputs for the Sub-Basin. Because of our analysis and comparison of the C2VSim Fine Mesh Beta Model with the water budget and groundwater conditions from the WRI and the draft Basin Setting; the C2VSim was deemed to be a viable source of regional information to supplement development of the KSHM. However, relative to a modeling approach using the KSHM, the C2VSIM model would not provide a more accurate or cost-efficient option for satisfying SGMA regulations.

KDWCD Model Assessment and Review with Respect to an Updated Model

The KDWCD Groundwater Model was originally developed by Fugro Consultants, Inc. (Fugro) under the direction and sponsorship by KDWCD. Model development was documented in the report "*Numerical Groundwater Flow Model for the Kaweah Delta Water Conservation District, Final Report*" (April 2005). The objective of the model was to simulate the water budget estimates as refined under the WRI in 2003 and evaluate calibrated groundwater elevations, and modeled fluxes to and from adjacent sub-basins.

In May 2012, the KDWCD model was expanded to the east and southeast by Fugro to include the service areas of the Cities of Lindsay and Exeter, and adjacent irrigation districts, including: the Lewis Creek Water District; some unincorporated land and significant portions of Exeter Irrigation District, Lindmore Irrigation District, and Lindsay-Strathmore Irrigation District. The purpose of this effort was to update only the geographic extent, and it did not include updates to the simulation period or the calibration. The model was intended to be updated, refined, and improved in the coming years to provide a rigorously calibrated model over this larger extent, but this proposed work was not performed prior to initiation of SGMA and GSP development efforts.

Modeling Code and Packages

The KDWCD model was developed using MODFLOW 2000. MODFLOW, developed and maintained by the United States Geological Survey (USGS), is one of the most commonly used groundwater modeling codes in the world and is considered an industry standard. The pre- and post-processing of groundwater model data was performed using Groundwater Vistas, a third-party graphical user interface (GUI) that is among the most commonly used software in the groundwater industry to facilitate the use of MODFLOW.

The previous two KDWCD model variants used the following MODFLOW modules, or "packages":

- Well Package (WELL)
- Recharge Package (RCH)
- General Head Boundary (GHB) Package

MODFLOW utilizes large text files of numerical values as input files that provide the model with the values of various physical parameters and fluxes; all incorporated into the three-dimensional (3D) model structure. Much of the pre-processing and spatial organization of the data used to develop the MODFLOW input files was accomplished by Fugro using customized FORTRAN routines, as well as a geographic information system (GIS). Because of more recently available evapotranspiration and applied water estimates from Davids Engineering, the use of these FORTRAN routines is no longer necessary; providing a significant cost and time savings.

A summary of the construction and implementation of various water budget components into these model packages is discussed in following sections.

Model Extent and Discretization

The spatial extent of the current KDWCD model is presented in Figure 1. The figure displays the original model extent as well as the expanded extent to the east from the 2012 update. The model extends approximately twelve miles from east to west and 7.5 miles from north to south. It is composed of uniform 1,000 foot by 1,000-foot model cells for each layer.

There are some areas of the Sub-Basin that are not currently within the model domain (Figure 1), including much of what is now the EKGSA area. To evaluate the entire Sub-Basin area, in support of SGMA, it will be necessary to expand the model area to include all of the areas within the Sub-Basin. The updated model must also have shared boundaries and shared buffer zones with all adjacent groundwater sub-basins, as well as an evaluation of subsurface inflow and outflow (underflow) between the sub-basins. Figure 2 shows the proposed, expanded model grid for the new KSHM extent.

Model Layers

The KDWCD model is vertically discretized into three layers as shown on hydrogeologic cross sections shown on Figures 3, 4, and 5. These hydrogeologic cross sections show the principal aquifers, aquitard, and associated geologic units located throughout the Sub-Basin. Layer 1 represents the unconfined, basin sediments from the ground surface down to the Corcoran Clay in the western portion of the model domain or deeper; also including some older Quaternary alluvial deposits in the eastern portion of the domain. Layer 2 represents the Corcoran Clay, which is the primary aquitard in the Sub-Basin, where it is present in the western portion of the domain. In the eastern portion of the model area, where the Corcoran Clay pinches out, Layer 2 is simply represented with a minimal thickness and hydraulic parameters comparable to those of Layer 1. Layer 3 represents the largely confined basin sediments below the Corcoran Clay, where it is present, and deeper unconsolidated sediments to the east of the occurrence of this regional confining unit.

Although some of the regional models covering large areas of the Central Valley (i.e., CVHM and C2VSim) have a more highly discretized vertical layering, the Modeling Team believes that the three-layer conceptual model represented in the KDWCD model is likely suitable for the primary modeling objectives that support GSP development.

Model Simulation Time Periods

The KDWCD model was originally set up with 38 6-month stress periods to simulate the 19-year (calendar) calibration period of 1981 through 1999. Water budget components as documented in the 2003 WRI were used as input into the model and spatially distributed to the degree feasible given the spatial resolution and precision of the data sources and model grid.

It is likely that, after any recommended changes to the KDWCD model are implemented into the KSHM, the Modeling Team will calibrate the model through water year 2017 and perform validation simulations to confirm that the previous calibration developed with the historic WRI information is a suitable starting point the new simulation period. After validation, additional model refinements and updates can proceed to further improve the predictive capabilities of the KSHM using the aforementioned recent, high-resolution datasets as well as updated Basin Setting information.

Model Parameters

- **Hydraulic Conductivity/Transmissivity.** Hydraulic conductivity values are documented in the 2005 Model Report as well as in previous iterations of the WRI and conform with industry-standard literature values for the types of aquifer materials encountered at these depth intervals. Calibrated, horizontal hydraulic conductivities for Layer 1 (upper, unconfined aquifer) range from 50 feet/day (ft/d) to 235 ft/d, with the highest values in the southwest portion of the model area. Horizontal hydraulic conductivities for the portion of Layer 2 representing the Corcoran Clay were set at 0.024 ft/d. In the eastern area of Layer 2, where the Corcoran Clay pinches out, hydraulic conductivity values range from 50 to 150 ft/d and are essentially equal to the values assigned to the same area in Layer 1. Horizontal hydraulic conductivities for Layer 3 range from 25 ft/d to 125 ft/d. This distribution of hydraulic conductivity is consistent with previously published estimates from both the WRI and industry-standard literature estimates for the lithologies encountered.
- **Vertical hydraulic conductivity.** Vertical hydraulic conductivity in the model is set to a ratio of the estimated horizontal hydraulic conductivity, or an anisotropy ratio of 1:1. This essentially means that the vertical hydraulic conductivity of the Corcoran Clay was assumed to be equal to its horizontal conductivity and was apparently based upon the extensive perforation of the Corcoran Clay and other aquifer units by fully penetrating wells. This perforation of the regional aquitard allows for greater hydraulic connection between the upper and lower aquifer units. The Modeling Team will assess the validity of this anisotropy ratio during the validation simulation and adjust where merited.
- **Storage Parameters.** Specific yields in the unconfined aquifer (Layer 1) range from approximately 8% to 14%. Storage coefficients for the confined areas were set at an order of magnitude of approximately 1×10^{-4}. The storage coefficients used for the unconfined and the confined portions of the model are typical of those found in the basin and documented in the WRI as well as other commonly referenced literature for large basin fill valleys.

Current Model Boundary Packages and WRI Water Budget Components

As mentioned previously, the current KDWCD model uses three MODFLOW packages: WELL, RCH, and GHBs. A discussion of how those packages are used follows below.

- **Well Package (WELL).** As currently constructed, the KCWCD model represents the following WRI water budget components; which were calculated outside of the model Groundwater Vistas graphical user interface (GUI) using GIS and a FORTRAN routine that are unavailable to the Modeling Team. The flux values specified in the WELL package input files are essentially "lumped" fluxes representing the sum of the following water budget components:

    - Well pumpage (outflow)
    - Rainfall-based recharge (inflow)
    - Irrigation return flows (inflow)
    - Ditch loss (inflow)
    - Recharge basins (inflow)

The compilation of multiple water budget components into a single MODFLOW package makes tracking and assessment of the individual water budget components from model simulations difficult. Additionally, this model flux accounting approach and design makes evaluation of possible changes in the water budget because of management actions, changes in water demand or availability, and groundwater projects problematic. Because of this lumping of separate water budget components, every cell in Layer 1 is represented in the WELL Package. This makes the exact validation of the test runs and verification of the calibration with the WRI challenging. Without access to the spatial and temporal distributions of all water budget components utilized by Fugro, it is not possible to re-create the exact WELL package input file. However, the gross water budget inflow, outflow and storage values from the earlier WRI's match those simulated by the model and were reproduced by the Modeling Team.

- **Recharge Package (RCH).** The natural stream channels of the St. John's and the Lower Kaweah Rivers are represented in the model using the MODFLOW RCH Package. The RCH package applies a flux (ft/yr) in the surficial (shallowest) cells at the location where applied. The natural seepage flux values (or groundwater recharge) applied to the model correspond to the values of stream infiltration spatially estimated for these rivers and documented in the WRI.
- **General Head Boundaries (GHB).** The KDWCD model has GHBs assigned to all cells on the exterior perimeter of the model, as seen on Figure 1. GHBs are commonly used to represent the edges of a model domain within a larger aquifer extent. Reference heads (groundwater elevations) and "conductance" terms for adjacent aquifers just outside the model domain are used by this package to calculate fluxes in and out across the boundary. The Modeling Team generally agrees with the use of GHBs in the north, south, and west portions of the Sub-Basin. However, we propose the removal of the GHBs along the eastern portion of the sub-basin at the Sierra Nevada mountain front. Conceptually, the eastern model boundary, especially with the expansion and inclusion of the EKGSA area, is not a head-dependent boundary, but a flux-dependent one based on mountain front recharge and seepage from natural drainages and streams adjacent to relatively impermeable material. Thus, this boundary will be better represented using a no-flow condition coupled with a recharge or prescribed underflow component.

Previous WRIs have included estimates of inflow and outflow across the study boundaries, and comparisons between modeled and calculated values vary significantly both spatially and by magnitude. However, there are several variables that directly impact estimated underflow values that have not been sufficiently constrained, due to the focus of previous work being on the interior of the KDWCD area. Recently updated basin conditions, improved understanding of appropriate regional groundwater conditions adjacent to the Sub-Basin and use of an expanded model area will significantly improve the certainty of these underflow estimates.

Model Calibration. Calibration of the KDWCD model for the historic simulation period of 1981-1999 is discussed in the April 2005 model report. These include charts of observed versus modeled water levels for three different time periods and transient hydrographs for 30 target well locations. The density of calibration targets was deemed adequate by the Modeling Team for a model of this area and with the resolution of the model input datasets. Detailed calibration statistics are not documented in the report, but qualitative inspection of the hydrographs indicates that the calibration is adequate for future use in predictive simulations. Additionally, an open-source and industry-standard parameter estimation and optimization algorithm and code (PEST) was used to enhance model calibration. This is a common and robust industry practice that typically improves model calibration statistics.

Adequacy of the KDWCD Groundwater Model for GSP Development

Layering scheme. The 3-layer model layering scheme incorporated into the KDWCD model was deemed adequate by the Modeling Team for use in GSP analyses, and likely does not need significant revision prior to use. This decision was based upon the agreement of the model layers with the hydrogeologic conceptual model for the Sub-Basin as well as the ability of the previous model to simulate historic fluctuations in groundwater elevations over an extensive spatial extent and temporal period. However, should the refinement of the lithologic and stratigraphic understanding of the basin and identification of specific pumping intervals require additional vertical resolution, both Layer 1 and Layer 2 can be split into two layers to improve the model's ability to match and describe key vertical gradients and changes in groundwater level elevations and pressures near prominent pumping centers. At present, this vertical refinement is not required nor supported by data.

Model area. The model area will need to be expanded so that the entire Sub-Basin is included in the model. In addition, at the request of and in coordination with the technical groups for both Kaweah and adjacent sub-basins, a buffer zone will be included outside the defined Sub-Basin boundaries so that adjacent models will overlap and share model input and monitoring data. This overlap will assist in reconciling differences between the direction and magnitude of groundwater gradients along sub-basin boundaries. The preliminary extent of this buffer zone is proposed to be approximately 3 miles; however, this value will be revised in areas based on of the estimated locations of pervasive groundwater divides or apparent hydrologic boundaries.

Cell size. The 1,000 feet square cell size appears to be adequate for the data density for most model inputs. However, due to improvements in computing speed and power, the Modeling Team recommends initially using a smaller cell size of 500 feet square to 1) accommodate improvements in assigning real world boundaries to the model grid, and 2) leverage the improved resolution of crop demand and evapotranspiration data available for this effort.

Parameters. Hydraulic conductivity and storage parameters will remain unchanged at the start of model revisions and calibration scenarios. These will be adjusted if the Modeling Team determines it is necessary during the model validation run or if model calibration standards require parameter refinements.

Stress Periods. The previous temporal discretization of the model incorporated 6-month stress periods. To appropriately characterize seasonal rainfall, surface water delivery and pumping patterns; one-month stress periods should be adopted for predictive simulations. This decision will be finalized after review and conditioning of the input groundwater demand and recharge datasets.

With these revisions to the model framework and geometry of the KDWCD model to support the development of the KSHM will be adequate for use to support GSP analyses. The following section summarizes additional, recommended revisions to the organization of the model inputs, parameters, boundary conditions, and MODLFOW packages.

Proposed Revisions to KDWCD Groundwater Model and Model Approach

The Modeling Team concludes that the KDWCD model is suitable to support GSP development if the following revisions and refinements to the model are performed to develop the KSHM. As mentioned above, once updated, the Modeling Team is recommending adoption of the name Kaweah Sub-Basin Hydrologic Model for this new SGMA tool. This nomenclature is based upon that fact that this model incorporates more than simply a groundwater model in the final analysis. It also incorporates crop demand/evapotranspiration (with precipitation modeling) and applied water models.

The Modeling Team recommends that the relationships between the water budget components, as defined in the WRI (December 2003, revised July 2007), and the MODFLOW modeling packages currently available, be re-organized such that lumping of different water budget components within single MODFLOW packages is minimized. Some degree of aggregation may be unavoidable, but efforts will be made to apply unique water budget components from the updated WRIs and associated water budget components to more appropriate and recent MODFLOW packages. Additionally, we will utilize features of MODFLOW and Groundwater Vistas that allow for tracking of unique components within a single model package when possible. The current and proposed revised conceptual assignments of water budget components to MODFLOW packages are summarized below.

A major change and advantage of this effort relative to previous modeling work involves the availability and use of time-series evapotranspiration and applied water estimates from 1999 through water year 2017, provided by Davids Engineering. This data set uses remote sensing imagery from Landsat satellites to estimate agricultural water demand throughout the Sub-Basin at a very high resolution (approximately 30 meters). This information was not available for previous model builds, and its use will not only improve the understanding and accuracy of agricultural water requirements relative to the previous land use and soil moisture balance calculations that have been used, but also enhance the spatial calibration and predictive capability of the updated and expanded KSHM. The Davids Engineering dataset also includes estimates of deep percolation of applied water and precipitation. During the review of the KDWCD model and development of this modeling approach, the Modeling Team performed testing of the use of this dataset and was able to readily develop crop requirements and associated pumping estimates at a resolution even finer than the proposed model resolution.

Well Pumping. Groundwater pumpage will be the dominant water budget component represented in the WELL package. Other, more limited fluxes may also be used to represent mountain front fluxes or other unforeseen fluxes that are specified but do not have a specific package that is appropriate. All pumpage will be coded within the WELL package input files to identify the pumping by source, use, or entity. Municipal wells will be specifically located and simulated when well permits and required data reports are accessible and provide data specific to each well. Agricultural well pumpage will likely be spatially averaged, or "spread across", irrigated areas because of the uncertainty associated with irrigation well location, construction, and monthly or seasonal pumping rates.

Precipitation-based recharge. The Modeling Team proposes to represent this water budget component using the Recharge package.

Natural channel infiltration. Infiltration of surface water in the natural stream channels of the St. John's and the Lower Kaweah Rivers is currently assigned to the Recharge Package. The Modeling Team proposes to maintain this data in the recharge package along the spatial location of the courses of the rivers. If deemed appropriate and more beneficial the latest version of the Stream Package (SFR2) may be used for localized reaches of continuously flowing water, where gages do not adequately monitor seepage that can be applied directly as recharge. The Stream package calculates infiltration (inflow) to the aquifer based on defined parameters regarding bed geometry and vertical conductivity, and this will likely involve some iterative re-definition of STREAM package components to accurately portray the calculated water budget component flux. Native evapotranspiration (ET), where relevant, will be subtracted from either the precipitation or natural channel infiltration modules. The inclusion of natural, riparian ET will be addressed specifically upon finalization of the water budget for the Sub-Basin.

Man-made channel recharge. (i.e., ditch and canal loss). This is currently incorporated with four other water budget components as a single summed value in the Well Package. The Modeling Team proposes to represent this water budget component using either the Recharge package or another Type 3 boundary condition type, such as a prescribed stage above land surface. Should another more advanced MODFLOW module prove to more effective in simulating this flux, it will be utilized, and the reasoning documented in the model development log.

Irrigation Return Flows. Irrigation return flows are the component of the water budget that infiltrates into the subsurface due to over-watering of crops. This is currently incorporated with four other water budget components as a single summed value in the WELL Package. The Modeling Team proposes to represent this water budget component using the Recharge package, but to differentiate it from precipitation-based recharge within Groundwater Vistas by assigning zone identifiers that are different from the rainfall-based recharge.

Artificial Recharge Basins. This is currently incorporated with four other water budget components as a single summed value in the WELL Package. Recharge basins are likely to be a common management strategy to help achieve sustainability in the Sub-Basin. As such, the model should be able to individually represent each recharge basin. These could be represented in the Recharge Package or other more sophisticated module if specifically merited.

Lateral Model Boundaries. These are currently simulated using the GHB Package. We will maintain this concept, but the locations of the GHBs will be moved to locations beyond the edge of the Sub-Basin up to the extent of the expanded model area. Assigned reference heads for the GHB cells will be based on observed groundwater elevations from historic groundwater elevation maps. GHB head assignments for predictive runs may be lowered over time if current trends indicate declining water levels over the next 20-40 years. These head assignments will be finalized in consultation and coordination with adjacent sub-basin technical groups as well as any regional modeling or State-derived predictive information.

Mountain Front Recharge. Currently, a GHB is assigned to the eastern edge of the Sub-Basin, along the front of the Sierra Nevada foothills. The modeling team will remove this GHB and represent mountain front recharge using the Recharge Package. Conceptually, mountain front recharge is not a head-dependent boundary, but a specified flux-dependent boundary.

Calibration Period and Validation Period. As discussed previously, the original model was calibrated to a 19-year calibration period using 6-month stress periods. The Modeling Team suggests that upon completion of the KSHM model, a validation run simulating the time period of 1999-2017 be made to assess that the model is still adequately calibrated. Upon assessment of the validation simulation, the KSHM will undergo the calibration process using both qualitative and quantitative measures, such as parameter estimation software (PEST), to produce the final calibrated simulation modeling tool to be used to refine the Sub-Basin water budget and be used for predictive simulations. Moving forward, the updated groundwater model for the Kaweah Sub-Basin will begin in 1999 and continue to be updated as new GSP updates are required and deemed necessary by the GSAs. This new start date is due to the substantially increased accuracy and spatial resolution of water budget features, primarily crop demand and surface water deliveries that result in agricultural pumping estimates, beginning with the first year that high quality satellite imagery and associated evapotranspiration/soil moisture balance models were provided by Davids Engineering. This modeling effort can be updated in the future with newer and more accurate local and regional data from neighboring GSAs to benefit required SGMA reporting, refinements, and optimization of the GSPs within the Sub-Basin.

Predictive Simulations. Predictive simulations through the SGMA timeframe of 2040 and beyond will be performed using the same monthly stress period interval and will be developed using the projected climate dataset provided by DWR. Correlations between this climatic projection and previously quantified groundwater demands and surface water deliveries will be developed to produce a suitable baseline predictive simulation that will serve as a starting point for assessing the impacts of various adaptive management actions and groundwater projects. Simulations will be performed for individual GSAs, but also the cumulative effects of future groundwater management in the Sub-Basin will be assessed relative to the baseline predictive simulation.

Collaboration with Neighboring Sub-Basins

The Modeling Team will be collaborating with neighboring sub-basin technical representatives during the update and application of the KSHM, with permission from the Kaweah Sub-Basin GSAs. The purpose for this coordination is to accomplish the following objectives:

- Receive input from GSAs' representatives on modeling tools and approaches in adjacent basins.
- Exchange data and information for consistency between tools.
- Agree on boundary conditions including both gradients and heads located at and outside of the boundaries of the Sub-Basin.
- Ensure that the KSHM integrates well, to the extent possible, with adjacent tools that our approaches for Kaweah Sub-Basin will not result in conflicting boundary conditions or water budgets.

The Modeling Team recommends that inter-basin model coordination meetings begin in August of 2018 and continue until the simulations required for use in developing the draft GSP is are completed. We anticipate the need for four (4) focused meetings on this approximate schedule:

1. KSHM Approach Meeting – Mid September 2018
2. KSHM Update Meeting – Late October 2018
3. KSHM Model Baseline Run and Boundary Flux Meeting – Late November 2018
4. KSHM Model Simulation Results Meeting – January 2019

The Modeling Team attended one meeting with the Tulare Lake Sub-Basin modeling group on June 15th, 2018 to facilitate data transfer between the two modeling efforts and improve agreement and conceptual consistency between the Sub-Basins. Upon request from the Kaweah Sub-Basin managers and committees, the Modeling Team will continue to collaborate and improve consensus with adjacent modeling groups to improve model agreement and sub-regional consistency between calibrated and predictive simulations. The Modeling Team is also prepared to develop and share baseline predictive simulation results with neighboring basins and accept in-kind data sharing to further improve predictive accuracy and understanding on adaptive management and project options and collaboration. These activities will be approved by GSA representatives prior to the Modeling Team sharing any information or data.

Conclusions and Recommendations Regarding Model Updates

In general, the Modeling Team believes that the KDWCD model provides an adequate precursor model that will be suitable for use in GSP development if the following revisions and updates are incorporated.

Groundwater Vistas Version 7 will be the processing software package utilized. We will maintain MODFLOW as the basic code and will update to MODFLOW-USG or MODFLOW-NWT to take advantage of advances in numerical solution techniques that are available in these updated MODFLOW revisions.

1. **Extent**. The model will need to be expanded to fill the area between the general head boundary of the current model and the Sub-Basin boundary shown in Figure 1 to include the entire area of the Kaweah Sub-Basin.
2. **Layers.** The model layering scheme depicting two water-bearing layers above and below the Corcoran Clay is suitable for the objective of supporting the GSP development.
3. **Historical Simulations.** The KDWCD model has been calibrated to the 1981-1999 hydrologic period. Based on inspection of the hydrographs presented in the 2005 modeling report and the 2012 Model update report, observed water levels are adequately simulated to consider this model effectively calibrated. The objective is to have a model suitable to simulate projected management actions through the entire Sub-Basin. No changes will be made to the inputs to the 1981-1999 run. Therefore, it is already calibrated to that period. We are just re-organizing the assignment of water budget components to different MODFLOW packages from 1999-2017, and beyond. Monthly stress periods will be used.
4. **Assignment of water budget components to MODFLOW Packages.** The Modeling Team proposes to revise the conventions used in the current KDWCD model. This will be the most involved part of the model revision. The updated water budget values that have been generated by the GSA will continue to be the primary input as far as flux values go. However, we propose to organize them into more readily identifiable currently available MODFLOW packages to help with the analyses of potential water budget changes that may correspond to management actions in the future.
5. **Recharge Components.** Spatial distribution of such water budget components as percolation of precipitation, irrigation return flow, recharge basins, etc., will be updated based on the most currently available data.
6. **Model Parameters**. Hydraulic conductivity (horizontal and vertical) and storage coefficient will initially stay unchanged during the validation period simulation. If the calibration target hydrographs for the validation period indicate that a suitable match is retained between observed and modeled water levels, the existing parameters will be retained.
7. **Flow Boundaries.** In areas where the current GHB boundaries are within the Kaweah Sub-Basin, they will be expanded approximately 1-2 miles, or at locations of any likely groundwater divides from the Sub-Basin boundary on the north, south, and west sides of the Sub-Basin. The assigned heads for these GHBs for the 1999-2017 verification run will be based on published groundwater elevations in the vicinity as depicted in contour maps published by DWR. Seasonal variability in assigned GHB heads can be incorporated.
8. **No-Flow Boundaries.** The eastern GHB along the base of the Sierra foothills will be removed. Instead, the flux in the Recharge Package will be increased along this boundary to represent mountain front recharge. The flux volume from the GHB will be evaluated, and this flux volume will be approximated using the Recharge Package.

Estimated Schedule of Model Update Activities

The Modeling Team proposes the following schedule for the major groundwater model update activities. Estimated timeframes for key inter-basin model coordination meetings and updates are also included in the following table to provide a more comprehensive schedule and to facilitate meeting planning. Specific model development and simulation tasks may shift to earlier or later timeframes, but it is the intention of the Modeling Team to comply with the overall schedule and satisfy deadlines for the final deliverable of the calibrated modeling tool and associated predictive scenarios. Should information not be available to the Modeling Team in time to use them in development of the calibrated model simulation or predictive simulations, the data will either not be included, or the schedule may be adjusted to accommodate their inclusion, per guidance from Sub-Basin GSA leadership.

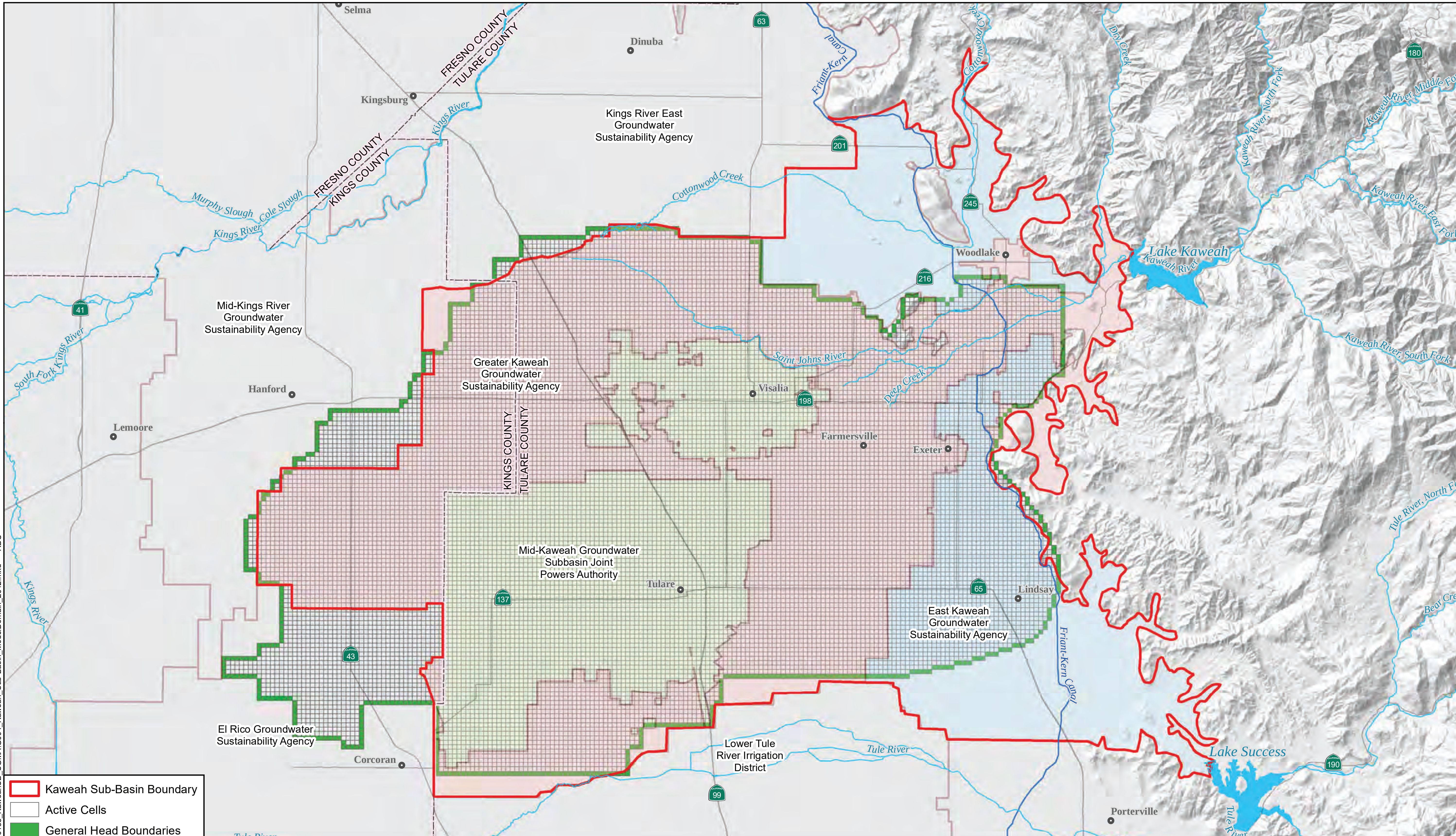
Updates and presentations on the status of the groundwater modeling efforts will occur at regular intervals during Coordinated Sub-Basin and individual GSA meetings, per the scope of work for the groundwater modeling task order.

Table 1: Anticipated Schedule of Groundwater Model Update Activities

Modeling Activity	Estimated Completion Timeframe
Refinement and expansion of model domain and boundary conditions	Early September 2018
Update water budget with Davids Engineering and EKGSA data	Early September 2018
Development of calibration targets	Mid-September 2018
Parameterization of model layers	Mid-September 2018
Refinement of groundwater fluxes	Mid-September 2018
Inter-basin KSHM Approach Meeting (inter-basin)	Mid-September 2018
Adjust boundary conditions, fluxes, and parameters using any new adjacent basin data	Late September 2018
Initiate Formal Calibration Process	Early October 2018
Inter-basin KSHM Update Meeting	Late October 2018
Complete initial calibration process	Early November 2018
Calibration and model refinements and preparation for predictive simulations	Late November 2018
Inter-basin KSHM Calibrated Model and Boundary Flux Meeting	Late November 2018
Develop predictive baseline scenario – Sub-Basin level –	Early December 2018
Develop GSA specific predictive simulations	Mid December 2018
Cumulative Sub-Basin simulations	Early January 2019

LIST OF FIGURES

1. 2012 KDWCD Model Domain with General Head Boundaries
2. Preliminary KSHM Grid Extent and Resolution including Boundary Zones with Cross Section Locations
3. Model Layering Scheme along Hydrogeologic Cross-Section A-A'
4. Model Layering Scheme along Hydrogeologic Cross-Section B-B'
5. Model Layering Scheme along Hydrogeologic Cross-Section C-C'



Kaweah Sub-Basin
Groundwater Modeling Task 1
Tulare County, California

Kaweah Sub-Basin

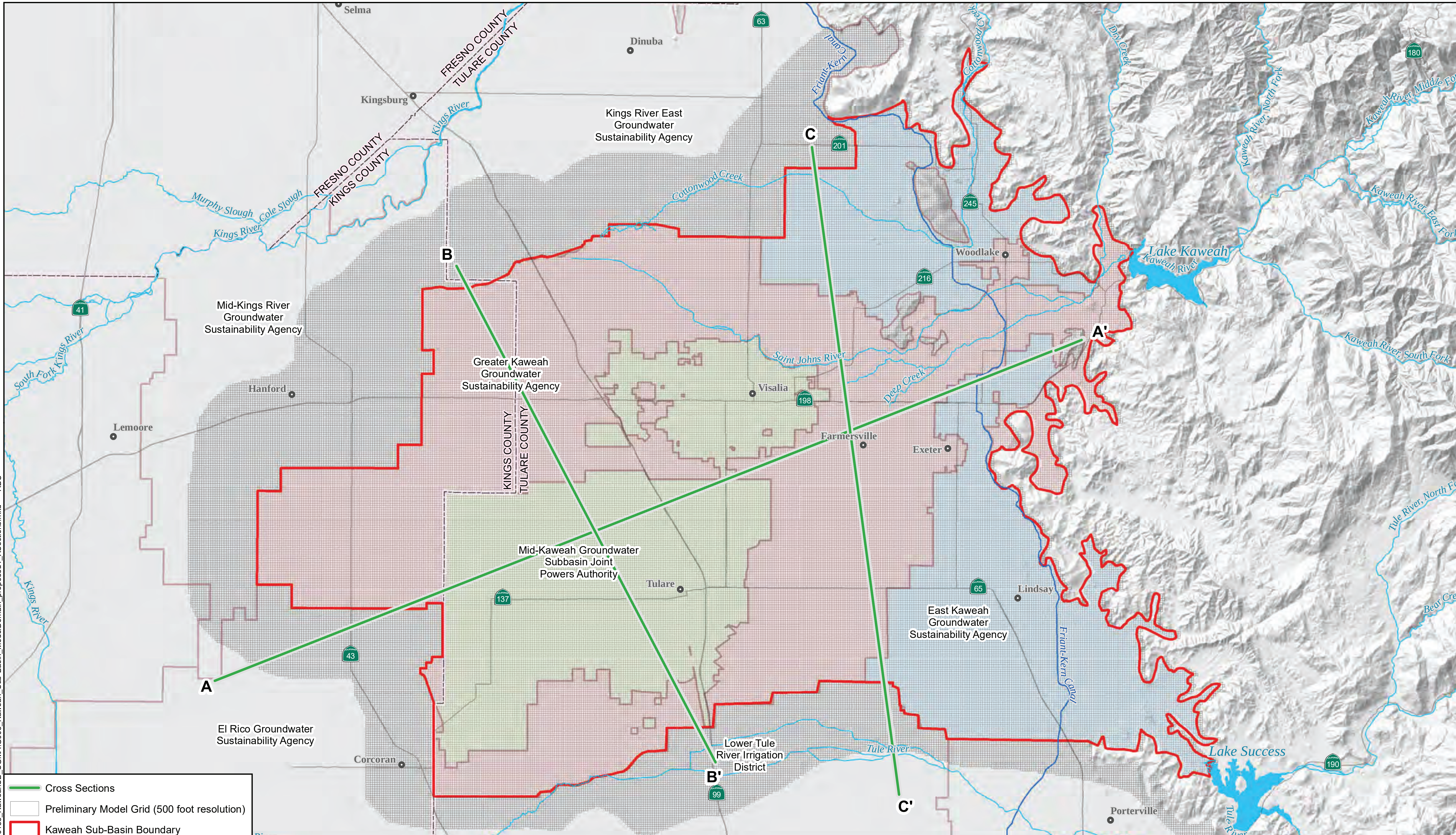
GSI Water Solutions, Inc.

GEI Consultants

2012 KDWCD EXPANDED MODEL DOMAIN WITH GENERAL HEAD BOUNDARIES

AUGUST 2018 DRAFT FIGURE 1

00Xxx0000 Z:\Projects\1800138_KaweahSB_SGMA\G004_Kaweah_Sub-Basin_ModelDomain_2012.mxd RBC



6 3 0 6
Miles

N

Kaweah Sub-Basin
Groundwater Modeling Task 1
Tulare County, California

Kaweah Sub-Basin

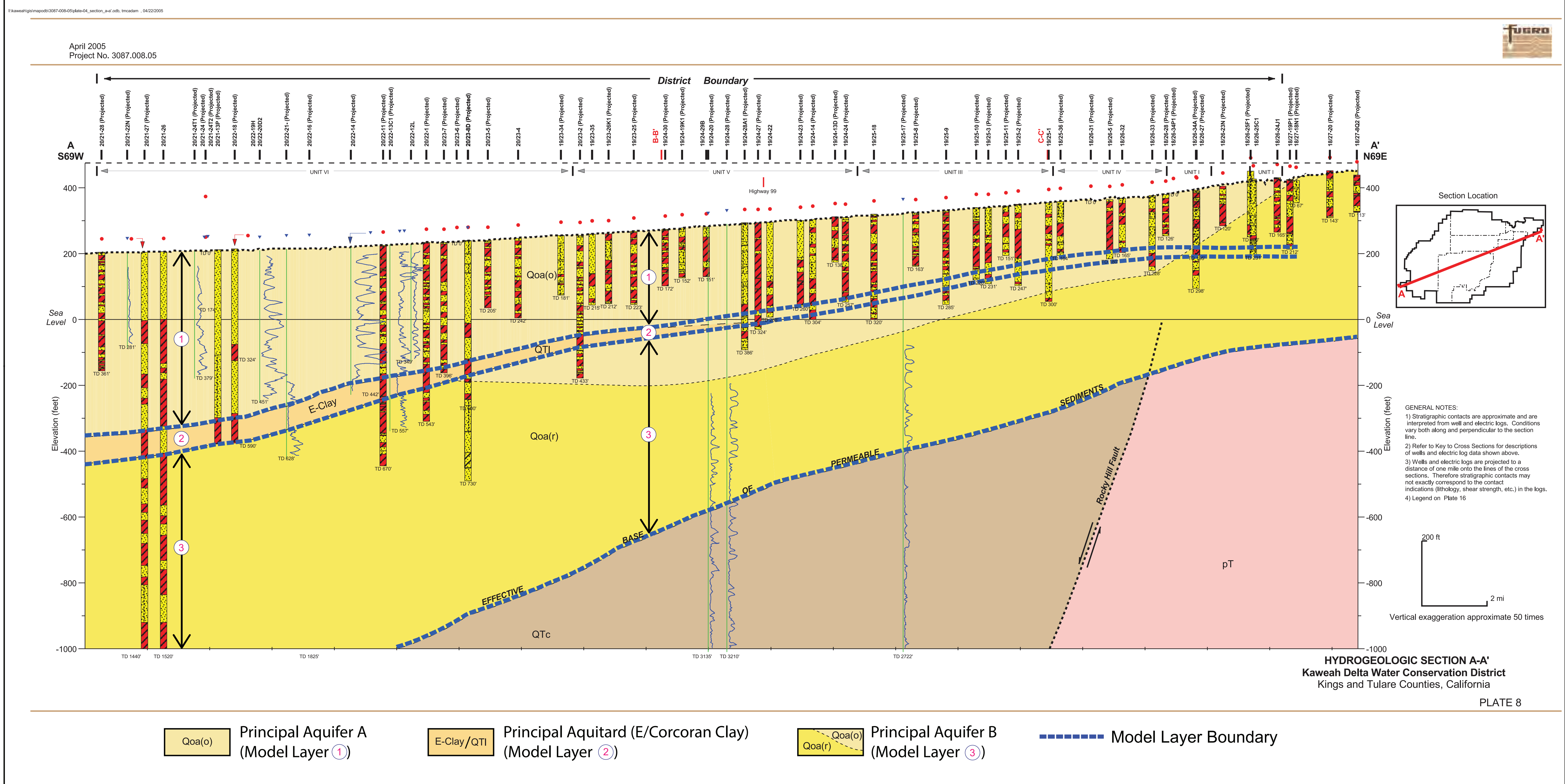
GSI Water Solutions, Inc.

GEI Consultants

PRELIMINARY KSHM GRID EXTENT AND RESOLUTION INCLUDING BUFFER ZONES AND CROSS SECTION LOCATIONS

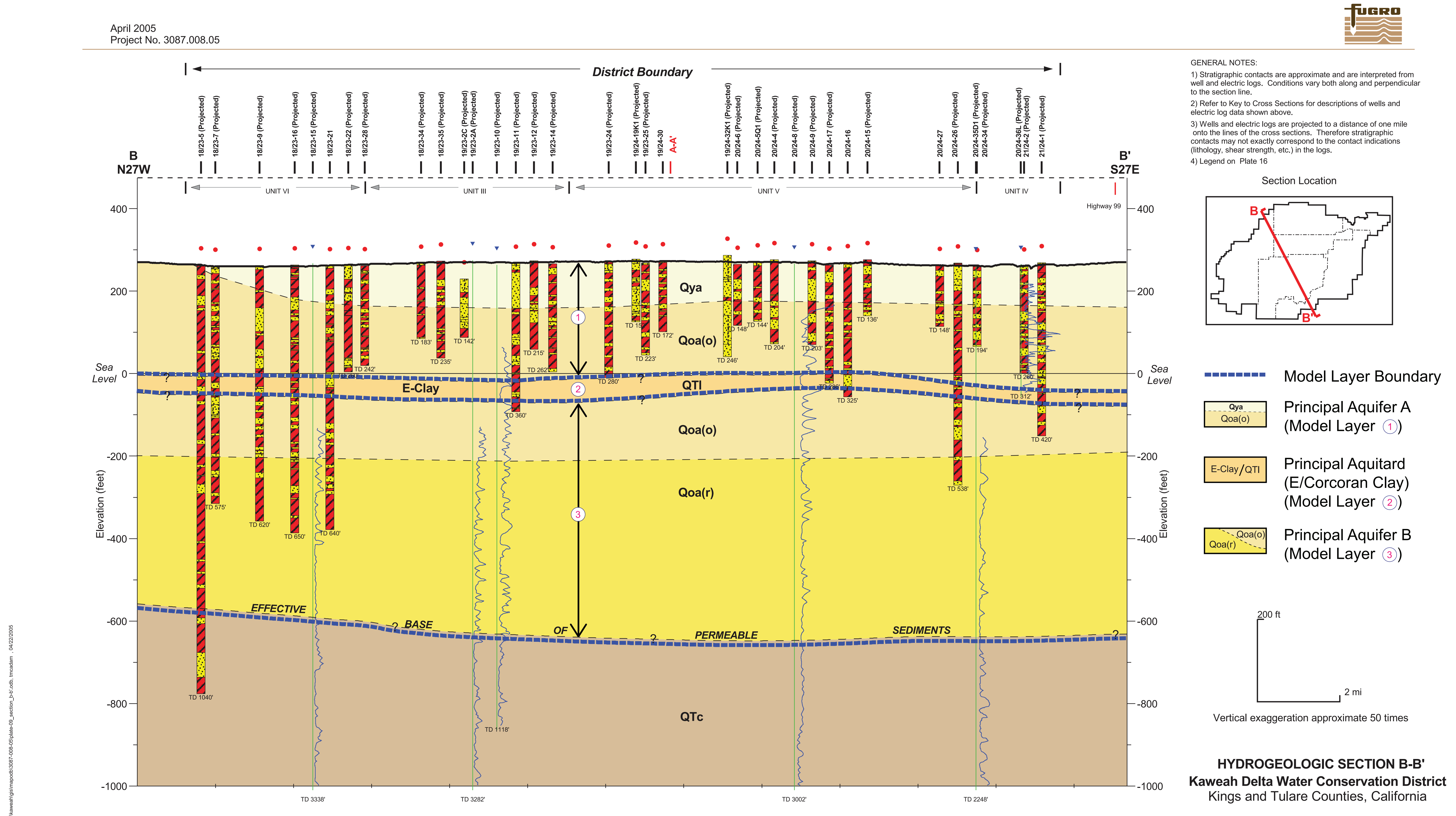
AUGUST 2018 | DRAFT | FIGURE 2

00Xxx0000 Z:\Projects\1800138_KaweahSB_SGMA\G003_Kaweah_Sub-Basin_ModelDomain_proposed1_XSections.mxd RBC



SOURCE: Numerical Groundwater Flow Model for the Kaweah Delta Water Conservation District (April 2005) Prepared for: Kaweah Delta Water Conservation District by Fugro West, Inc.

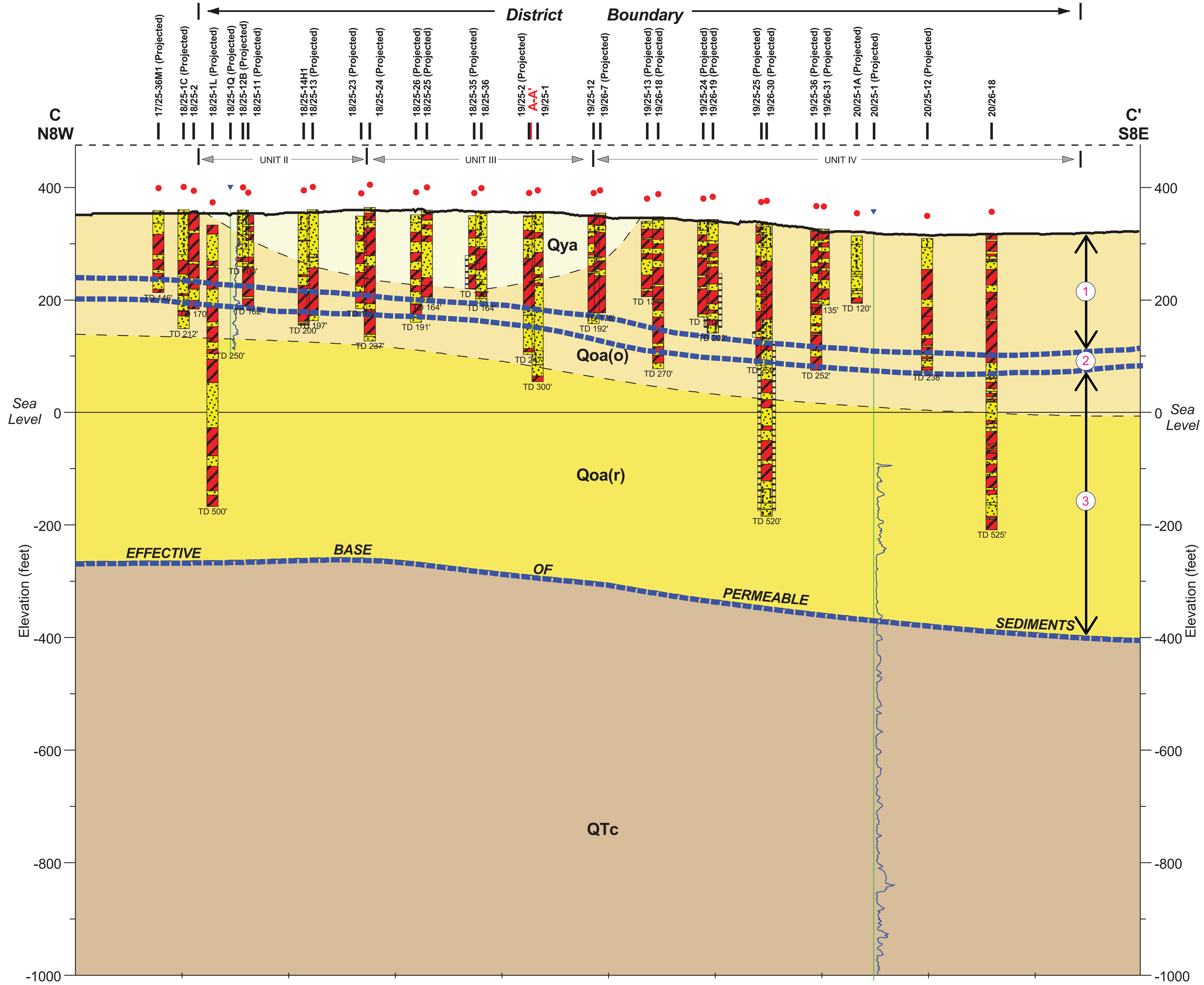
2 1 0 2 Miles	Kaweah Sub-Basin Groundwater Modeling Task 1 Tulare County, California	GSI Water Solutions, Inc. GEI Consultants	Model Layering Scheme along Hydrogeologic Cross Section A-A'
	Kaweah Sub-Basin		AUGUST 2018 DRAFT FIGURE 3



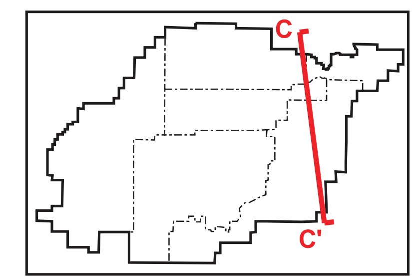
SOURCE: Numerical Groundwater Flow Model for the Kaweah Delta Water Conservation District (April 2005) Prepared for: Kaweah Delta Water Conservation District by Fugro West, Inc.

2 1 0 2 Miles	Kaweah Sub-Basin Groundwater Modeling Task 1 Tulare County, California	GSI Water Solutions, Inc. GEI Consultants	Model Layering Scheme along Hydrogeologic Cross Section B-B'
	Kaweah Sub-Basin		AUGUST 2018 DRAFT FIGURE 4

April 2005
Project No. 3087.008.05



Section Location



GENERAL NOTES:

1) Stratigraphic contacts are approximate and are interpreted from well and electric logs. Conditions vary both along and perpendicular to the section line.

2) Refer to Key to Cross Sections for descriptions of wells and electric log data shown above.

3) Wells and electric logs are projected to a distance of one mile onto the lines of the cross sections. Therefore stratigraphic contacts may not exactly correspond to the contact indications (lithology, shear strength, etc.) in the logs.

4) Legend on Plate 16

Model Layer Boundary

Qya / Qoa(o) — Principal Aquifer A (Model Layer 1)

Qoa(o) — Principal Aquifer A (Model Layer 2)

Qoa(o) / Qoa(r) — Principal Aquifer B (Model Layer 3)

200 ft

2 mi

Vertical exaggeration approximate 50 times

HYDROGEOLOGIC SECTION C-C'
Kaweah Delta Water Conservation District
Kings and Tulare Counties, California

PLATE 10

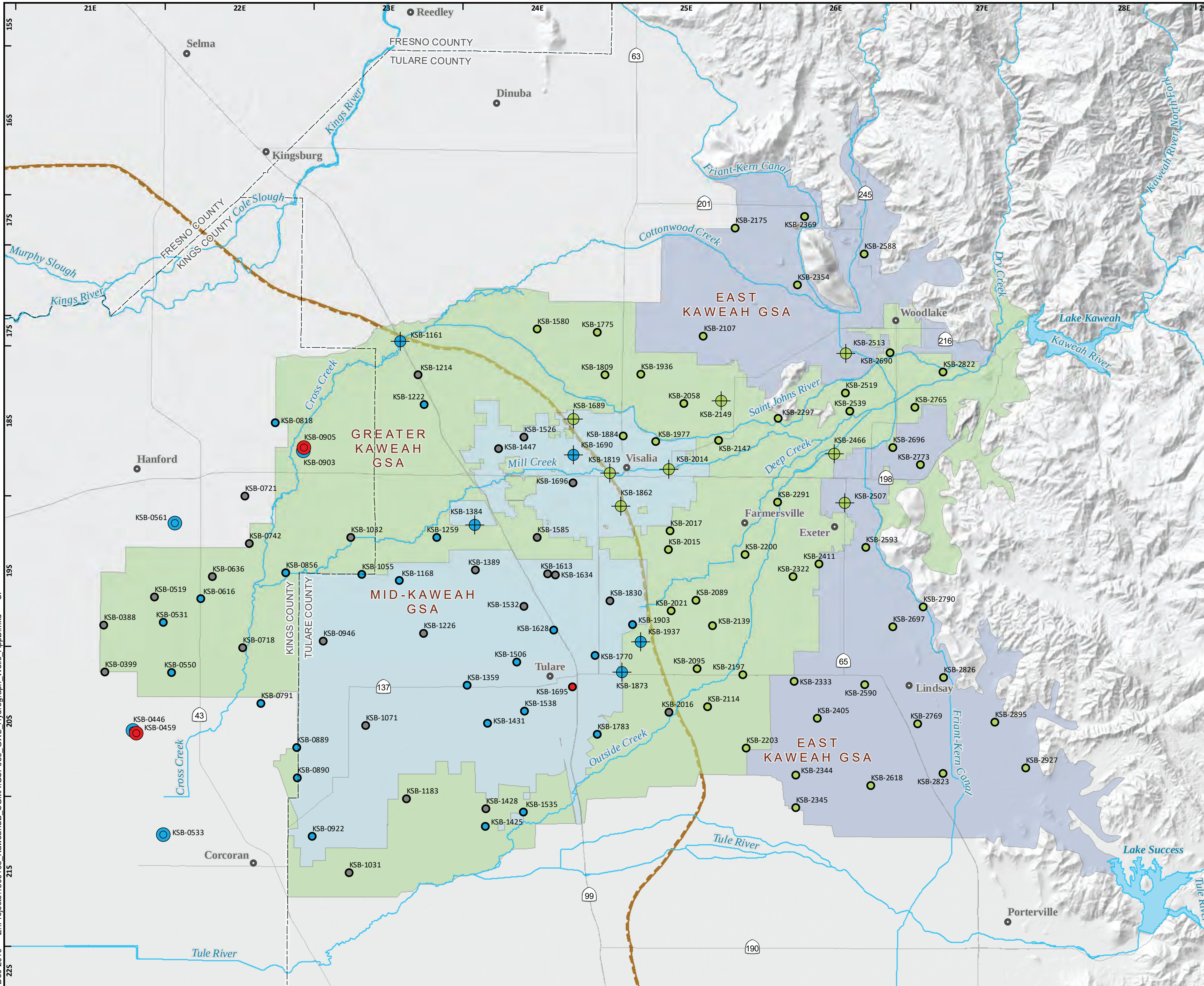
SOURCE: Numerical Groundwater Flow Model for the Kaweah Delta Water Conservation District (April 2005) Prepared for: Kaweah Delta Water Conservation District by Fugro West, Inc.

2 1 0 2
Miles

Kaweah Sub-Basin Groundwater Modeling Task 1 Tulare County, California	Model Layering Scheme along Hydrogeologic Cross Section C-C'
Kaweah Sub-Basin	AUGUST 2018 — DRAFT — FIGURE 5

Appendix B

Key Well Information



KEY WELLS WITH HYDROGRAPHS

Well Types

- Lower Aquifer
- Upper Aquifer
- Single Aquifer
- Unknown
- Dedicated Monitoring Well
- Dual Completion Well
- Monitoring Well

Approximate Extent of Corcoran Clay

GSA Boundaries

- East Kaweah GSA
- Greater Kaweah GSA
- Mid-Kaweah GSA

All Other Features

- Highway
- Waterway
- Lake

0 2 4 8
Miles

N

Kaweah Subbasin Managers
Groundwater Sustainability Plan
Tulare County, California

Kaweah Subbasin

GEI Consultants
GSI Water Solutions, Inc.

DECEMBER 2018 **DRAFT** FIGURE B-1

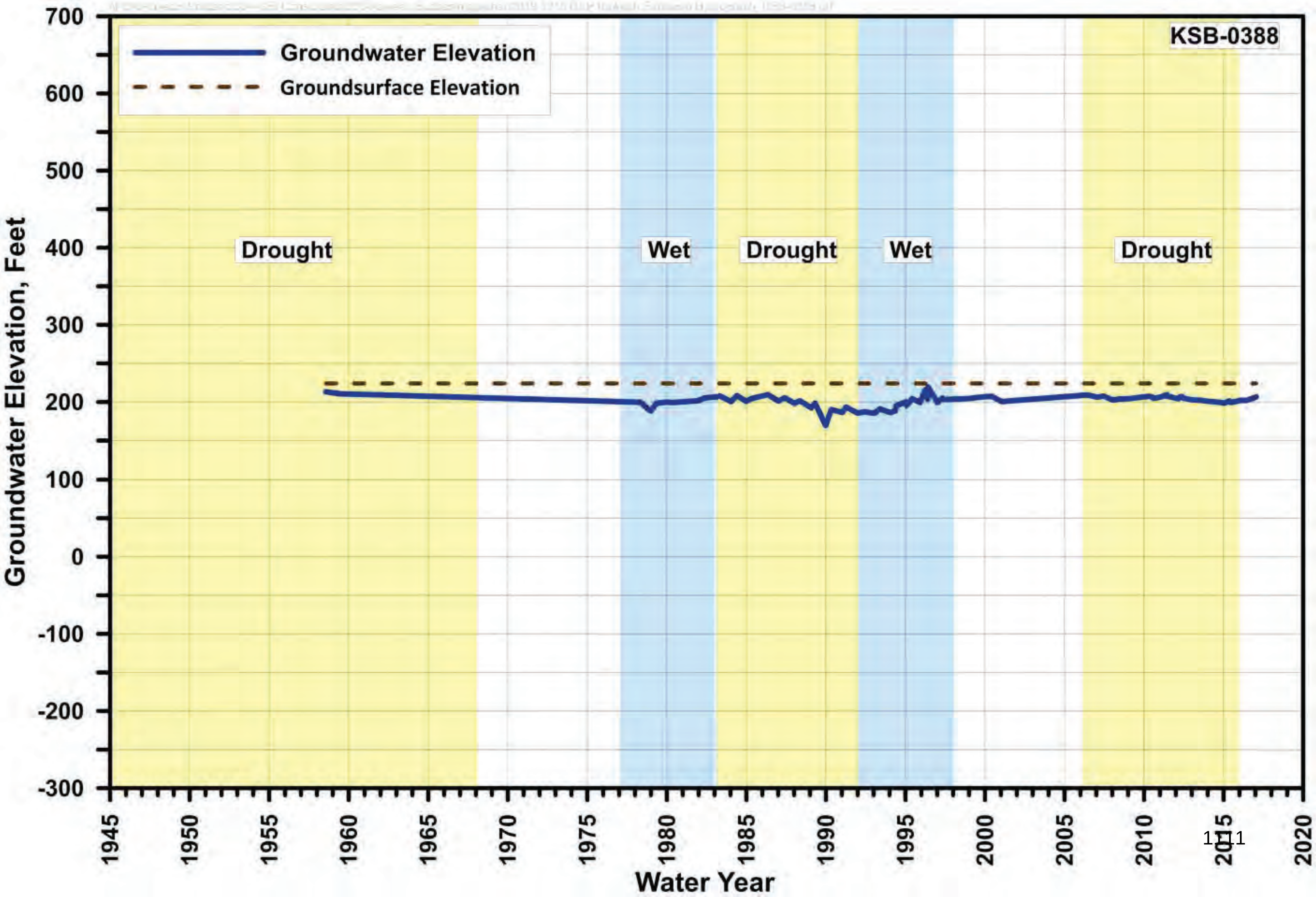
11-Dec-2019 Z:\Projects\1800138_KaweahSB_SGMA\GSP053_GWL_Hydrograph_Wells_AppB.mxd SI

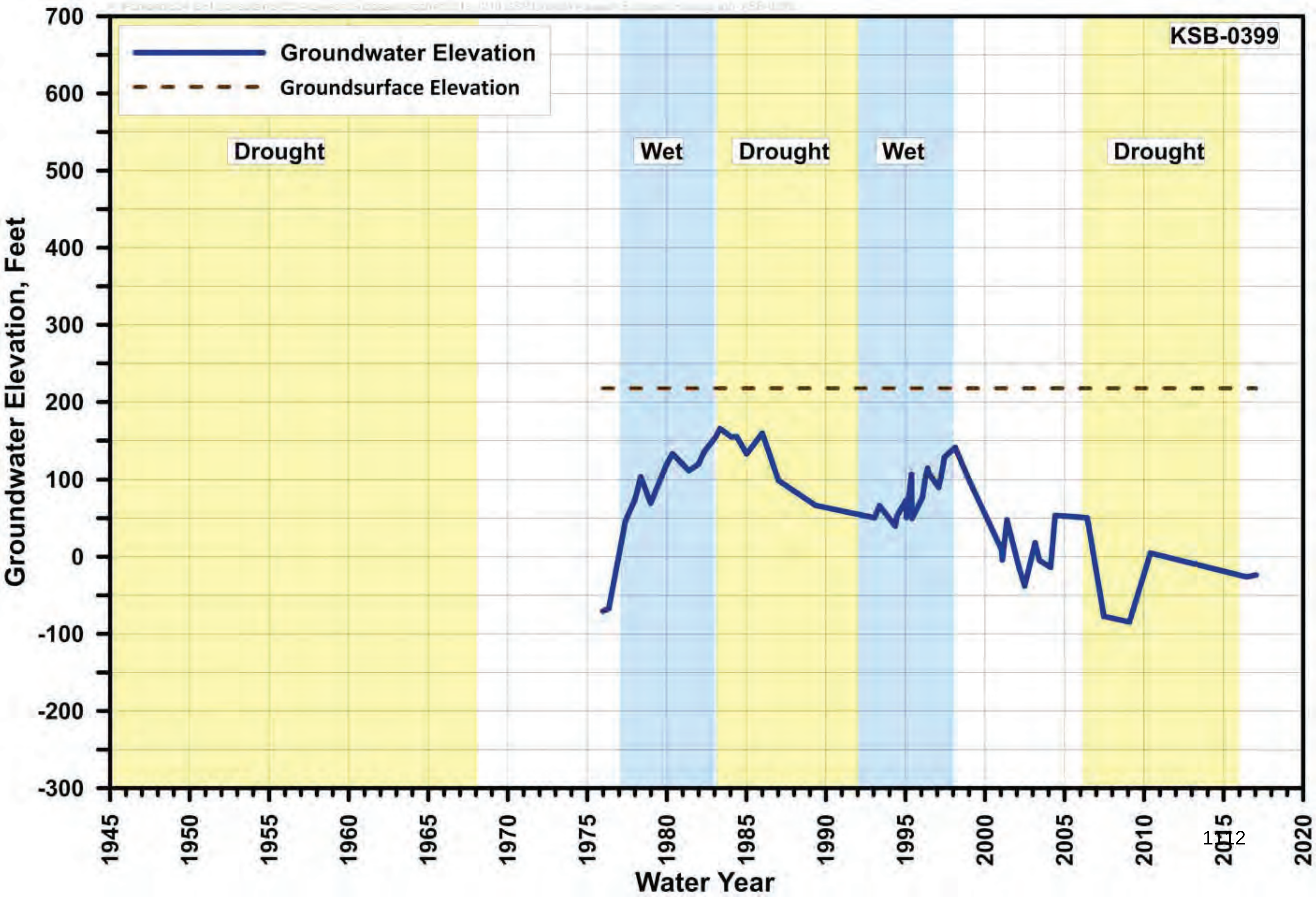
Table _ - Kaweah Sub-basin Key Well Information

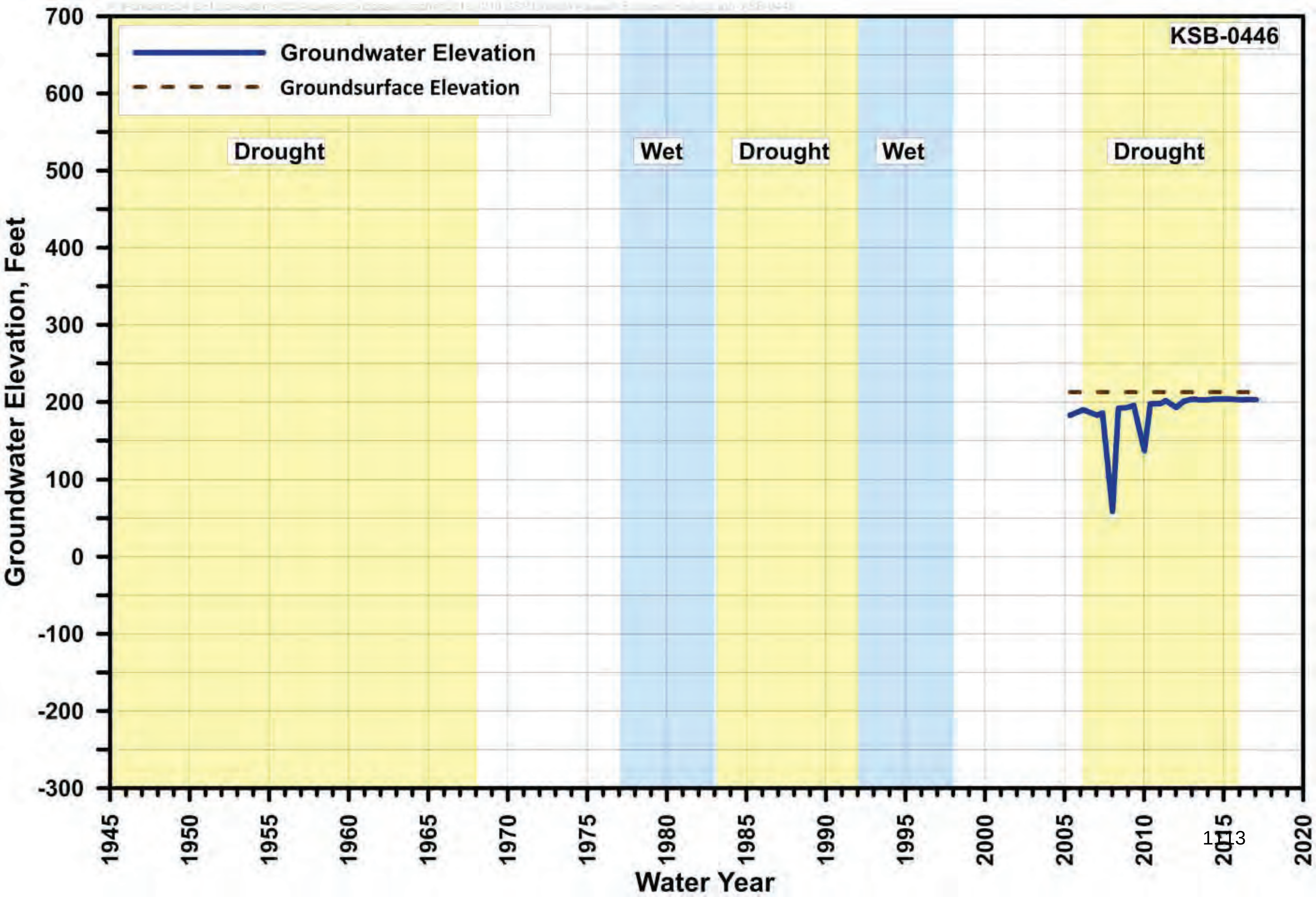
KSB ID	State Well #	CASGEM SITE_CODE	Common Name Well	Water Level Measurement Organization	Water Supply Service Area	GSA	Count of Water Level Measurements	Earliest Measurement Date on Record	Latest Measurement Date on Record	Known Construction? (Y/N)	Dedicated Monitoring Well (Y/N)	Dual Completion Well (Y/N)	Total Depth (Feet)	Top of Screen (Feet)	Bottom of Screen (Feet)	Within the Corcoran Clay? (Y/N)	Reported Ground Surface Elevation (Feet)	Aquifer Screened	LATITUDE	LONGITUDE
KSB-0388	19S21E35D001M	362383N1196704W001		Department of Water Resources	Lakeside Irrigation W.D.	Greater Kaweah GSA	80	Apr-59	Oct-17	N	N	N				y	227	UNK	36.2383	-119.67
KSB-0399	20S21E11D001M	362106N1196685W001		Bureau of Reclamation			52	Sep-76	Oct-17	N	N	N				y	217	UNK	36.2106	-119.669
KSB-0446	20S21E24F901M			Kaweah Delta Water Conservation District	Melga W.D.		23	Feb-06	Oct-17	Y	Y	Y	186	170	186	y	213	UAS	36.176661	-119.648219
KSB-0459	20S21E24F001M	361753N1196460W001		Kaweah Delta Water Conservation District	Melga W.D.		42	Feb-06	Mar-18	Y	Y	Y	700	650	690	y	213	LAS	36.1753	-119.646
KSB-0519	19S22E30D001M	362547N1196341W001		Kaweah Delta Water Conservation District	Lakeside Irrigation W.D.	Greater Kaweah GSA	119	Feb-63	Oct-17	N	N	N				y	230	UNK	36.2547	-119.634
KSB-0531	19S22E31B002M	362400N1196274W001		Bureau of Reclamation	Lakeside Irrigation W.D.	Greater Kaweah GSA	200	Feb-63	Oct-13	Y	N	N		247	271	y	226	UAS	36.24	-119.627
KSB-0532	21S22E07J001M	361158N1196258W001		Kaweah Delta Water Conservation District	Corcoran I.D.		40	Feb-07	Oct-17	Y	Y	Y	775	735	775	y	204	LAS	36.1158	-119.626
KSB-0533	21S22E07J901M			Kaweah Delta Water Conservation District	Corcoran I.D.		20	Oct-07	Oct-17	Y	Y	Y	314	274	314	y	204	UAS	36.115798	-119.625828
KSB-0550	20S22E07A003M	362106N1196216W001		Kings River Conservation District	Lakeside Irrigation W.D.	Greater Kaweah GSA	120	Feb-63	Mar-18	Y	N	N	421	181	421	y	220	UAS	36.2106	-119.622
KSB-0560	19S22E08D002M	362981N1196189W001		Kaweah Delta Water Conservation District	Lakeside Irrigation W.D.		40	Feb-07	Mar-18	Y	Y	Y	700	625	665	y	243	LAS	36.2981	-119.619
KSB-0561	19S22E08D902M			Kaweah Delta Water Conservation District	Lakeside Irrigation W.D.		21	Oct-07	Oct-17	Y	Y	Y	355	315	355	y	244	UAS	36.298133	-119.618932
KSB-0616	19S22E28D001M	362539N1196004W001		Bureau of Reclamation	Lakeside Irrigation W.D.	Greater Kaweah GSA	198	Feb-63	Mar-18	Y	N	N	362	190	360	y	232	UAS	36.2539	-119.6
KSB-0636	19S22E21C001M	362669N1195924W001		Kings County Water District	Lakeside Irrigation W.D.	Greater Kaweah GSA	117	Feb-63	Oct-17	N	N	N				y	237	UNK	36.2669	-119.592
KSB-0718	20S22E03B001M	362256N1195702W001		Department of Water Resources	Lakeside Irrigation W.D.	Greater Kaweah GSA	104	Feb-66	Oct-17	N	N	N				y	232	UNK	36.2256	-119.57
KSB-0721	18S22E34R001M	363142N1195685W001		Bureau of Reclamation	Lakeside Irrigation W.D.		81	Jan-72	Mar-18	N	N	N				y	245	UNK	36.3142	-119.569
KSB-0742	19S22E10R002M	362864N1195654W002		Bureau of Reclamation	Lakeside Irrigation W.D.		85	Oct-61	Oct-17	N	N	N				y	244	UNK	36.2864	-119.565
KSB-0791	20S22E14C001M	361928N1195563W001		Kaweah Delta Water Conservation District	Corcoran I.D.		23	Oct-88	Oct-13	Y	N	N		323	1600	y	225	UAS	36.1928	-119.556
KSB-0818	18S22E24D001M	363572N1195468W001		Department of Water Resources	Kings County W.D.		138	Oct-49	Oct-17	Y	N	N		240	340	y	258	UAS	36.3572	-119.547
KSB-0856	19S22E24B001M	362694N1195393W001		Kaweah Delta Water Conservation District	Kings County W.D.	Greater Kaweah GSA	77	Sep-69	Mar-18	N	N	N	160			y	244	UAS	36.2694	-119.539
KSB-0889	20S22E24R001M	361672N1195299W001		Bureau of Reclamation	Corcoran I.D.	Greater Kaweah GSA	37	Sep-87	Mar-18	Y	N	N	332	196	204	y	227	UAS	36.1672	-119.53
KSB-0890	20S22E36A001M	361497N1195296W001		Bureau of Reclamation	Unincorporated	Greater Kaweah GSA	143	Oct-75	Oct-17	Y	N	N	210	155	206	y	222	UAS	36.1497	-119.53
KSB-0903	18S23E30D901M			Kaweah Delta Water Conservation District	Kings County W.D.	Greater Kaweah GSA	22	Feb-06	Oct-17	Y	Y	Y	154	114	154	y	255	UAS	36.340824	-119.526639
KSB-0905	18S23E30D001M	363426N1195264W001		Kaweah Delta Water Conservation District	Kings County W.D.	Greater Kaweah GSA	39	Feb-06	Mar-18	Y	Y	Y	440	400	440	y	255	LAS	36.3426	-119.526
KSB-0922	21S23E07J001M	361156N1195191W001		Bureau of Reclamation	Tulare I.D.	Mid-Kaweah GSA	171	Aug-58	Oct-17	Y	N	N	428	322	420	y	221	UAS	36.1156	-119.519
KSB-0946	19S23E31R001M	362297N1195121W001		Department of Water Resources	Tulare I.D.	Mid-Kaweah GSA	148	Oct-45	Mar-17	N	N	N				y	245	UNK	36.2297	-119.512
KSB-1031	21S23E21C003M	360942N1194921W001		Department of Water Resources	Unincorporated	Greater Kaweah GSA	82	Feb-63	Oct-17	N	N	N				y	219	UNK	36.0942	-119.492
KSB-1032	19S23E08J001M	362903N1194927W001		Department of Water Resources	Kings County W.D.	Greater Kaweah GSA	146	Oct-49	Mar-17	N	N	N				y	256	UNK	36.2903	-119.493
KSB-1055	19S23E21C001M	362686N1194846W001		Kaweah Delta Water Conservation District	Tulare I.D.	Mid-Kaweah GSA	83	Feb-64	Oct-13	Y	N	N		168	195	y	255	UAS	36.2686	-119.485
KSB-1071	20S23E21B001M	361803N1194813W001		Department of Water Resources	Tulare I.D.	Mid-Kaweah GSA	100	Oct-60	Oct-17	N	N	N				y	241	UNK	36.1803	-119.481
KSB-1161	17S23E34J001M	364049N1194573W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	38	Apr-07	Mar-18	Y	Y	N	126	96	126	y	275	UAS	36.4049	-119.457
KSB-1168	19S23E22H001M	362653N1194571W001		Bureau of Reclamation	Tulare I.D.	Mid-Kaweah GSA	129	Oct-52	Mar-16	Y	N	N	331	178	190	y	265	UAS	36.2653	-119.457
KSB-1183	21S23E02A001M	361378N1194513W001		Kaweah Delta Water Conservation District	Elk Bayou D.C.	Greater Kaweah GSA	100	Sep-63	Oct-17	N	N	N				y	238	UNK	36.1378	-119.451
KSB-1214	18S23E02Q001M	363856N1194443W001		Kings County Water District	Unincorporated	Greater Kaweah GSA	144	Feb-52	Mar-18	N	N	N				y	278	UNK	36.3856	-119.444
KSB-1222	18S23E14A001M	363683N1194399W001		Bureau of Reclamation	Goshen D.C.	Greater Kaweah GSA	160	Oct-69	Oct-14	Y	N	N		115	330	y	280	UAS	36.3683	-119.44
KSB-1226	19S23E35H001M	362344N1194396W001		Tulare Irrigation District	Tulare I.D.	Mid-Kaweah GSA	142	Oct-53	Jan-18	N	N	N				y	264	UNK	36.2344	-119.44
KSB-1259	19S23E12L001M	362906N1194304W001		Department of Water Resources	Persian D.C.	Greater Kaweah GSA	144	Sep-69	Oct-13	Y	N	N		192	600	y	275	UAS	36.2906	-119.43
KSB-1359	20S24E07G001M	362042N1194082W001		Tulare Irrigation District	Tulare I.D.	Mid-Kaweah GSA	75	Feb-55	Mar-15	Y	N	N	456	216	456	y	264	UAS	36.2042	-119.408
KSB-1384	19S24E08D002M	362979N1194028W001		Kaweah Delta Water Conservation District	Persian D.C.	Greater Kaweah GSA	29	Apr-07	Mar-18	Y	Y	N	121	91	121	y	287	UAS	36.2979	-119.403
KSB-1389	19S24E17N001M			Tulare Irrigation District	Tulare I.D.	Mid-Kaweah GSA	115	Feb-54	Oct-14	N	N	N				y	287	UNK	36.27166667	-119.4016667
KSB-1425	21S24E08A001M	361219N1193946W001		Kaweah Delta Water Conservation District	Elk Bayou D.C.	Greater Kaweah GSA	109	Oct-51	Mar-18	Y	N	N	520	144	356	y	247	UAS	36.1219	-119.395
KSB-1428	21S24E05H002M	361319N1193938W001		Kaweah Delta Water Conservation District	Elk Bayou D.C.	Greater Kaweah GSA	108	Jan-70	Mar-18	N	N	N				y	250	UNK	36.1319	-119.394
KSB-1431	20S24E17P001M	361819N1193935W001		Department of Water Resources	Tulare I.D.	Mid-Kaweah GSA	128	Feb-56	Oct-17	Y	N	N	229	170	210	y	257	UAS	36.1819	-119.394
KSB-1447			075-01		Unincorporated	Mid-Kaweah GSA	120	Sep-93	Dec-10	N	N	N				y		UNK	36.34244882	-119.3853457
KSB-1506	20S24E04K01M		Well 26		Unincorporated	Mid-Kaweah GSA	114	Mar-92	Feb-18	Y	N	N	720	300	720	y	280	UAS	36.21798677	-119.371617
KSB-1526	18S24E22E001M			Kaweah Delta Water Conservation District	St. Johns W.D.	Mid-Kaweah GSA	9	Mar-12	Oct-17	N	N	N				y	307	UNK	36.34930676	-119.3671998
KSB-1532	19S24E28H001M	362503N1193677W001		Department of Water Resources	Tulare I.D.	Mid-Kaweah GSA	127	Oct-54	Oct-17	N	N	N				y	292	UNK	36.2503	-119.368
KSB-1535	21S24E03L001M	361303N1193665W001		Bureau of Reclamation	Elk Bayou D.C.	Greater Kaweah GSA	126	Feb-53	Oct-17	Y	N	N	325	200	317	y	257	UAS	36.1303	-119.367
KSB-1538	20S24E16H001M	361892N1193667W001		Department of Water Resources	Tulare I.D.	Mid-Kaweah GSA	182	Oct-53	Jan-18	Y	N	N		157	357	y	265	UAS	36.1892	-119.367
KSB-1580	17S24E34B001M	364125N1193588W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	208	Sep-30	Mar-14	N	N	N				n	298	SAS	36.4125	-119.359
KSB-1585	19S24E10G001M	362911N1193579W001		Department of Water Resources	Tulare Irrigation Company	Greater Kaweah GSA	115	Oct-56	Oct-17	N	N	N				y	304	UNK	36.2911	-119.358
KSB-1613	19S24E15R001M			Kaweah Delta Water Conservation District	Tulare I.D.	Mid-Kaweah GSA	7	Mar-14	Mar-17	N	N	N				y	306	UNK	36.26949556	-119.3497664
KSB-1628	19S24E35E01M		Well 27		Tulare I.D.	Mid-Kaweah GSA	104	Jul-93	Feb-18	Y	N	N	720	320	720	y	293	UAS	36.23653948	-119.345132
KSB-1634	19S24E23D001M	362689N1193445W001		Department of Water Resources	Tulare I.D.	Mid-Kaweah GSA	139	Oct-36	Jan-18	N	N	N				y	307	UNK	36.2689	-119.345
KSB-1689	18S24E13N001M	363601N1193320W001		Kaweah Delta Water Conservation District	Modoc D.C.	Mid-Kaweah GSA	34	May-08	Mar-18	Y	Y	N	110	70	110	n	321	SAS	36.3601	-119.332
KSB-1690	18S24E25D001M	363391N1193316W001		Kaweah Delta Water Conservation District	Modoc D.C.	Mid-Kaweah GSA	32	May-08	Mar-18	Y	Y	N	123	83	123	n	317	UAS	36.3391	-119.332
KSB-1695	20S24E11J02M		Well 11		Unincorporated	Mid-Kaweah GSA	121	Mar-92	Feb-18	Y	N	N	774	348	756	y	288	LAS	36.20362572	-119.3315452
KSB-1696			025-01		Unincorporated	Mid-Kaweah GSA	393	Jan-71	Apr-18	N	N	N				y		UNK	36.32262819	-119.3314731
KSB-1770	20S24E01H02M		Well 15		Unincorporated	Mid-Kaweah GSA	115	Mar-92	Feb-18	Y	N	N	715	300	700	y	112	UAS	36.22191281	-119.3154621
KSB-1775	17S24E36H003M	364106N1193145W001		Kaweah Delta Water Conservation District	Uphill D.C.	Greater Kaweah GSA	128	Oct-61	Oct-17	N	N	N				n	314	SAS	36.4106	-119.315
KSB-1783	20S24E24H001M	361756N1193140W001		Bureau of Reclamation	Farmers D.C.	Greater Kaweah GSA	160	Feb-69	Oct-16	Y	N	N	355	178	182	y	281	UAS	36.1756	-119.314
KSB-1809	18S25E06P001M			Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	4	Mar-16	Oct-17	N	N	N				n	323	SAS	36.386016	-119.308785
KSB-1819	18S25E30Q001M	363286N1193054W001		Kaweah Delta Water Conservation District	Unincorporated	Mid-Kaweah GSA	23	May-08	Mar-17	Y	Y	N	123	83	123	n	326	SAS	36.3286	-119.305
KSB-1830	19S25E30C001M	362539N1193051W001		Department of Water Resources	Tulare I.D.	Mid-Kaweah GSA	167	Oct-54	Oct-17	N	N	N				y	313	UNK	36.2539	-119.305
KSB-1862	19S25E06A001M	363094N1192974W001		Kaweah Delta Water Conservation District	Evans D.C.	Mid-Kaweah GSA	21	May-08	Mar-14	Y	Y	N	124	84	124	n	327	SAS	36.3094	-119.297
KSB-1873	20S25E06R002M	362122N1192962W001		Kaweah Delta Water Conservation District	Farmers D.C.	Greater Kaweah GSA	18	Apr-07	Oct-13	Y	Y	N	125	95	125	y	299	UAS	36.2122	-119.296
KSB-1884			036-01		Unincorporated	Mid-Kaweah GSA	368	Jul-71	Apr-18	N	N	N				n		SAS	36.35027811	-119.2954358
KSB-1903	19S24E36C002M		Well 36		Farmers D.C.	Mid-Kaweah GSA	27	Oct-04	Feb-18	Y	N	N	620	320	620	y	302	UAS	36.24008	-119.2882

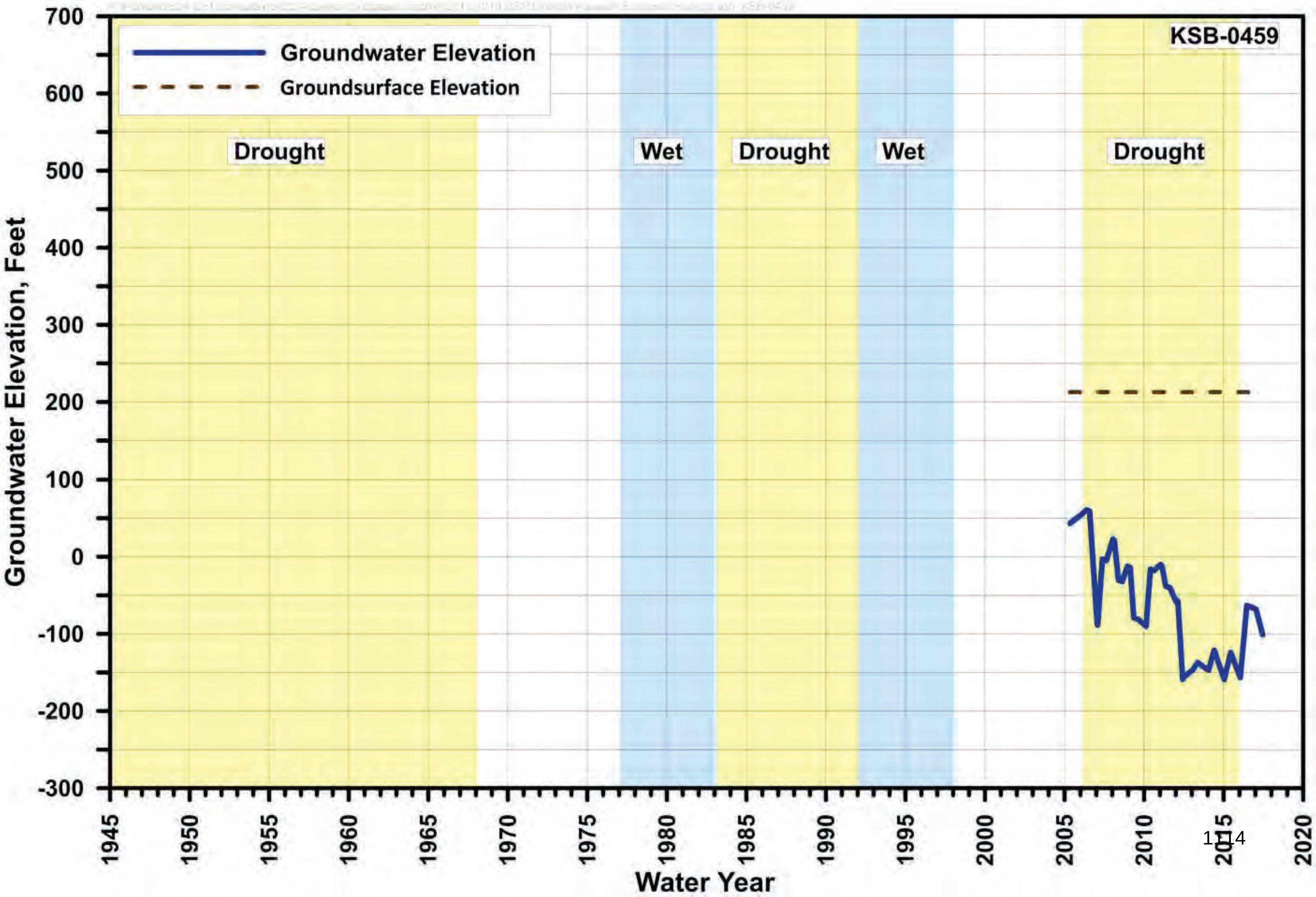
Table _ - Kaweah Sub-basin Key Well Information

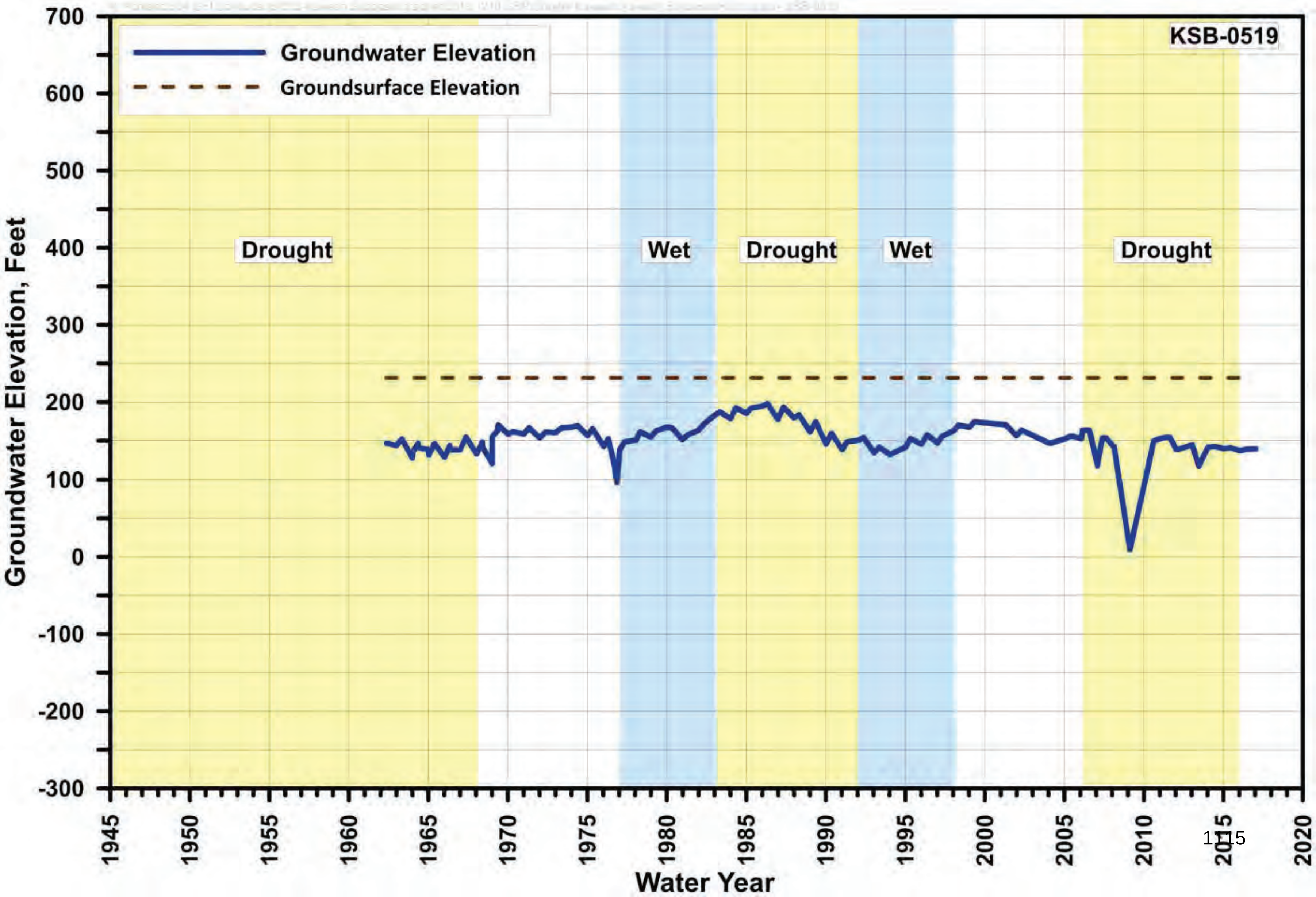
KSB ID	State Well #	CASGEM SITE_CODE	Common Name Well	Water Level Measurement Organization	Water Supply Service Area	GSA	Count of Water Level Measurements	Earliest Measurement Date on Record	Latest Measurement Date on Record	Known Construction? (Y/N)	Dedicated Monitoring Well (Y/N)	Dual Completion Well (Y/N)	Total Depth (Feet)	Top of Screen (Feet)	Bottom of Screen (Feet)	Within the Corcoran Clay? (Y/N)	Reported Ground Surface Elevation (Feet)	Aquifer Screened	LATITUDE	LONGITUDE
KSB-1936	18S25E05Q001M	363864N1192834W001		Kaweah Delta Water Conservation District	Mathews D.C.	Greater Kaweah GSA	140	Feb-64	Mar-18	N	N	N	278			n	333	SAS	36.3864	-119.283
KSB-1937	19S25E32J001M	362301N1192828W001		Kaweah Delta Water Conservation District	Farmers D.C.	Greater Kaweah GSA	20	Apr-07	Oct-13	Y	Y	N	115	85	115	y	312	UAS	36.2301	-119.283
KSB-1977			053-01		Unincorporated	Mid-Kaweah GSA	276	Mar-80	Apr-18	N	N	N				n		SAS	36.34705864	-119.2719874
KSB-2014	18S25E28R001M	363309N1192627W001		Kaweah Delta Water Conservation District	Unincorporated	Mid-Kaweah GSA	21	Oct-11	Oct-17	Y	Y	N	100	60	100	n	342	SAS	36.3309	-119.263
KSB-2015	19S25E16A002M	362839N1192634W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	140	Oct-50	Mar-18	N	N	N				n	335	SAS	36.2839	-119.263
KSB-2016	20S25E16J002M	361889N1192620W001		Kaweah Delta Water Conservation District	Farmers D.C.	Greater Kaweah GSA	138	Feb-67	Oct-17	N	N	N				y	299	UNK	36.1889	-119.262
KSB-2017	19S25E09H001M	362947N1192617W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	133	Oct-61	Oct-17	N	N	N				n	338	SAS	36.2947	-119.262
KSB-2021	19S25E28H001M	362481N1192609W001		Kaweah Delta Water Conservation District	Farmers D.C.	Greater Kaweah GSA	135	Feb-68	Oct-17	N	N	N				n	322	SAS	36.2481	-119.261
KSB-2058	18S25E15C001M	363692N1192520W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	175	Oct-41	Oct-17	N	N	N	90			n	348	SAS	36.3692	-119.252
KSB-2089	19S25E27A001M	362544N1192431W001		Kaweah Delta Water Conservation District	Farmers D.C.	Greater Kaweah GSA	137	Feb-68	Oct-17	N	N	N				n	332	SAS	36.2544	-119.243
KSB-2095	20S25E03R001M			Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	97	Feb-63	Oct-17	N	N	N				n	308	SAS	36.214539	-119.24285
KSB-2107	17S25E35E001M	364086N1192381W001		Ivanhoe Irrigation District	Ivanhoe I.D.	East Kaweah GSA	169	Mar-53	Mar-14	N	N	N				n	354	SAS	36.4086	-119.238
KSB-2114	20S25E14F004M	361922N1192337W003		Kaweah Delta Water Conservation District	Consolidated Peoples D.C.	Greater Kaweah GSA	118	Feb-68	Oct-17	N	N	N				n	306	SAS	36.1922	-119.234
KSB-2139	19S25E35B002M	362394N1192309W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	133	Sep-63	Oct-16	N	N	N				n	327	SAS	36.2394	-119.231
KSB-2147	18S25E23J001M	363478N1192267W001		Kaweah Delta Water Conservation District	Fleming D.C.	Greater Kaweah GSA	136	Sep-63	Mar-15	N	N	N				n	360	SAS	36.3478	-119.227
KSB-2149	18S25E12N001M	363711N1192250W001		Kaweah Delta Water Conservation District	Wutchumna W.C.	Greater Kaweah GSA	21	Apr-07	Mar-13	Y	Y	N	82	52	82	n	397	SAS	36.3711	-119.225
KSB-2175	17S25E01P001M	364718N1192151W001		Bureau of Reclamation	Unincorporated	East Kaweah GSA	355	Dec-31	Oct-10	N	N	N				n	356	SAS	36.4718	-119.215
KSB-2197	20S25E12A001M	362108N1192092W001		Kaweah Delta Water Conservation District	Consolidated Peoples D.C.	Greater Kaweah GSA	130	Feb-66	Oct-16	N	N	N				n	316	SAS	36.2108	-119.209
KSB-2200	19S25E13A002M	362811N1192076W001		Kaweah Delta Water Conservation District	Consolidated Peoples D.C.	Greater Kaweah GSA	156	Oct-61	Mar-18	N	N	N				n	350	SAS	36.2811	-119.208
KSB-2203	20S25E24R001M	361681N1192067W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	151	Oct-45	Oct-17	N	N	N	170			n	315	SAS	36.1681	-119.207
KSB-2291	19S26E05C001M	363117N1191842W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	143	Sep-63	Oct-17	N	N	N				n	367	SAS	36.3117	-119.184
KSB-2297	18S26E17L001M	363606N1191837W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	166	Oct-50	Mar-18	N	N	N				n	385	SAS	36.3606	-119.184
KSB-2322	19S26E20A001M	362683N1191728W001		Bureau of Reclamation	Unincorporated	Greater Kaweah GSA	195	Nov-48	Oct-17	N	N	N				n	353	SAS	36.2683	-119.173
KSB-2333	20S26E08H001M	362069N1191723W001		Lindmore Irrigation District	Lindmore ID	East Kaweah GSA	102	Feb-54	Mar-16	N	N	N				n	329	SAS	36.2069	-119.172
KSB-2344	20S26E32A001M	361522N1191706W001		Bureau of Reclamation	Lindmore ID	East Kaweah GSA	270	Oct-45	Mar-16	N	N	N	340			n	335	SAS	36.1522	-119.171
KSB-2345	21S26E04F001M	361333N1191703W001		Bureau of Reclamation	Lower Tule ID	East Kaweah GSA	132	Oct-61	Mar-16	N	N	N				n	343	SAS	36.1333	-119.17
KSB-2354	17S26E21E001M	364388N1191703W001		Bureau of Reclamation	Ivanhoe I.D.	East Kaweah GSA	179	Jan-61	Mar-14	N	N	N				n	397	SAS	36.4388	-119.17
KSB-2369	17S26E04F002M	364788N1191653W001		Stone Corral Irrigation District	Stone Corral I.D.	East Kaweah GSA	98	Feb-62	Mar-16	N	N	N				n	406	SAS	36.4788	-119.165
KSB-2405	20S26E16R001M	361853N1191551W001		Bureau of Reclamation	Lindmore ID	East Kaweah GSA	182	Sep-61	Mar-16	Y	N	N	492	210	485	n	338	SAS	36.1853	-119.155
KSB-2411	19S26E16J002M	362756N1191545W001		Bureau of Reclamation	Unincorporated	East Kaweah GSA	186	Oct-61	Mar-18	N	N	N	131			n	366	SAS	36.2756	-119.154
KSB-2466	18S26E27B001M	363403N1191434W001		Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	30	Apr-07	Mar-18	Y	Y	N	29	9	29	n	394	SAS	36.3403	-119.143
KSB-2507	19S26E03A001M	363115N1191358W001		Kaweah Delta Water Conservation District	Exeter I.D.	East Kaweah GSA	28	Apr-07	Mar-18	Y	Y	N	90	60	90	n	402	SAS	36.3115	-119.136
KSB-2513	18S26E02D002M	363990N1191352W001		Kaweah Delta Water Conservation District	Ivanhoe I.D.	East Kaweah GSA	38	Apr-07	Oct-17	Y	Y	N	69	39	69	n	422	SAS	36.399	-119.135
KSB-2519	18S26E10J001M	363755N1191353W001		Department of Water Resources	Unincorporated	Greater Kaweah GSA	233	Oct-51	Mar-13	Y	N	N	140	57	87	n	408	SAS	36.3755	-119.135
KSB-2539	18S26E14E001M	363649N1191318W001		Kaweah Delta Water Conservation District	Lindsay-Strathmore I.D.	Greater Kaweah GSA	9	Mar-16	Mar-18	N	N	N				n	404	SAS	36.3649	-119.132
KSB-2588	17S26E14B001M	364568N1191217W001		Bureau of Reclamation	Unincorporated	East Kaweah GSA	115	Nov-48	Mar-07	N	N	N				n	489	SAS	36.4568	-119.122
KSB-2590	20S26E11H001M	362053N1191217W001		Kaweah Delta Water Conservation District	Lindmore ID	East Kaweah GSA	99	Feb-54	Mar-13	N	N	N				n	359	SAS	36.2053	-119.122
KSB-2593	19S26E11R001M	362853N1191209W001		Exeter Irrigation District	Exeter I.D.	East Kaweah GSA	107	Oct-50	Mar-16	N	N	N				n	394	SAS	36.2853	-119.121
KSB-2618	20S26E35H001M	361461N1191165W001		Lindmore Irrigation District	Lindmore ID	East Kaweah GSA	148	Feb-54	Mar-16	N	N	N				n	364	SAS	36.1461	-119.117
KSB-2690	17S26E36R001M	363993N1191028W001		Kaweah Delta Water Conservation District	Sweeney Ditch Area	Greater Kaweah GSA	121	Feb-68	Mar-18	N	N	N				n	427	SAS	36.3993	-119.103
KSB-2696	18S26E24J003M	363438N1191012W001		Bureau of Reclamation	Exeter I.D.	East Kaweah GSA	141	Oct-61	Mar-18	N	N	N				n	432	SAS	36.3438	-119.101
KSB-2697	19S26E25R001M	362389N1191009W001		Bureau of Reclamation	Lewis Creek WD	East Kaweah GSA	178	Jan-70	Mar-16	Y	N	N	290	96	226	n	358	SAS	36.2389	-119.101
KSB-2765	18S27E18A001M			Kaweah Delta Water Conservation District	Unincorporated	Greater Kaweah GSA	4	Mar-16	Oct-17	N	N	N				n	429	SAS	36.367412	-119.084864
KSB-2769	20S27E18R001M	361822N1190831W001		Lindmore Irrigation District	Lindmore ID	East Kaweah GSA	113	Nov-52	Mar-16	N	N	N				n	412	SAS	36.1822	-119.083
KSB-2773	18S27E30H001M	363338N1190817W001		Exeter Irrigation District	Exeter I.D.	East Kaweah GSA	82	Feb-62	Mar-16	N	N	N	213			n	456	SAS	36.3338	-119.082
KSB-2790	19S27E29D001M	362506N1190795W001		Lindsay-Strathmore Irrigation District	Lindsay-Strathmore ID	East Kaweah GSA	99	Oct-49	Mar-16	N	N	N	200			n	388	SAS	36.2506	-119.08
KSB-2822	18S27E05J001M	363880N1190651W001		Bureau of Reclamation	Unincorporated	Greater Kaweah GSA	237	Oct-61	Mar-18	Y	N	N	98	24	79	n	447	SAS	36.388	-119.065
KSB-2823	20S27E29R001M	361533N1190645W001		Lindmore Irrigation District	Lindmore ID	East Kaweah GSA	125	Oct-61	Oct-11	N	N	N				n	403	SAS	36.1533	-119.065
KSB-2826	20S27E08A001M	362094N1190645W001		Lindsay-Strathmore Irrigation District	Lindsay-Strathmore ID	East Kaweah GSA	130	Oct-36	Mar-16	N	N	N				n	403	SAS	36.2094	-119.065
KSB-2895	20S27E15R001M	361833N1190278W001		Lindsay-Strathmore Irrigation District	Lindsay-Strathmore ID	East Kaweah GSA	108	Feb-52	Mar-16	N	N	N	200			n	468	SAS	36.1833	-119.028
KSB-2927	20S27E25N001M	361564N1190048W001		Lindsay-Strathmore Irrigation District	Lindsay-Strathmore ID	East Kaweah GSA	139	Feb-52	Mar-16	N	N	N				n	478	SAS	36.1564	-119.005


KSB-0388
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

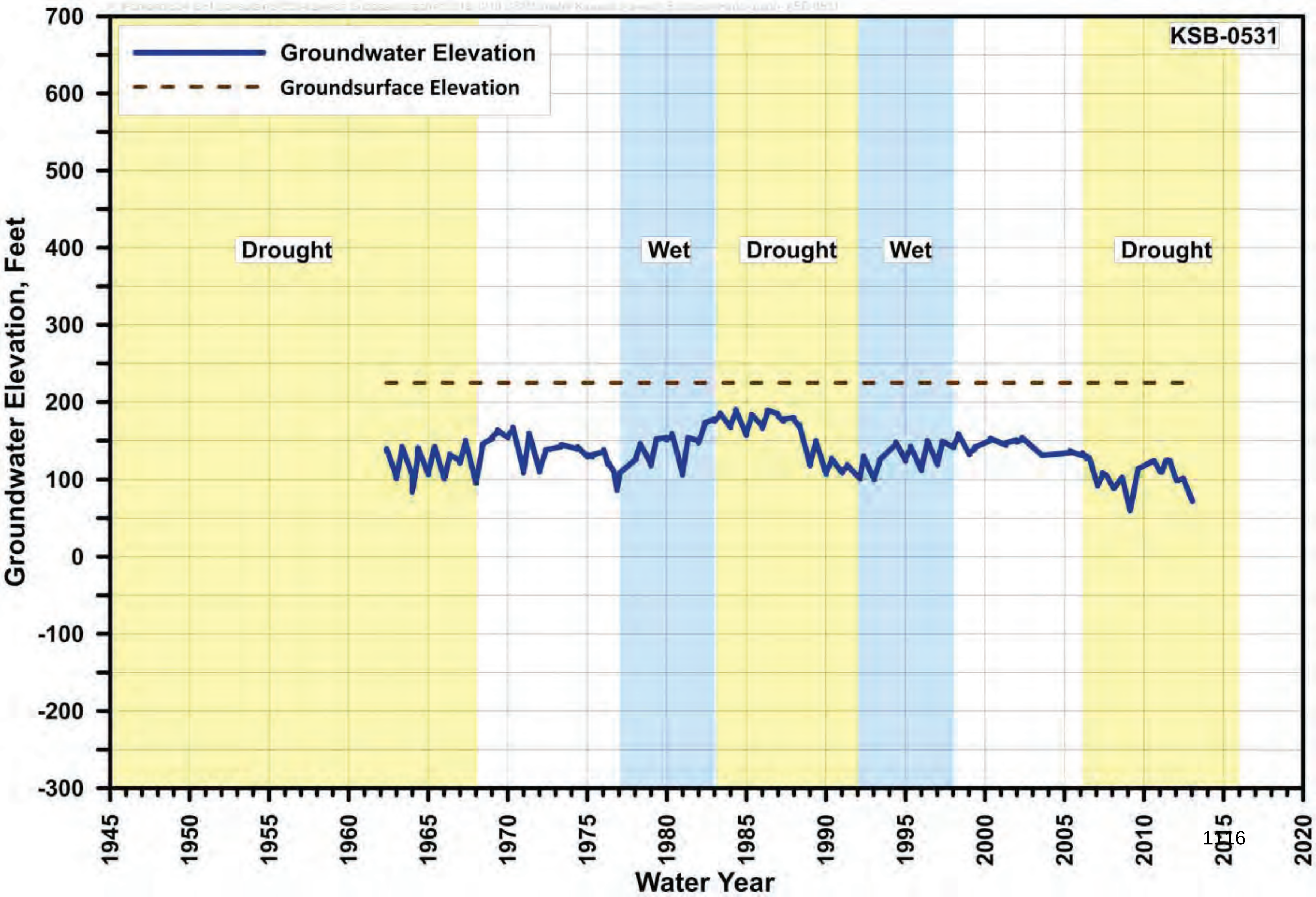

KSB-0399
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-0446
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

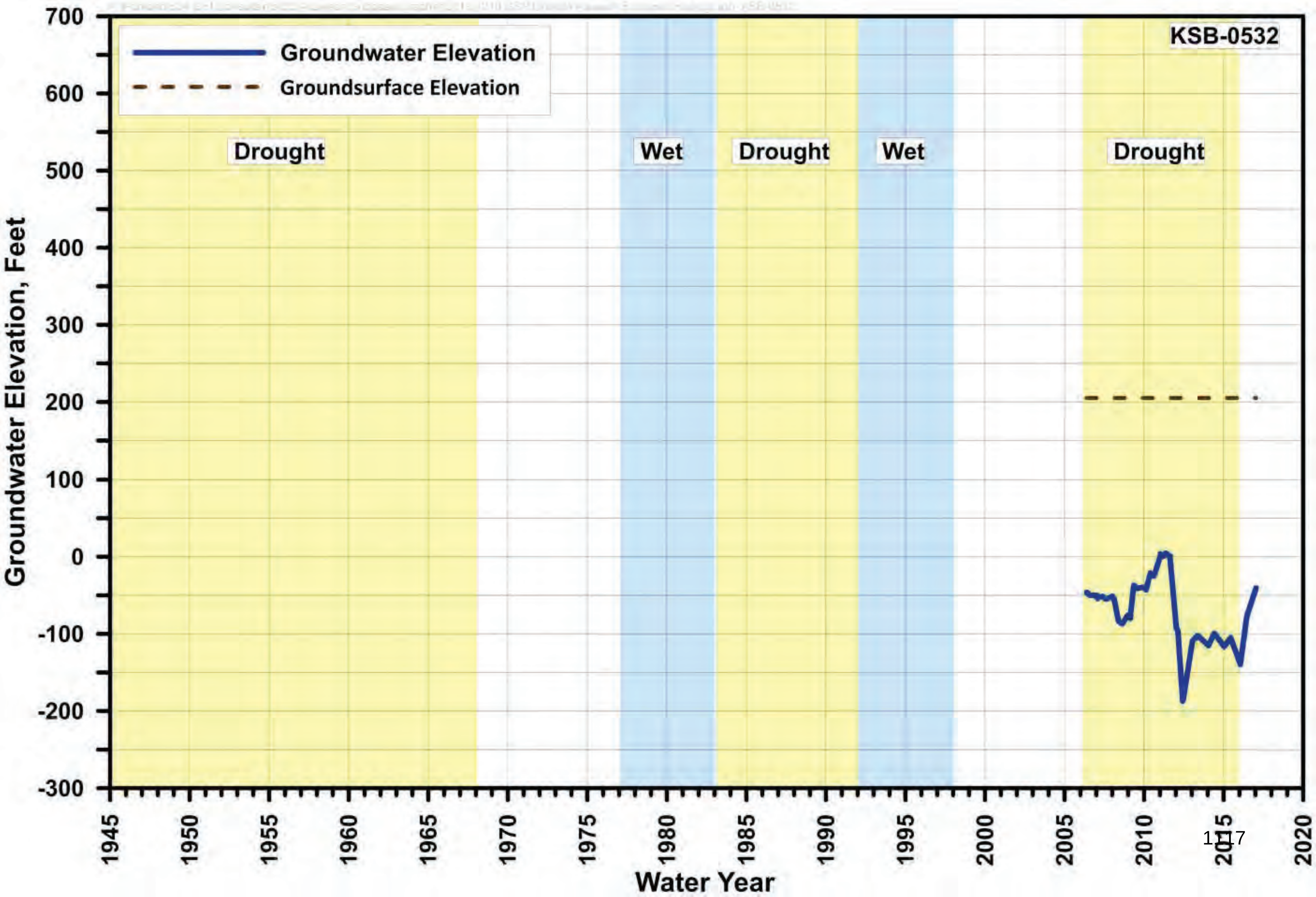

KSB-0459
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

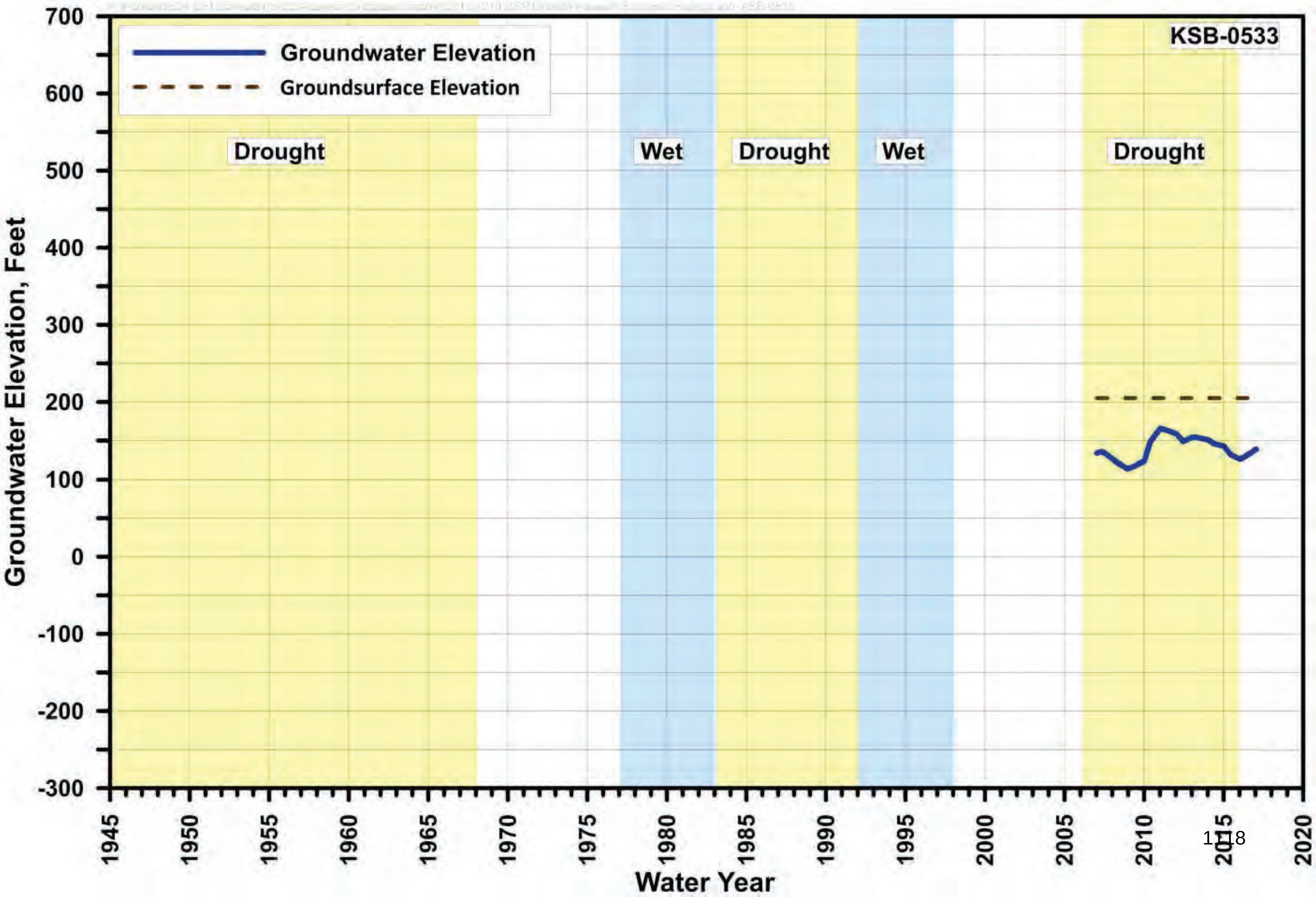


Groundwater Elevation
Groundsurface Elevation
KSB-0519
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

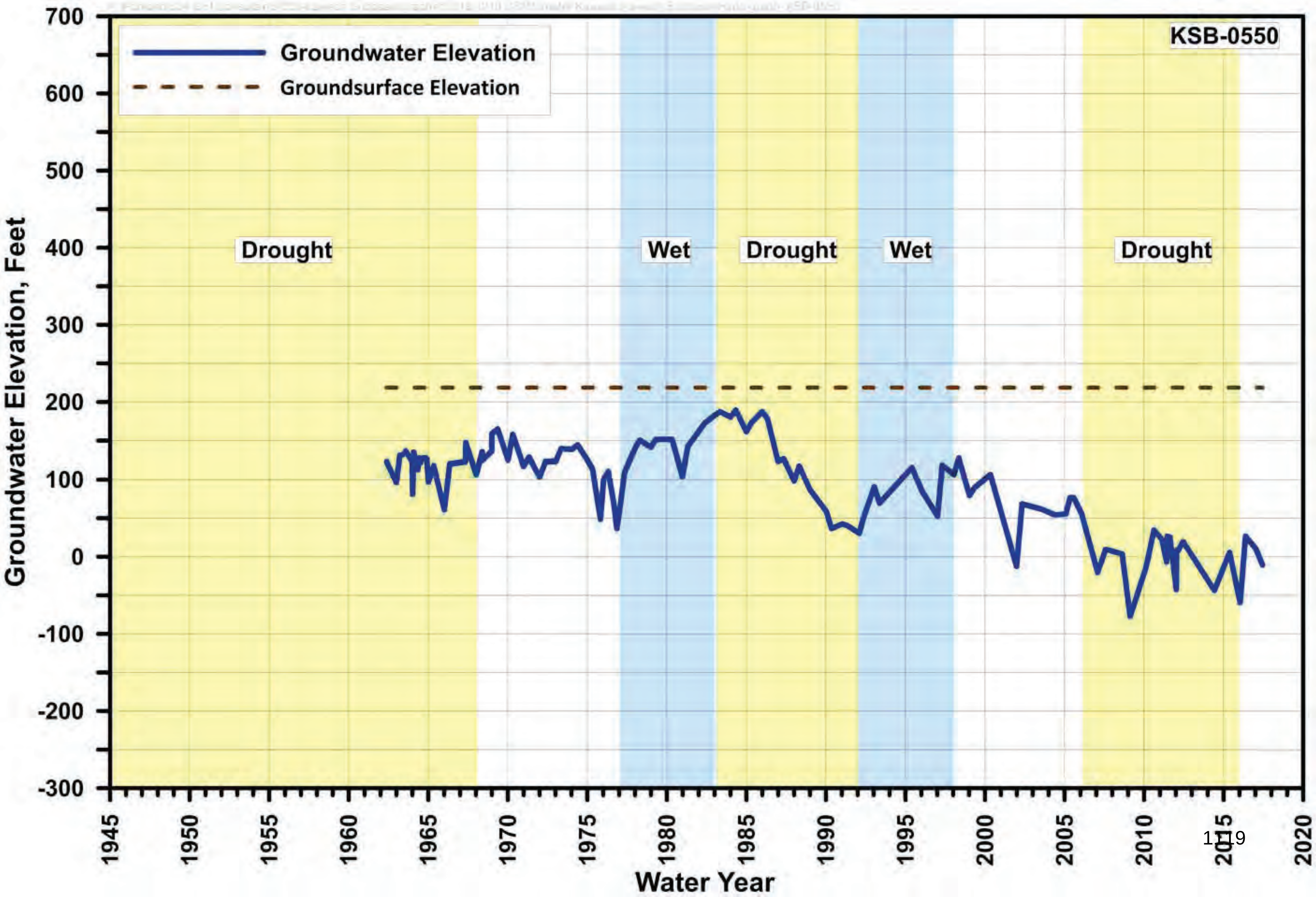


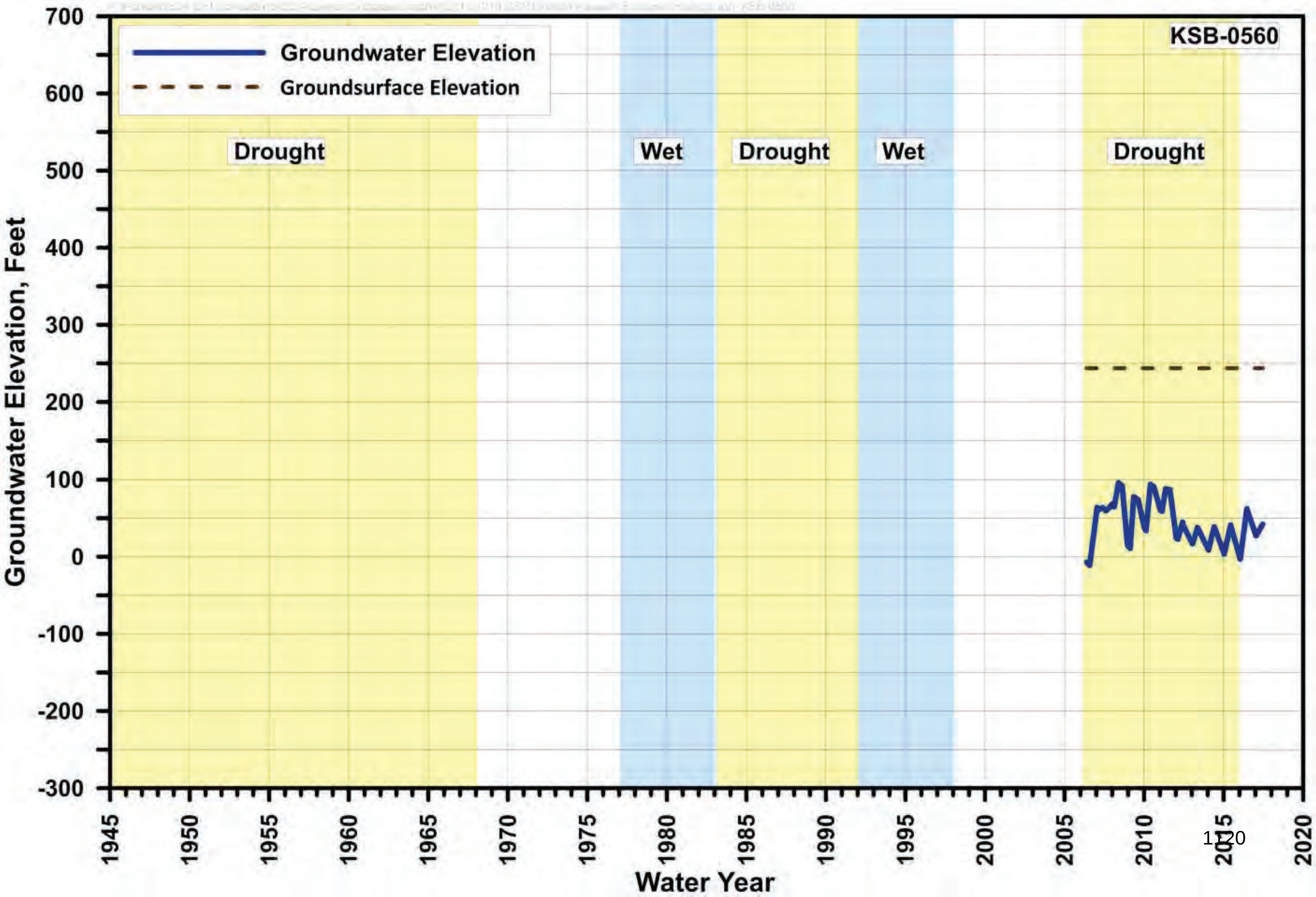
KSB-0531
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

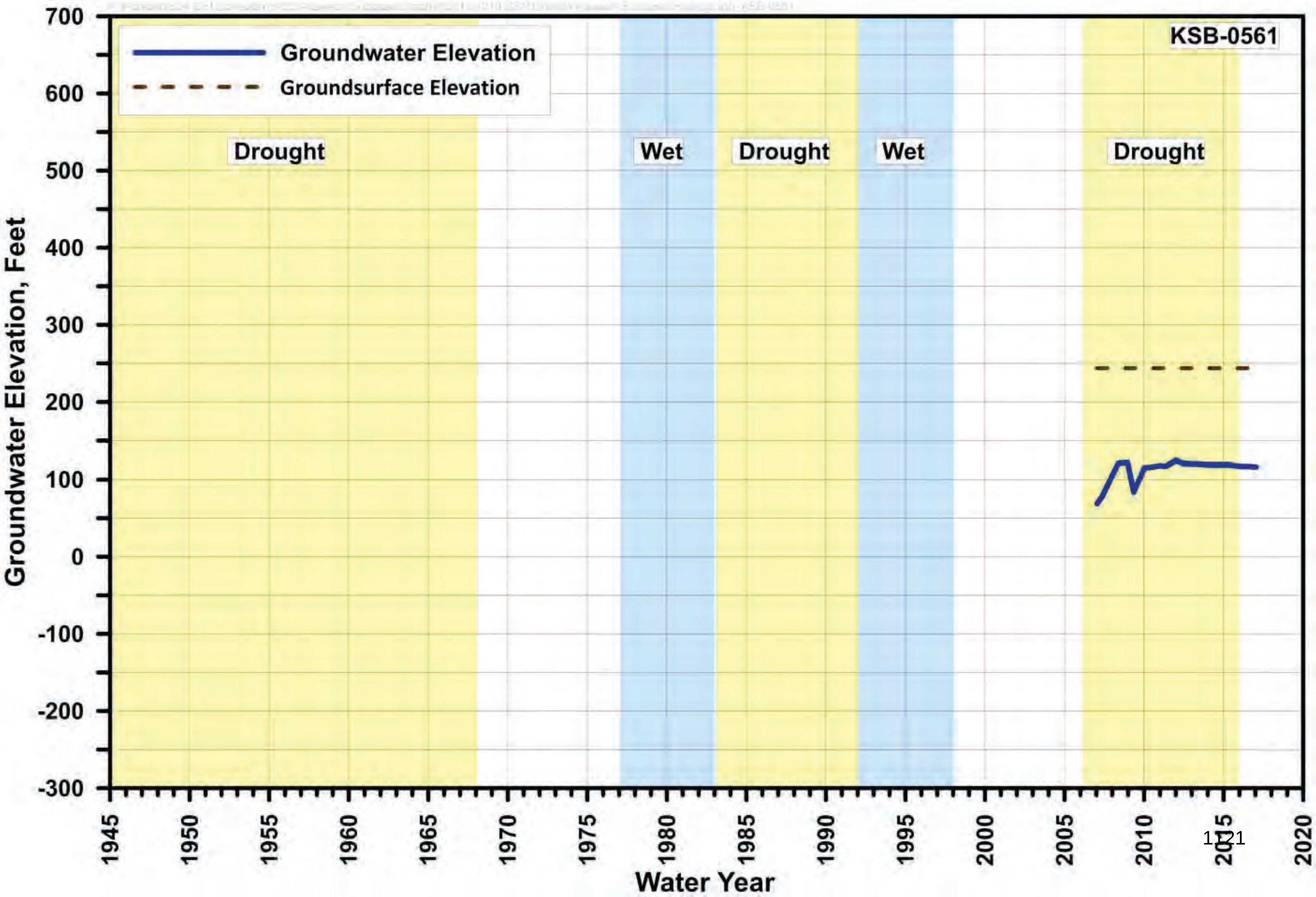

KSB-0532
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

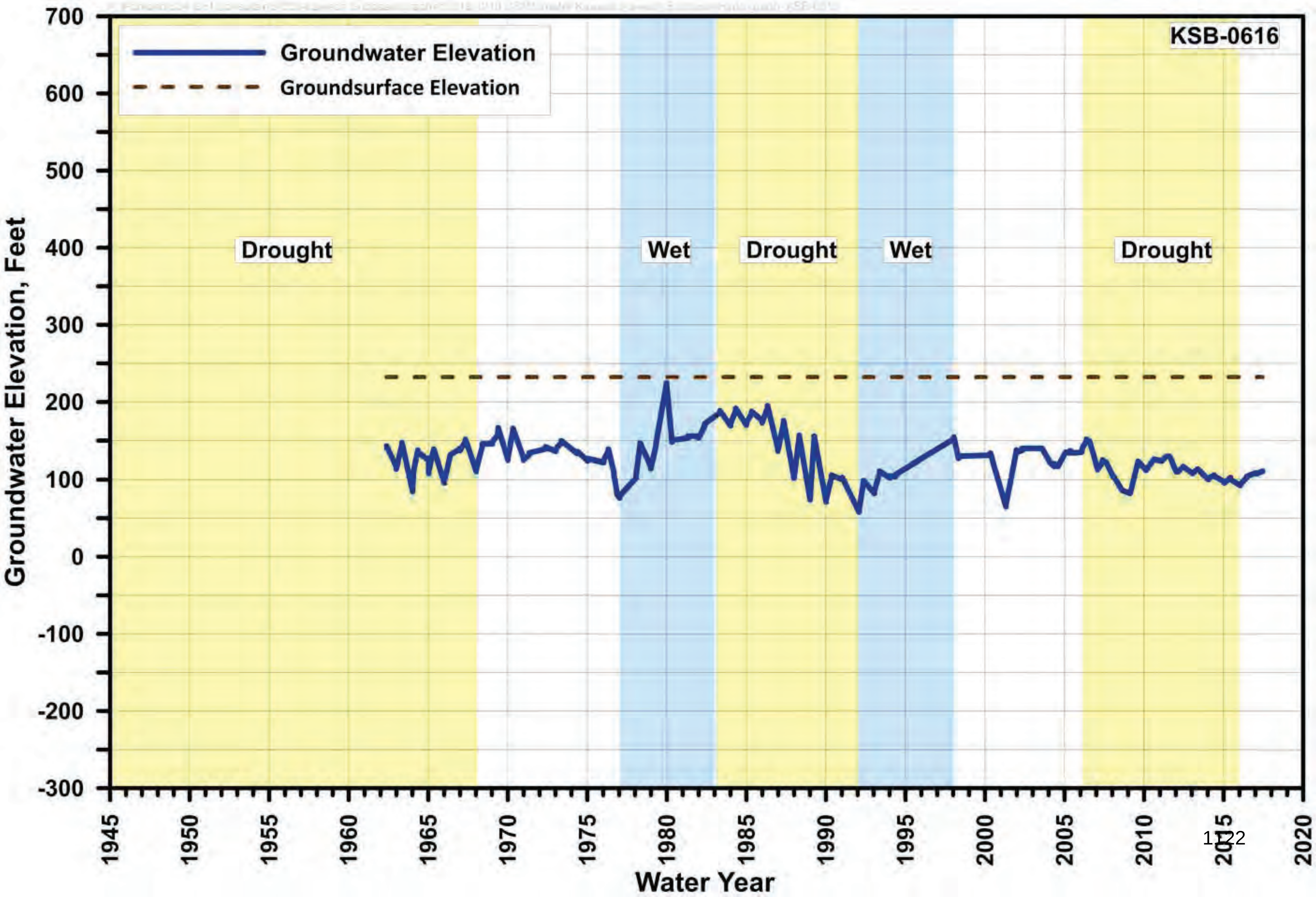


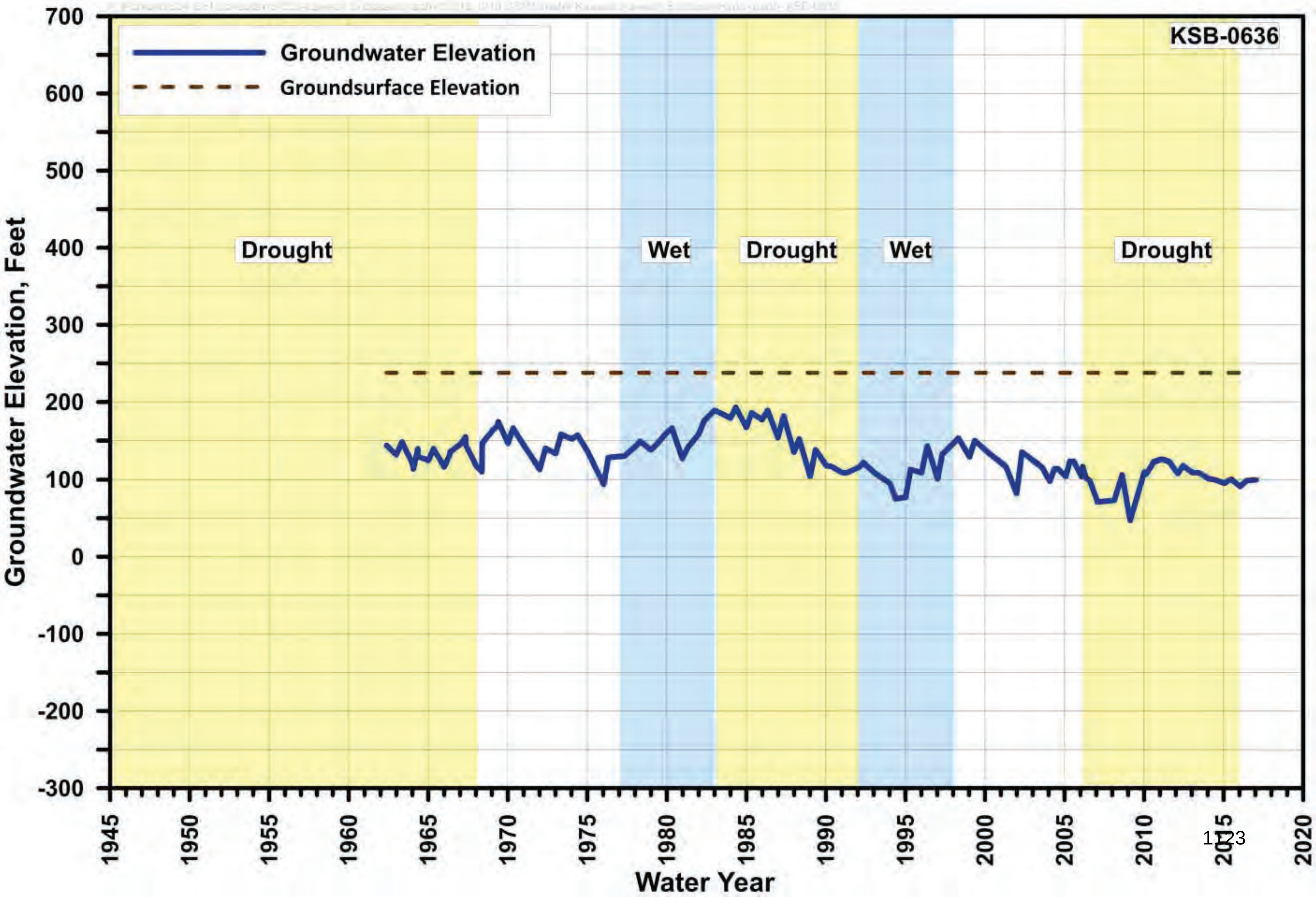
700
600
500
400
300
200
100
0
-100
-200
-300
Groundwater Elevation, Feet
Groundwater Elevation
Groundsurface Elevation
KSB-0533
Drought
Wet
Drought
Wet
Drought
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

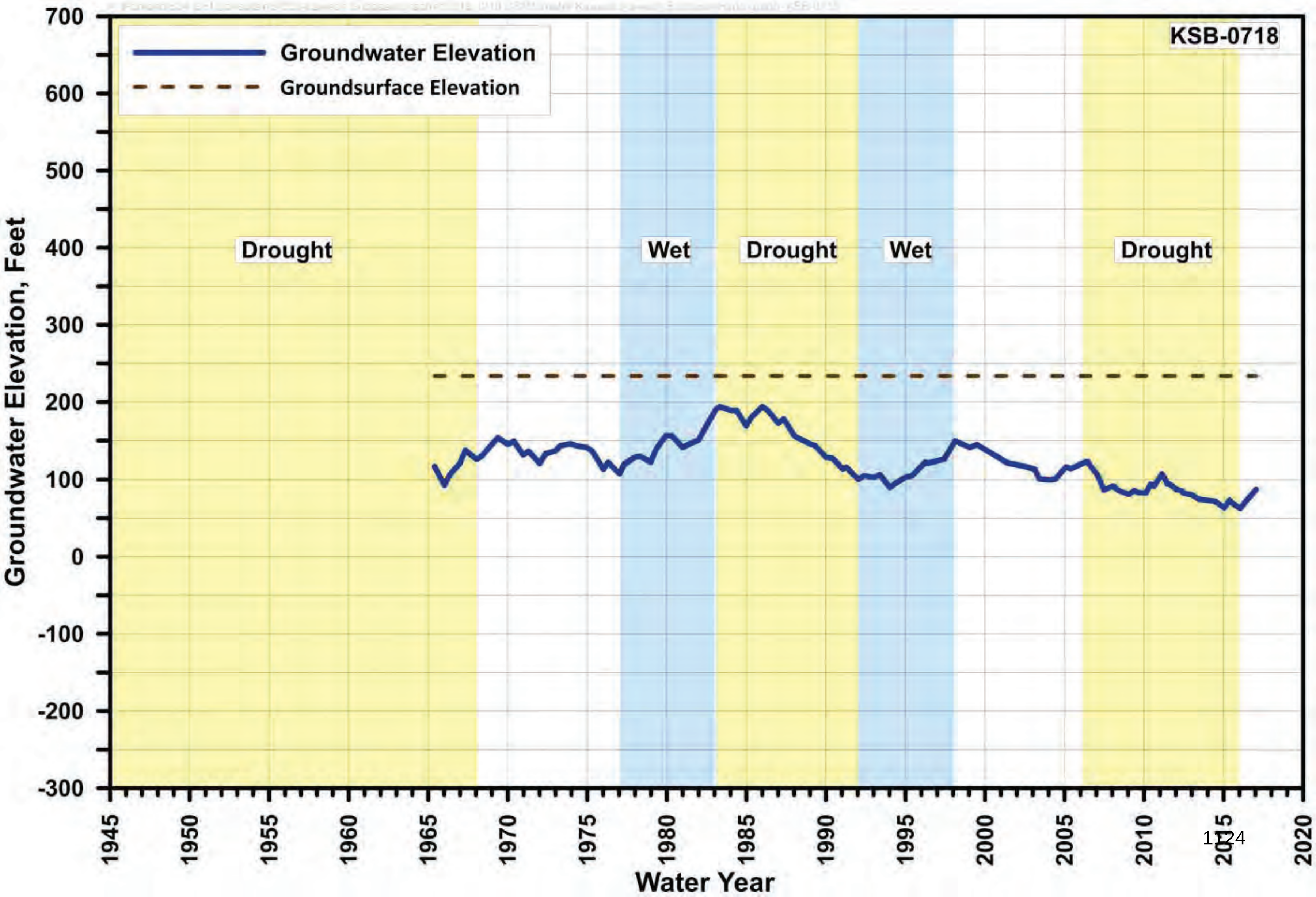

KSB-0550
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-0560
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

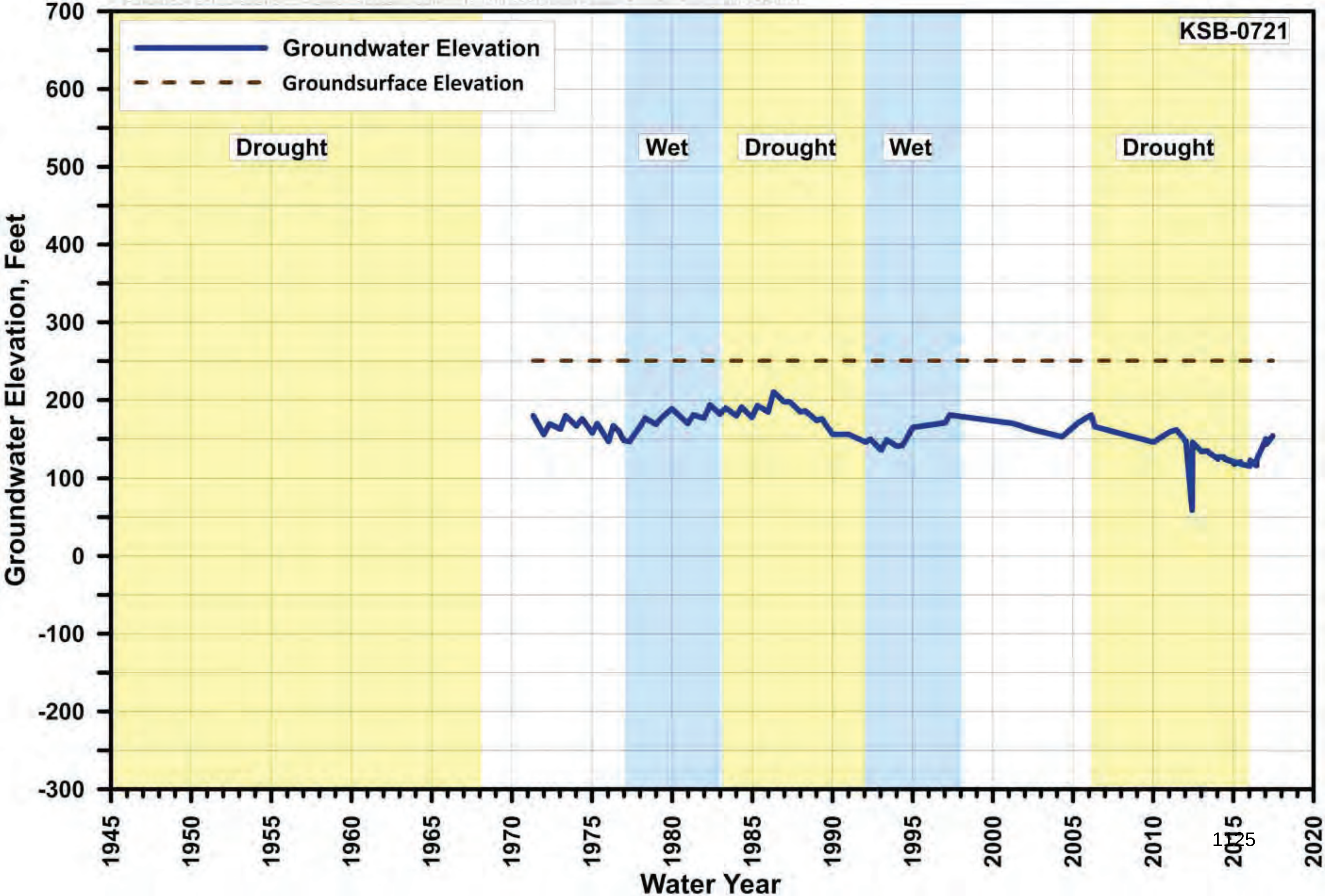

KSB-0561
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-0616
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

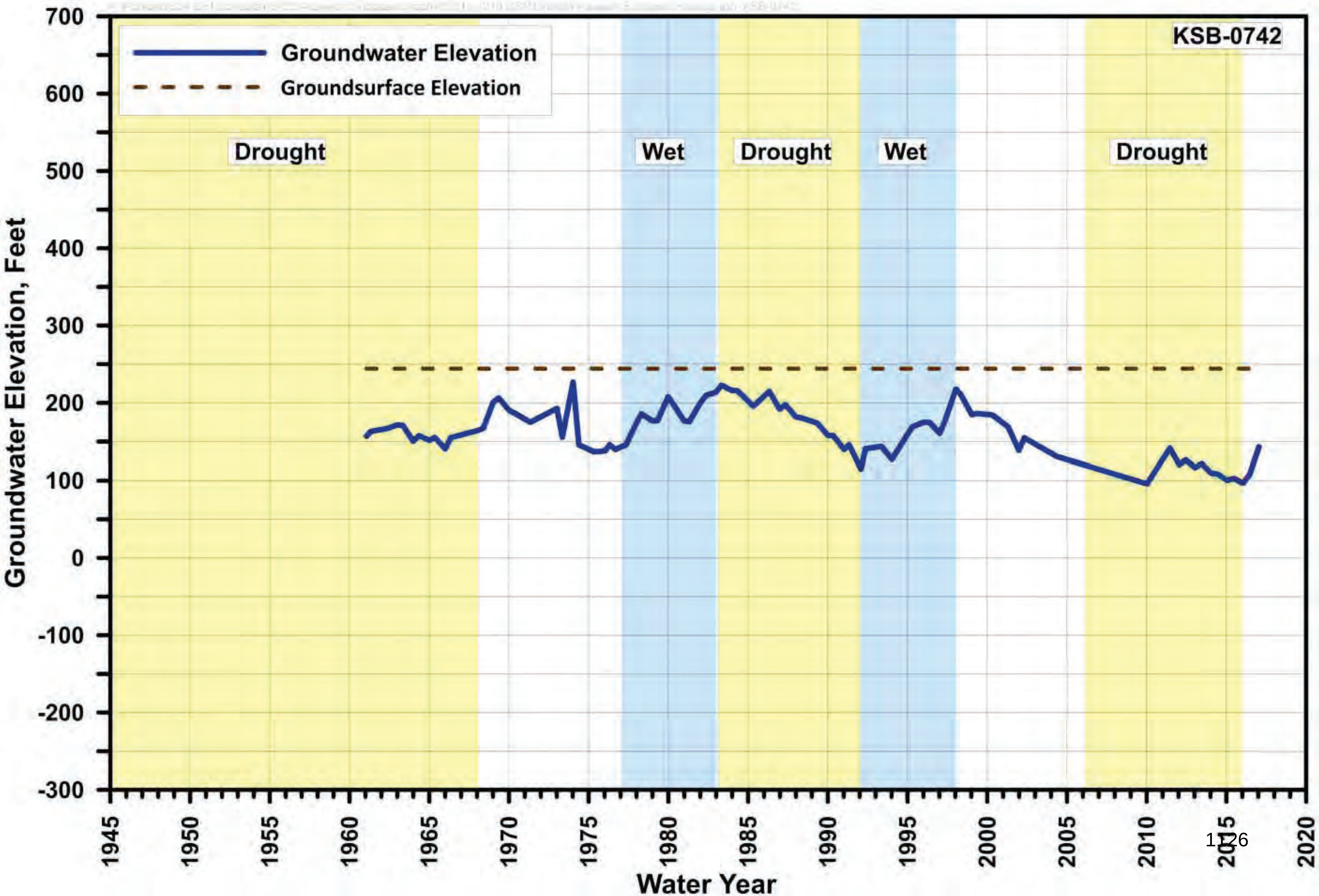

KSB-0636
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

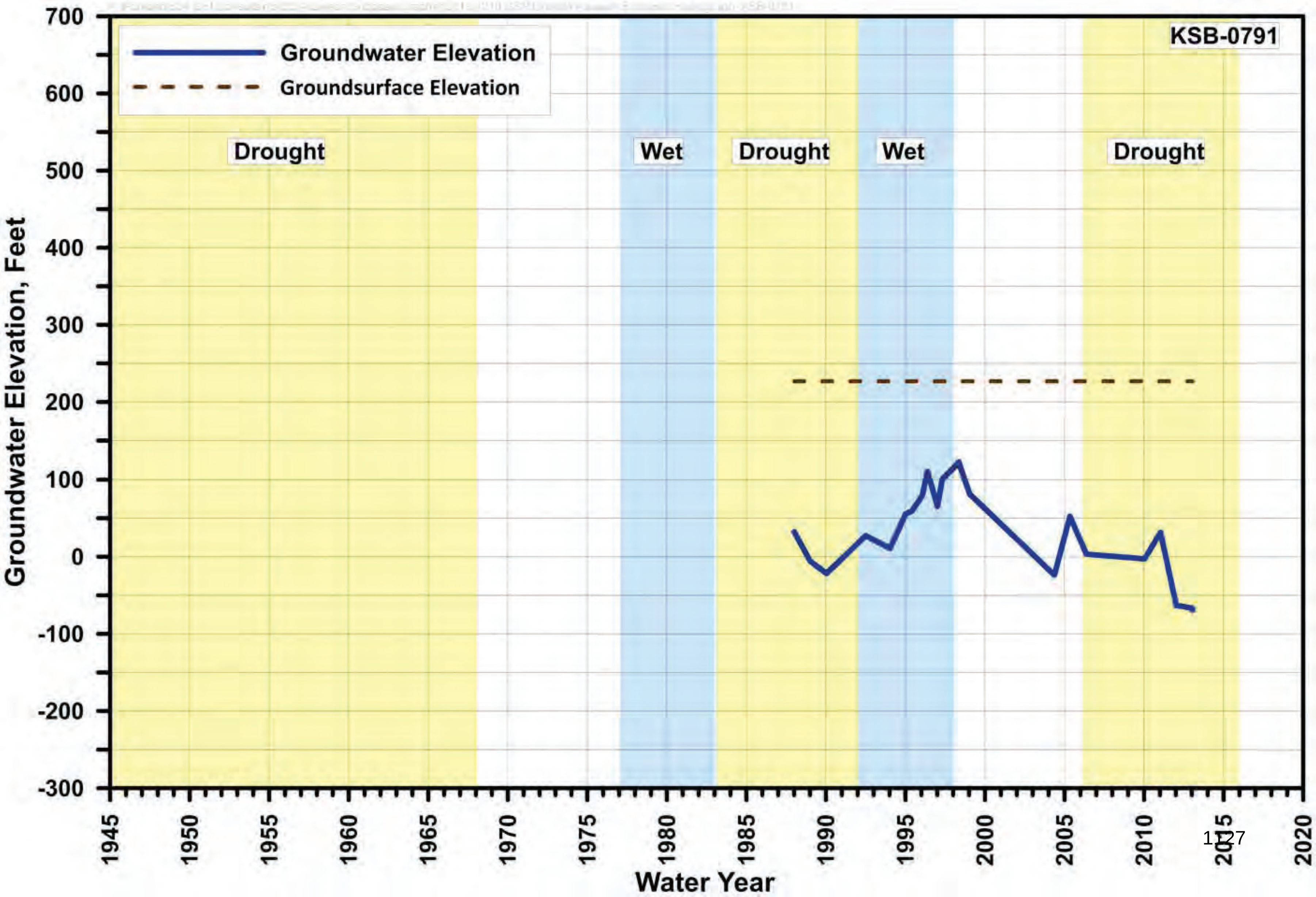


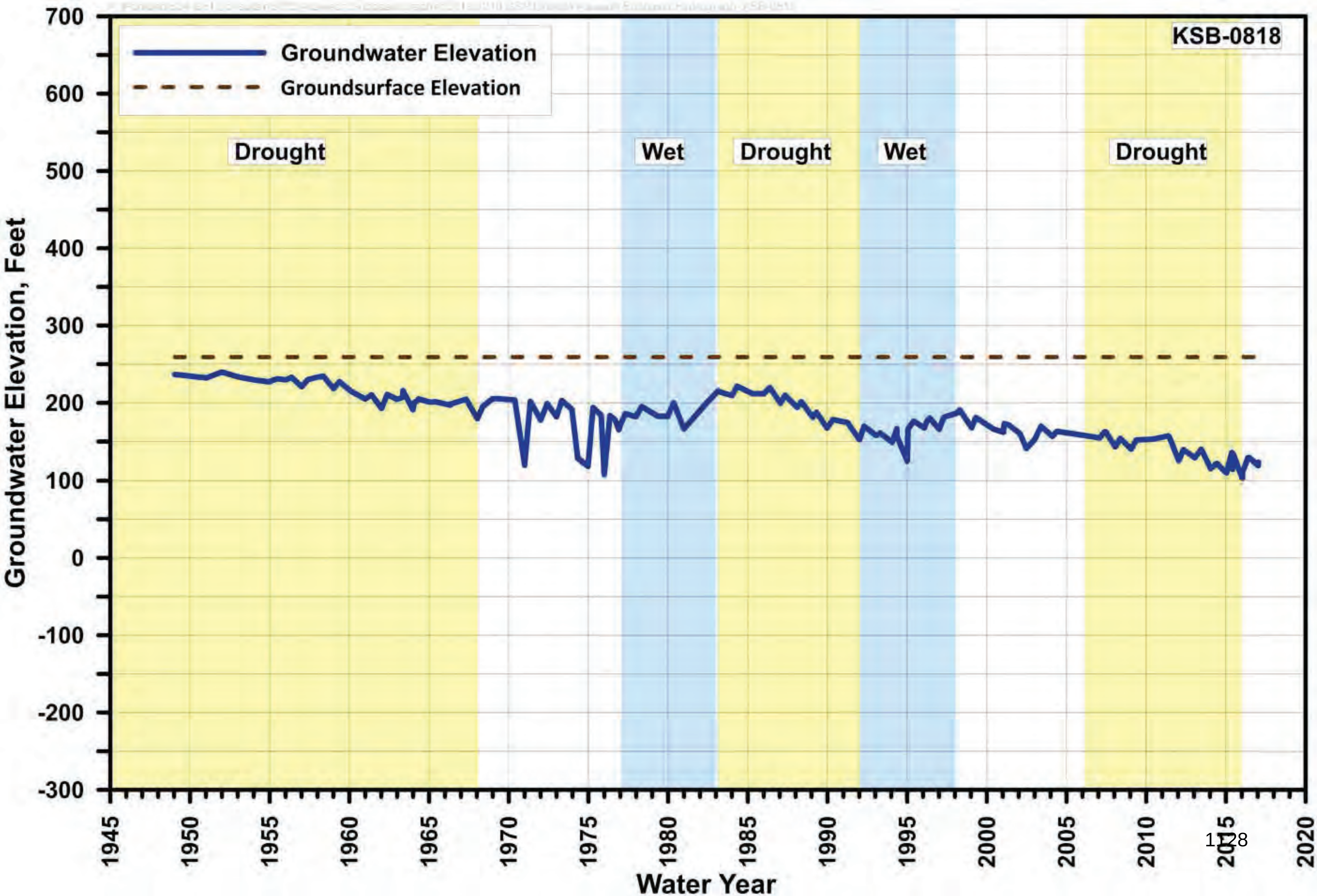
KSB-0718
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



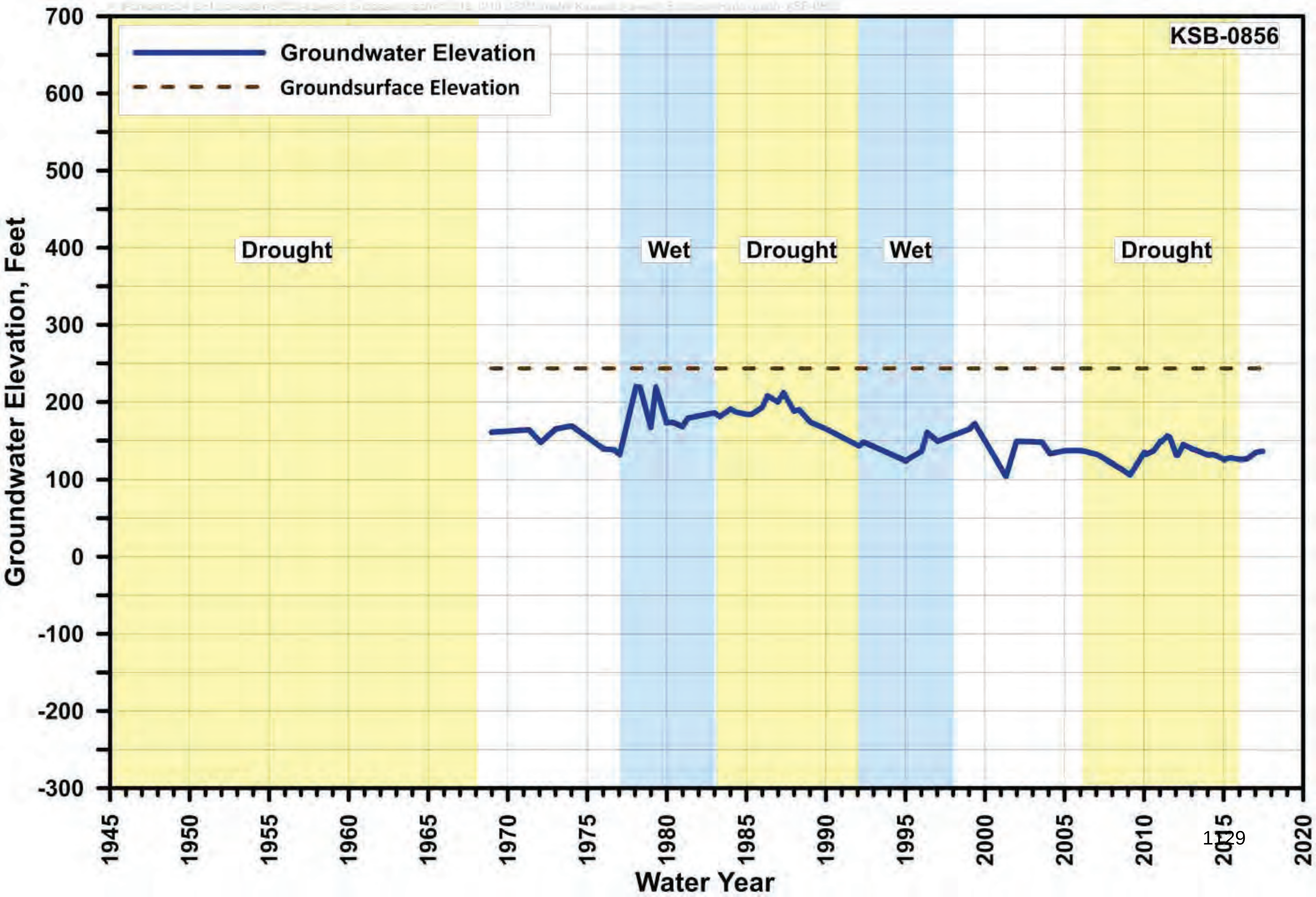
KSB-0721
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

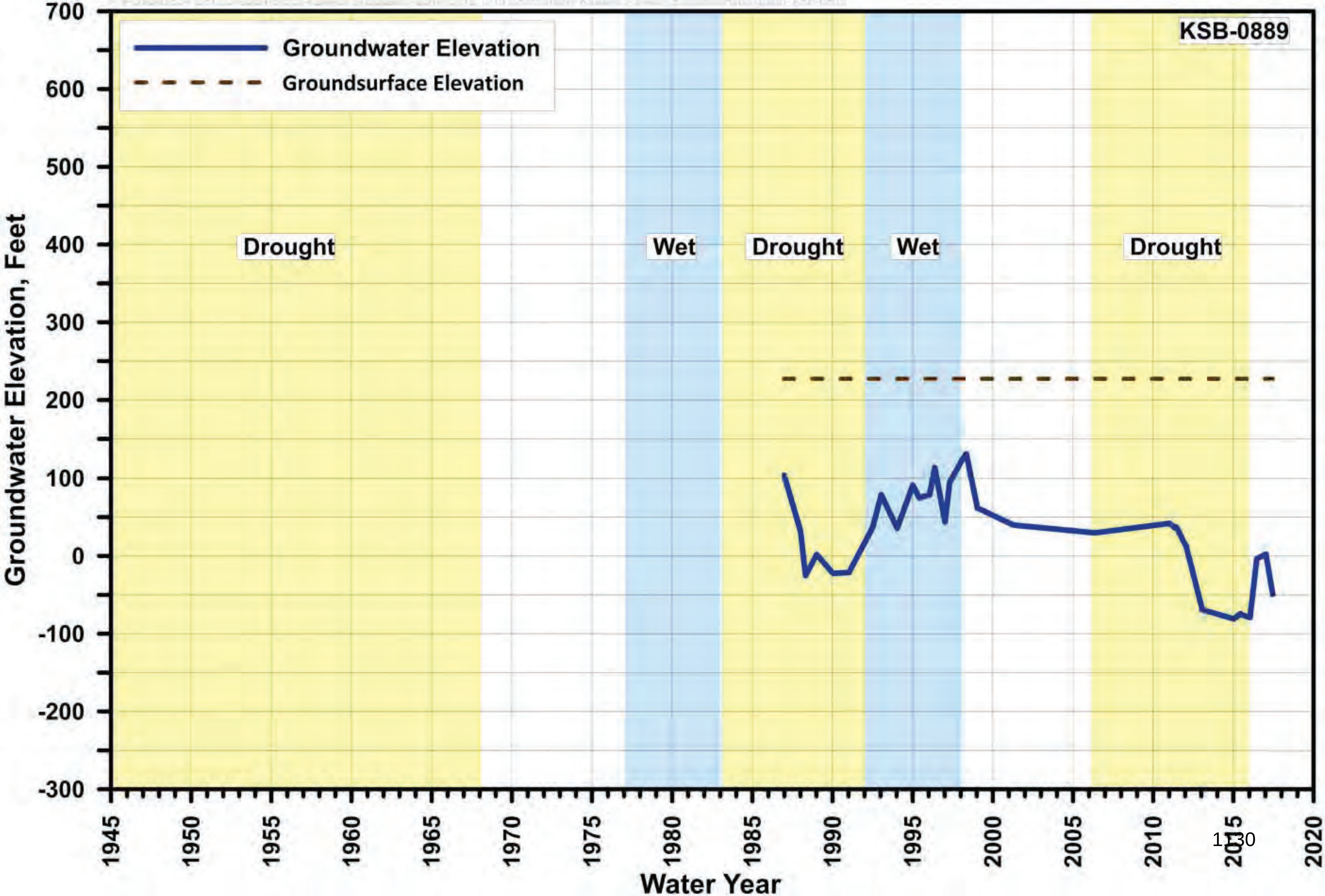

KSB-0742
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

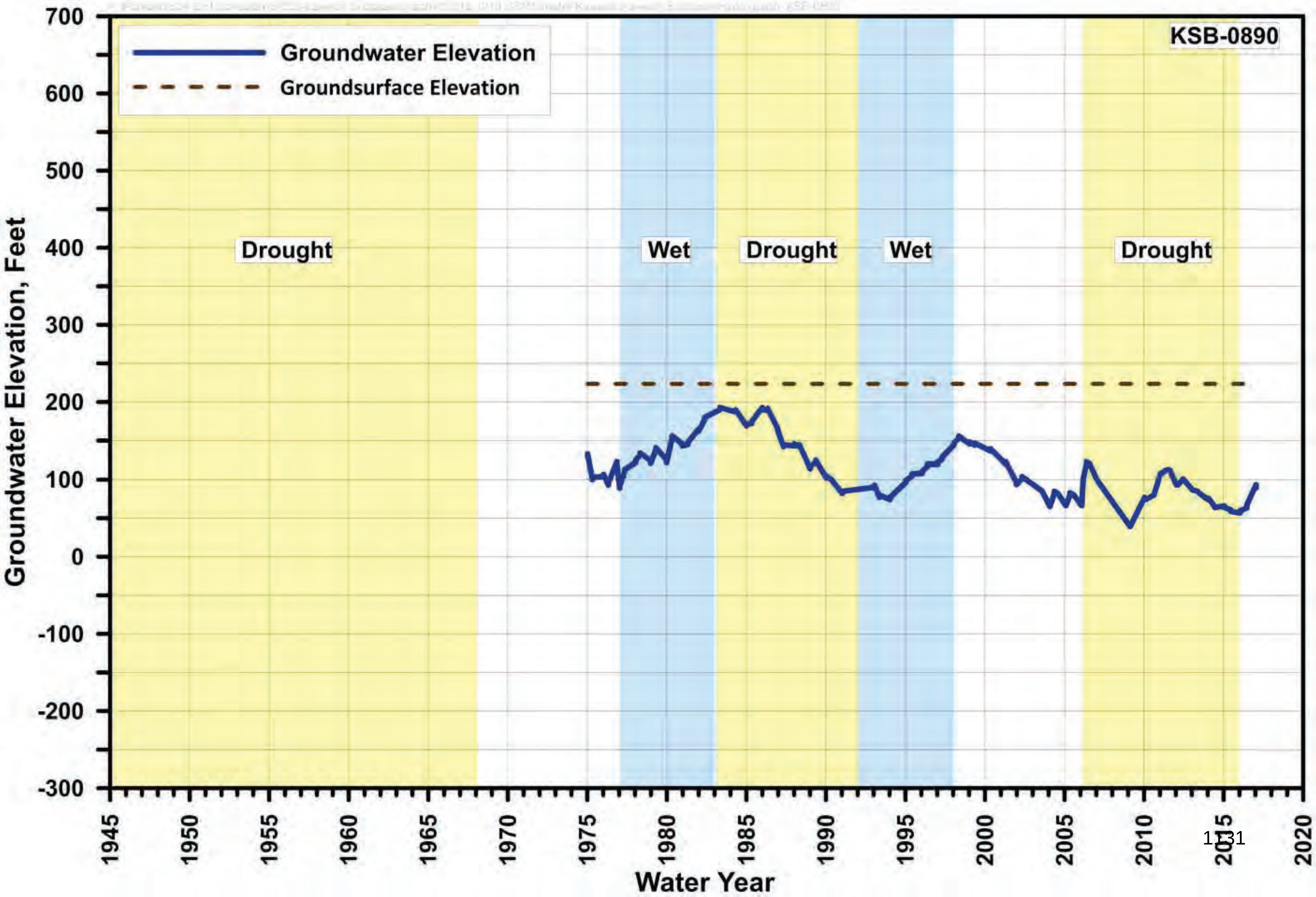

KSB-0791
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



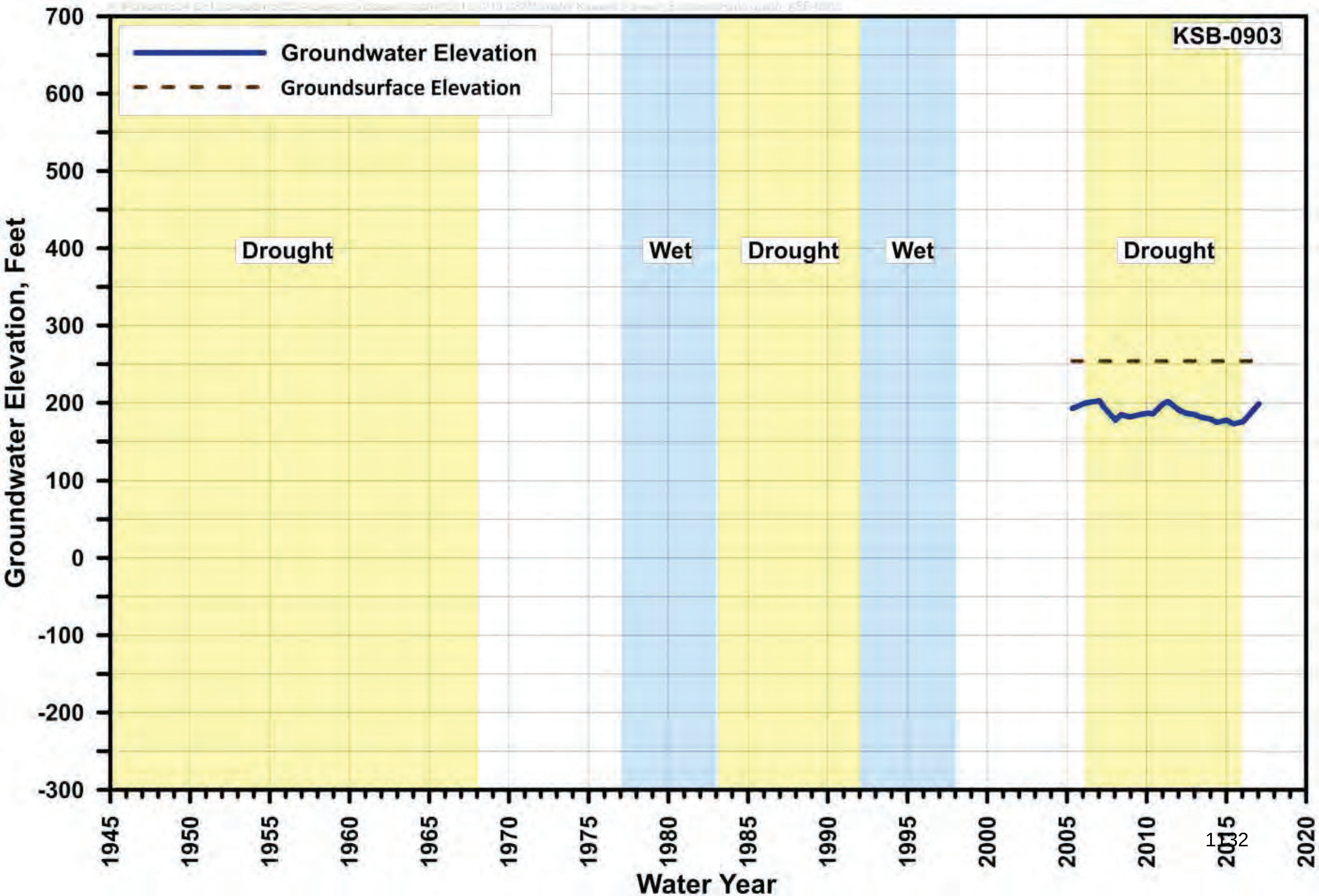
KSB-0818
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

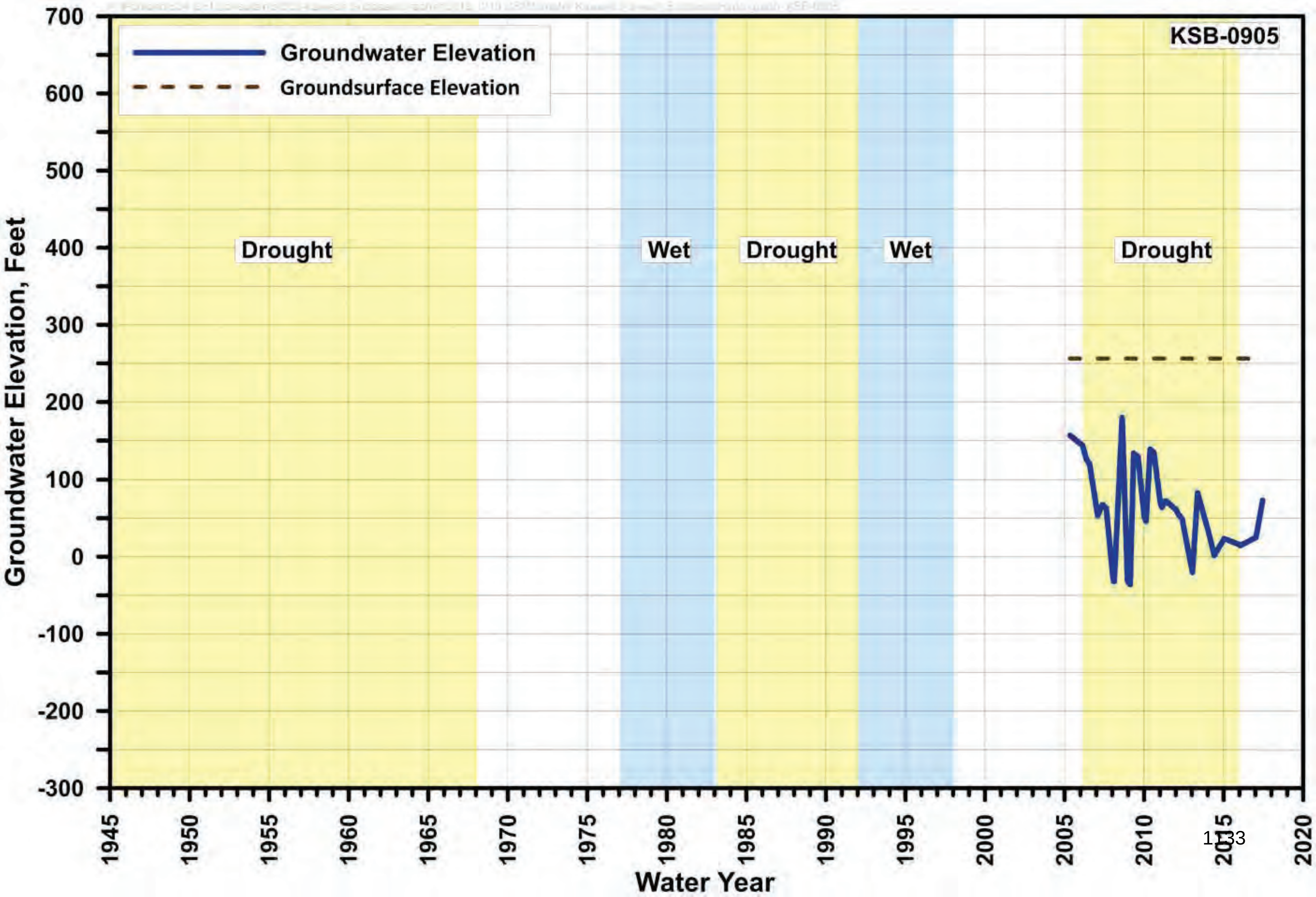

KSB-0856
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

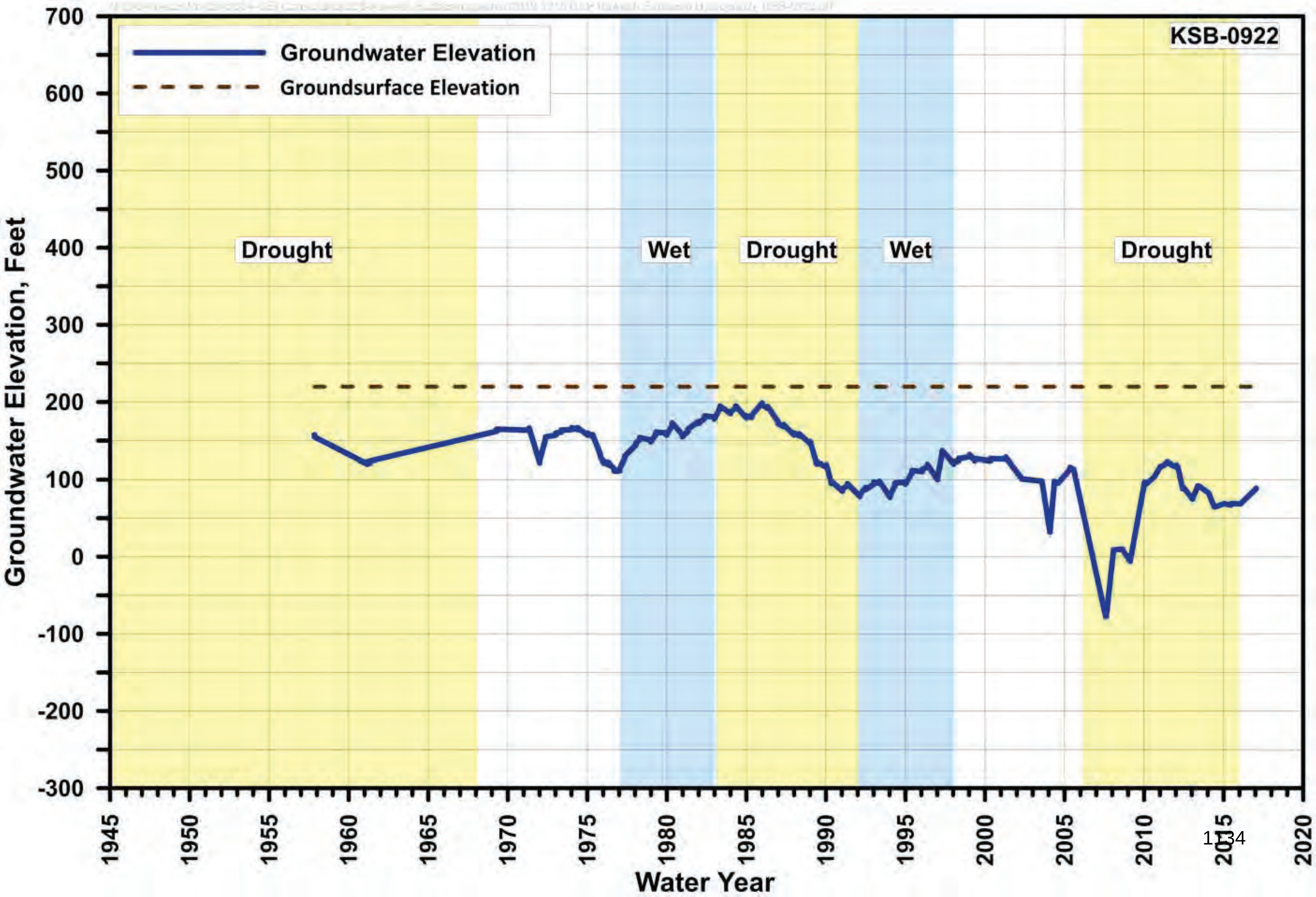

KSB-0889
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

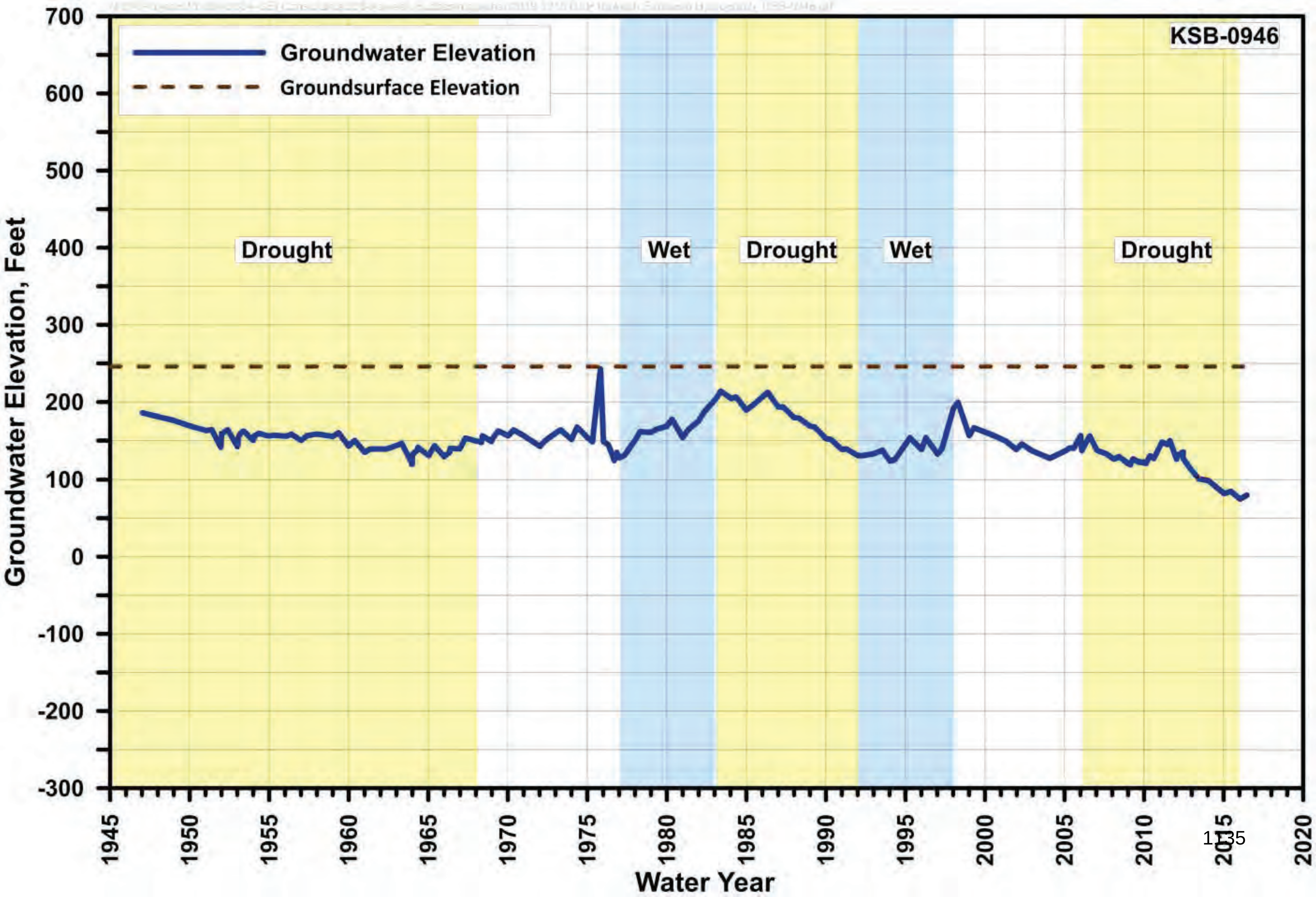


KSB-0890
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

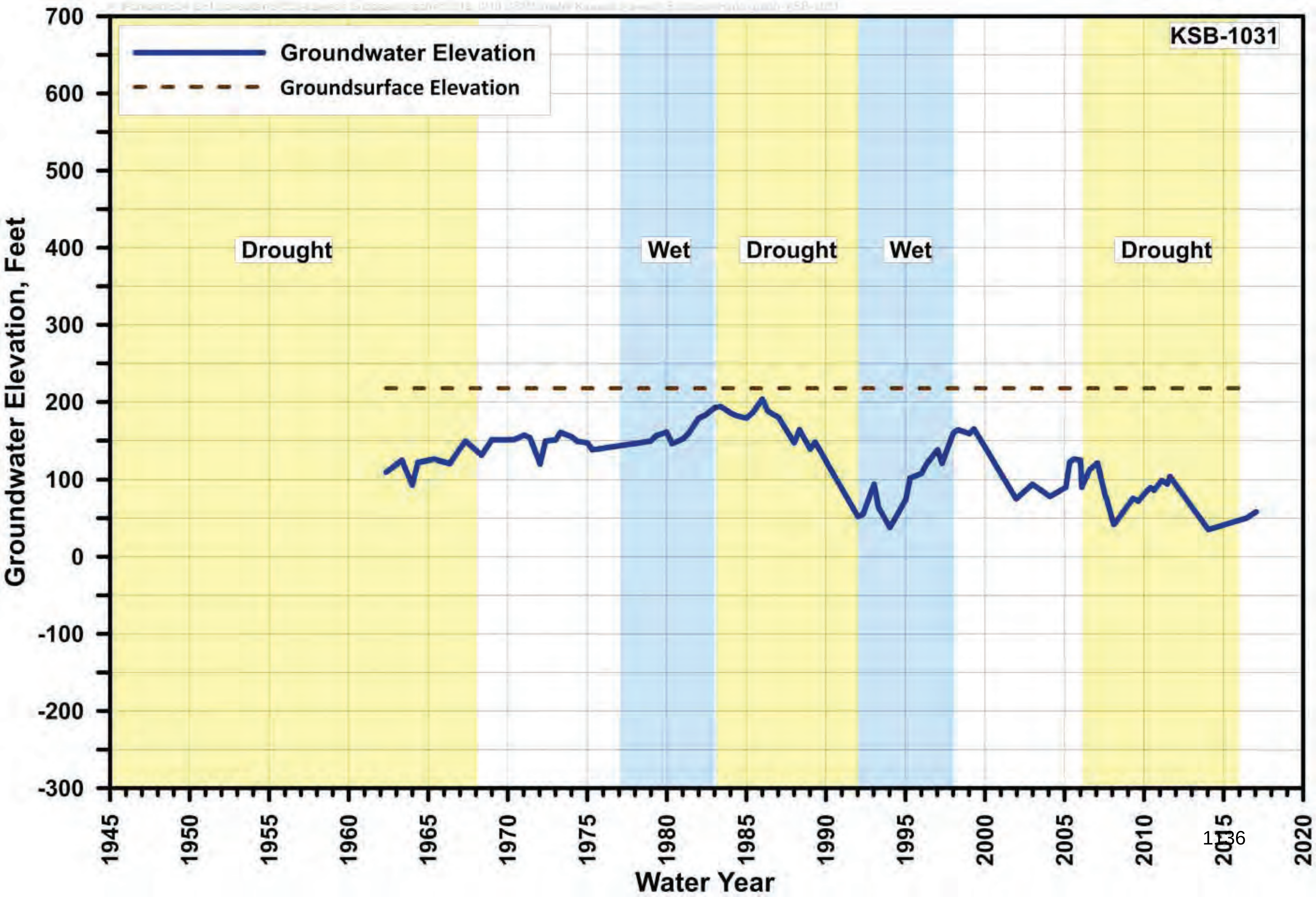

KSB-0903
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-0905
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

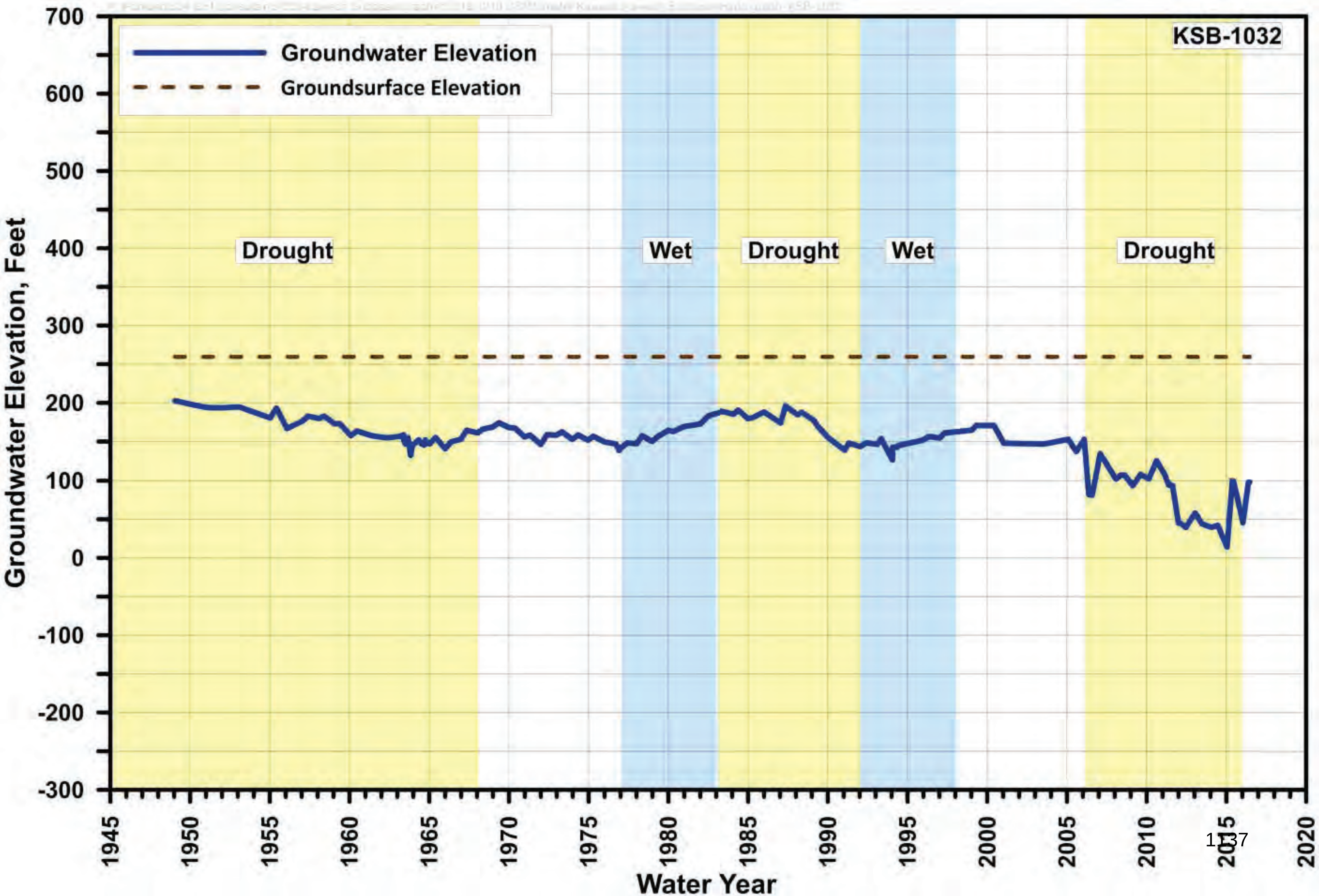

KSB-0922
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

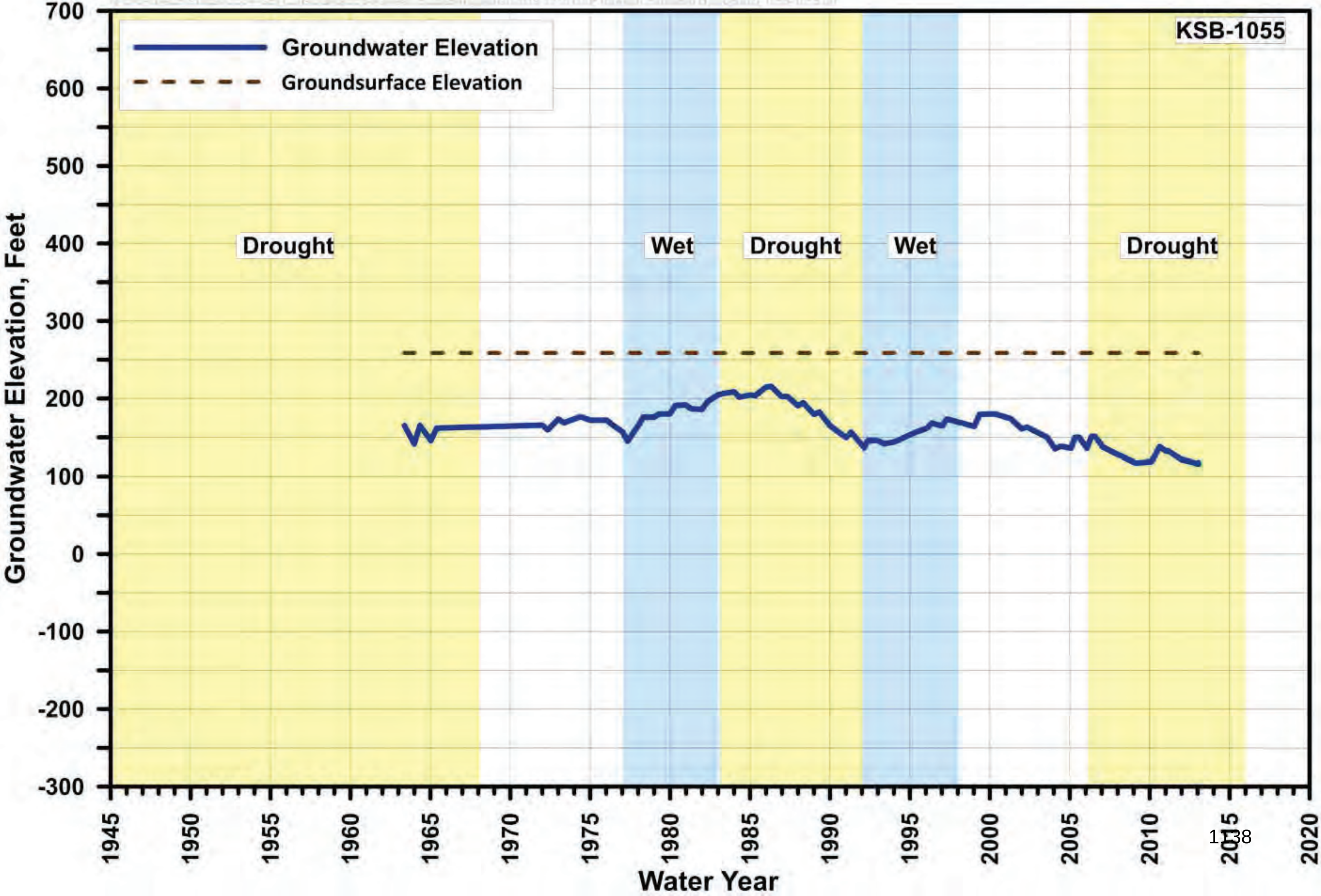


KSB-0946
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

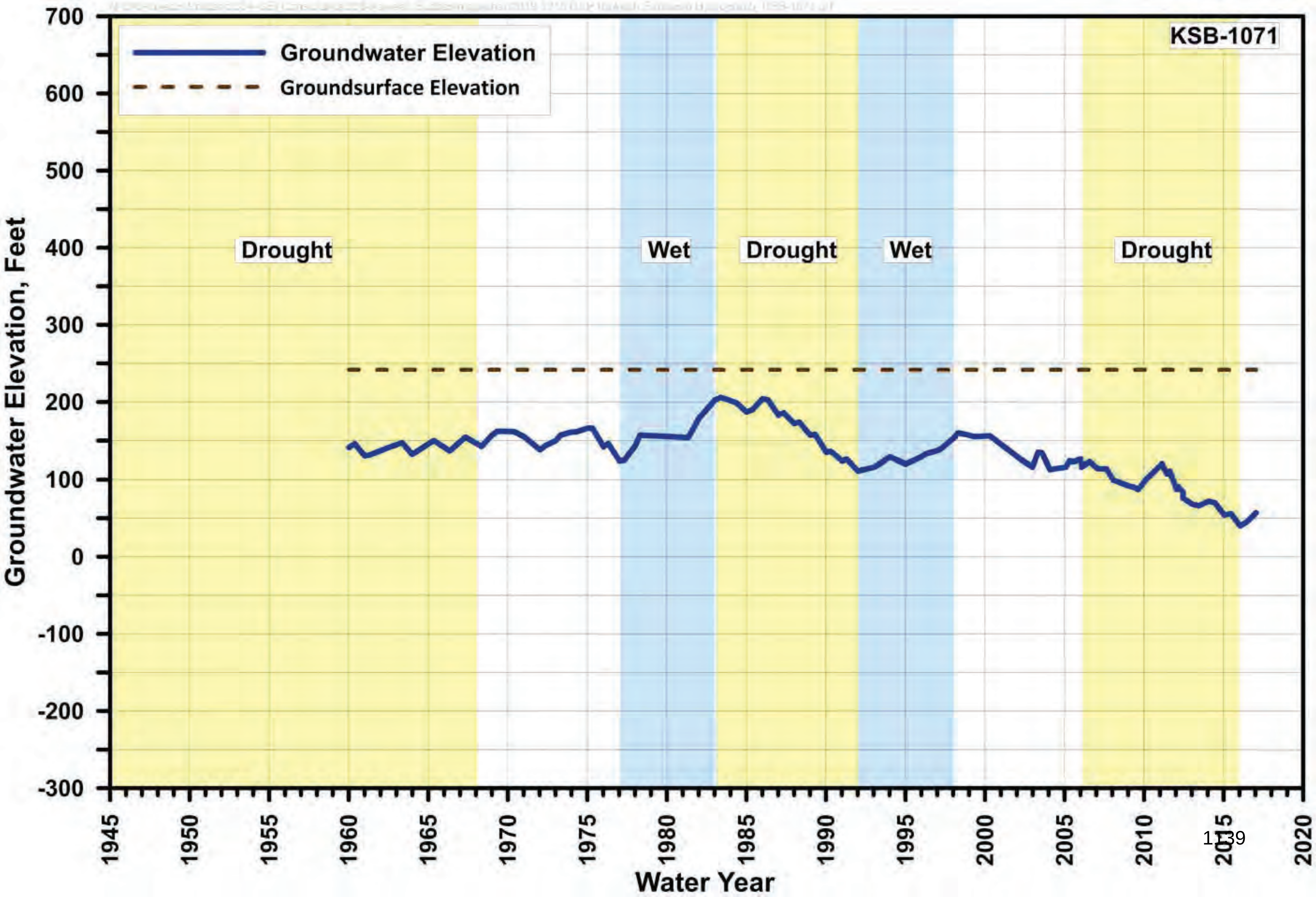


KSB-1031
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

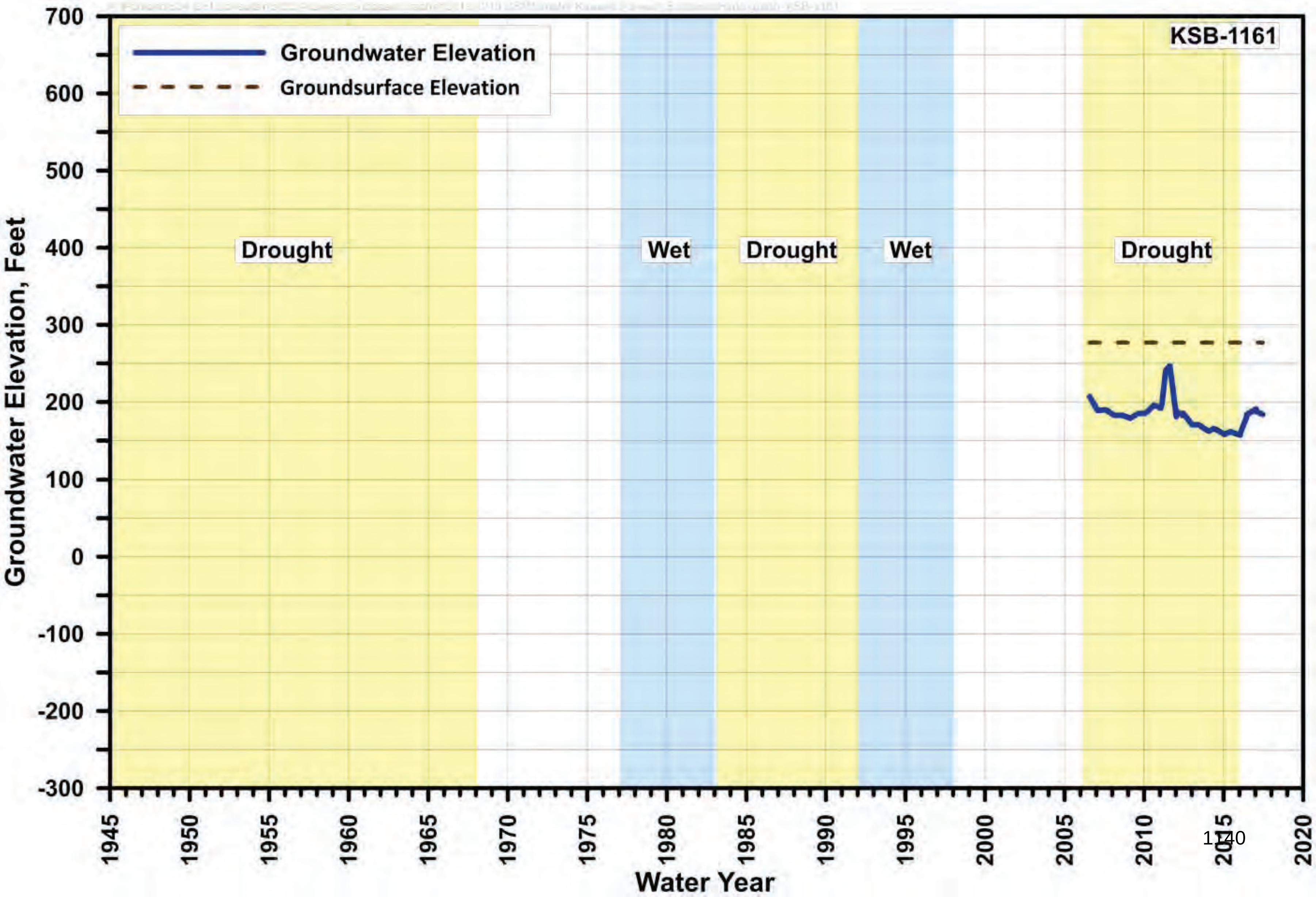

KSB-1032
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

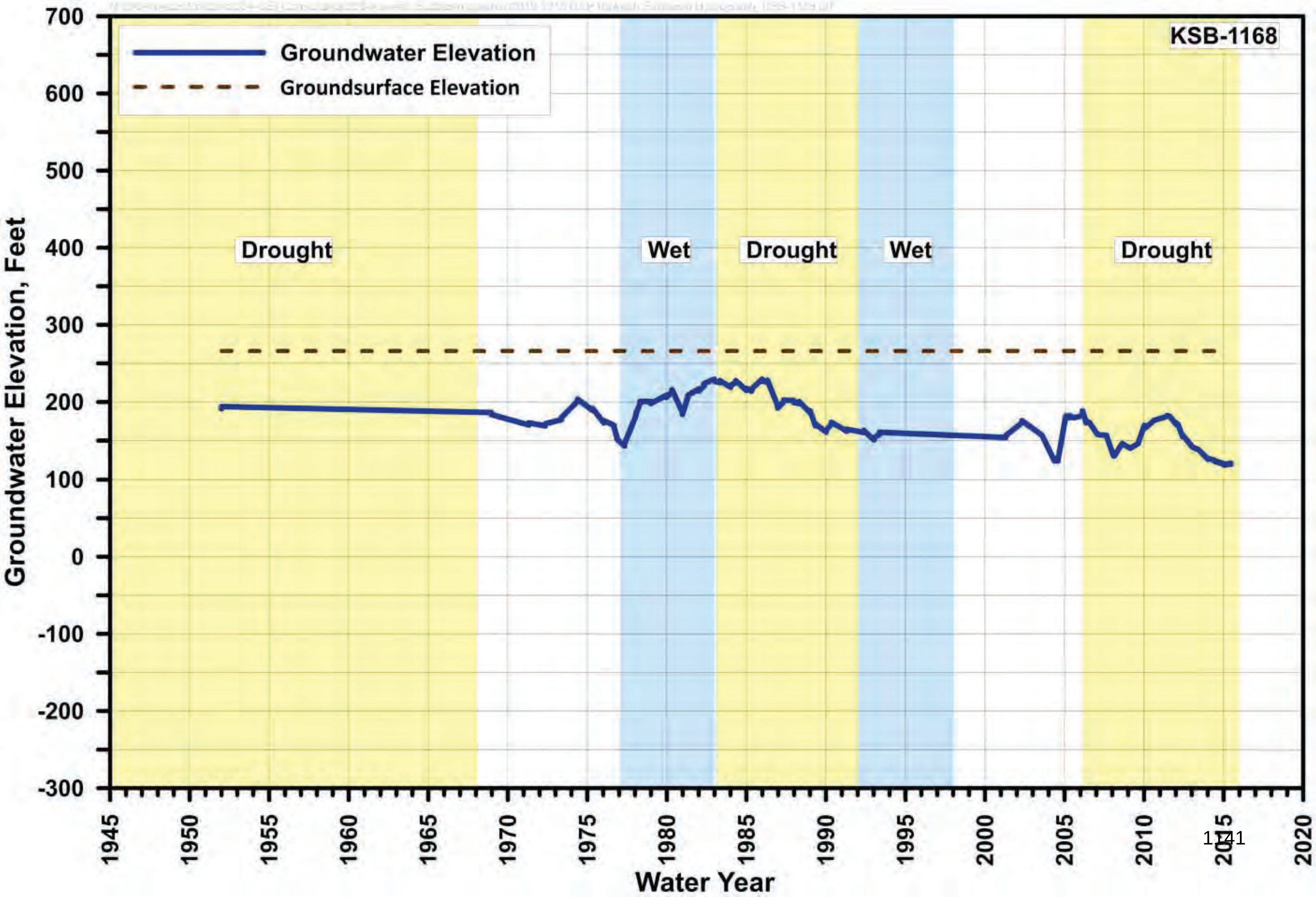


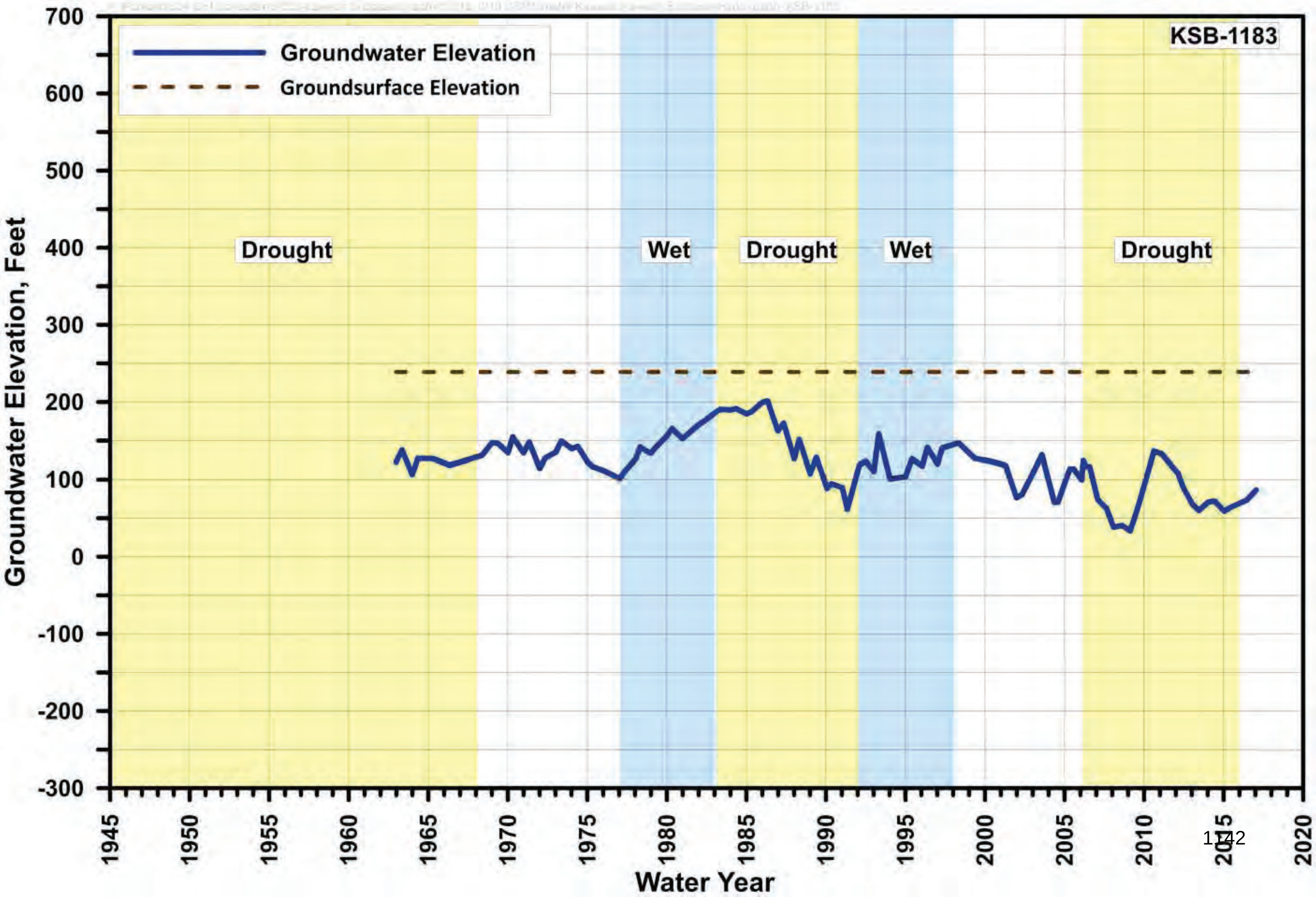
KSB-1055
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020



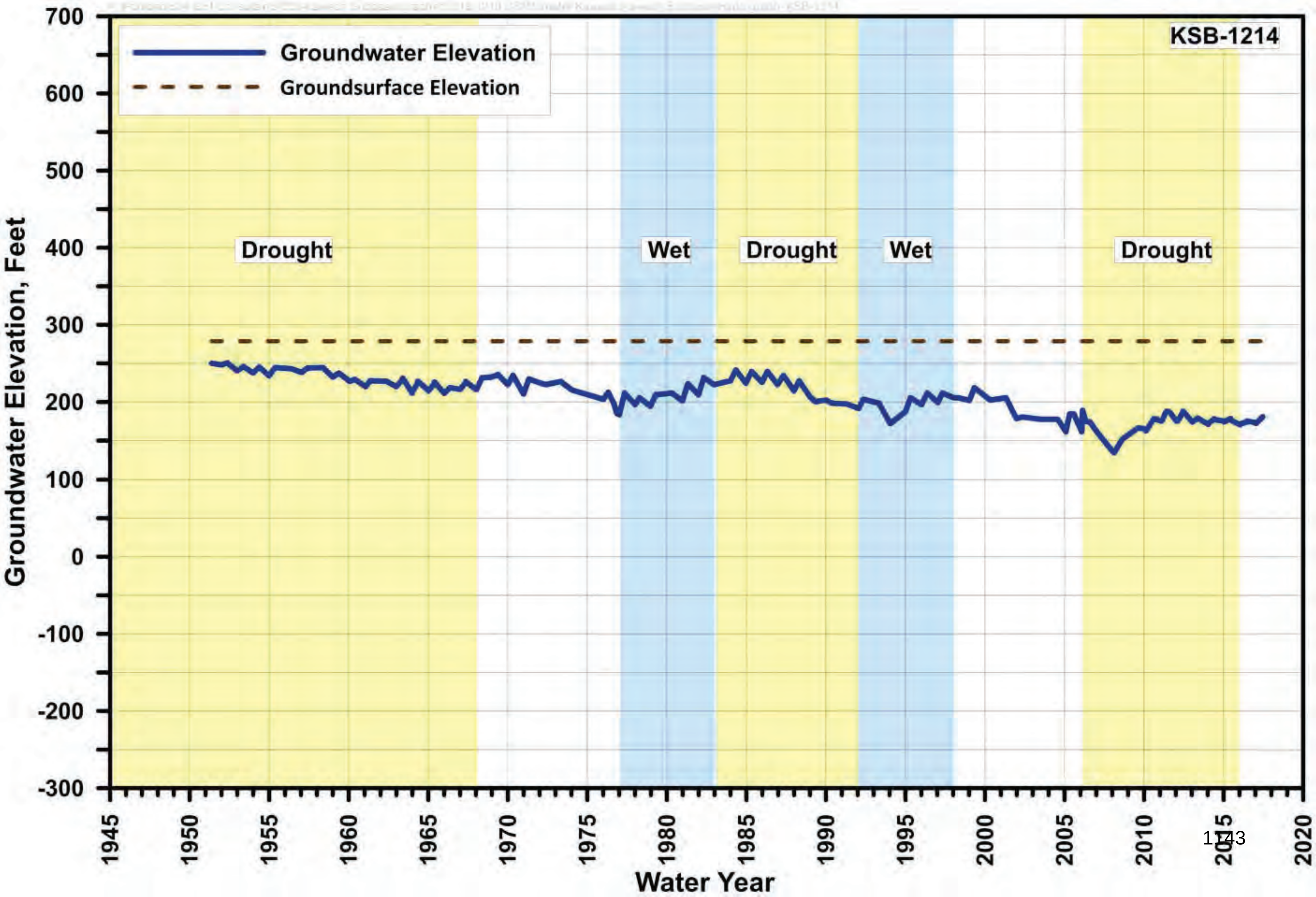
KSB-1071
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1161
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

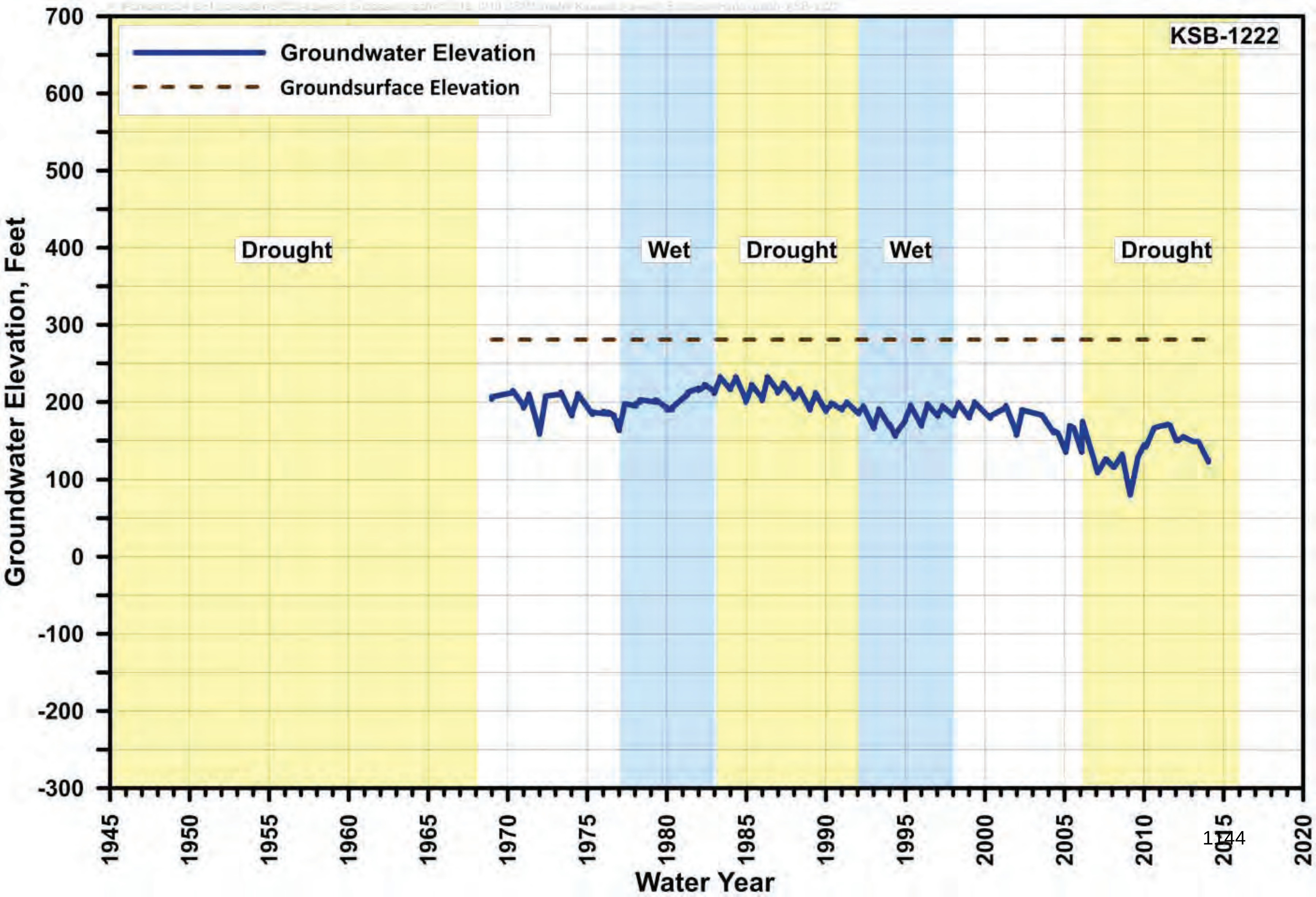

KSB-1168
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

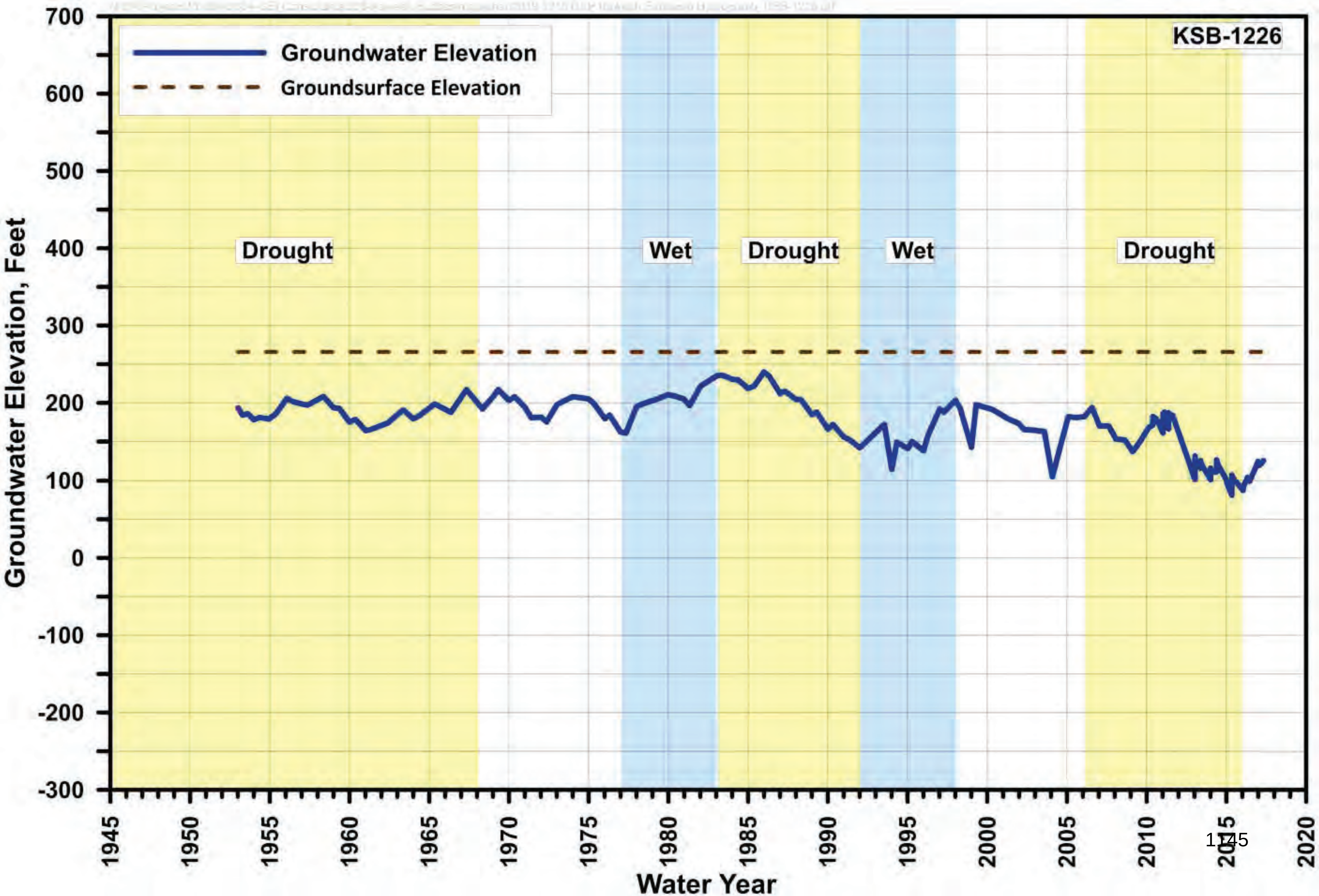


KSB-1183
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

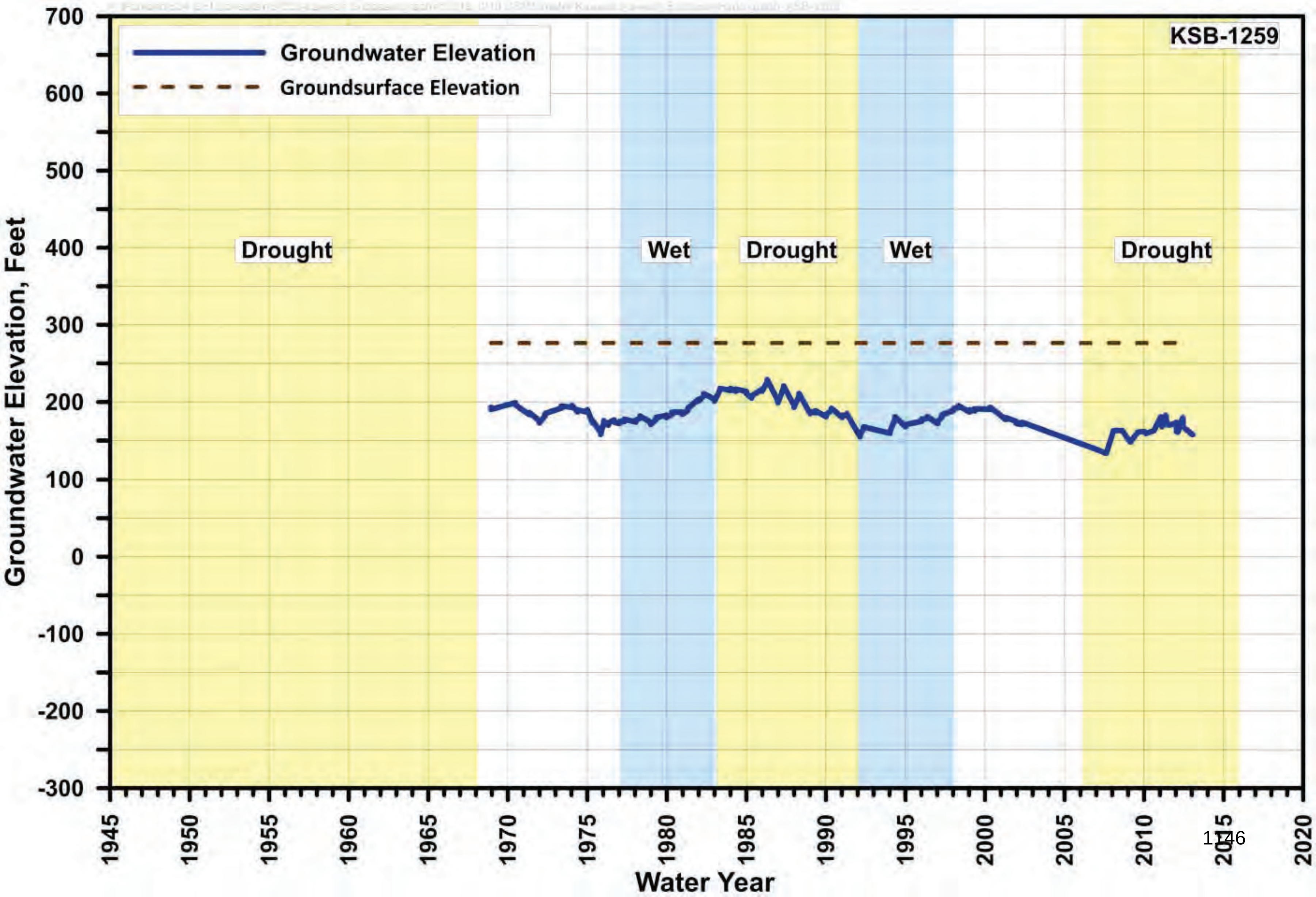


KSB-1214
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

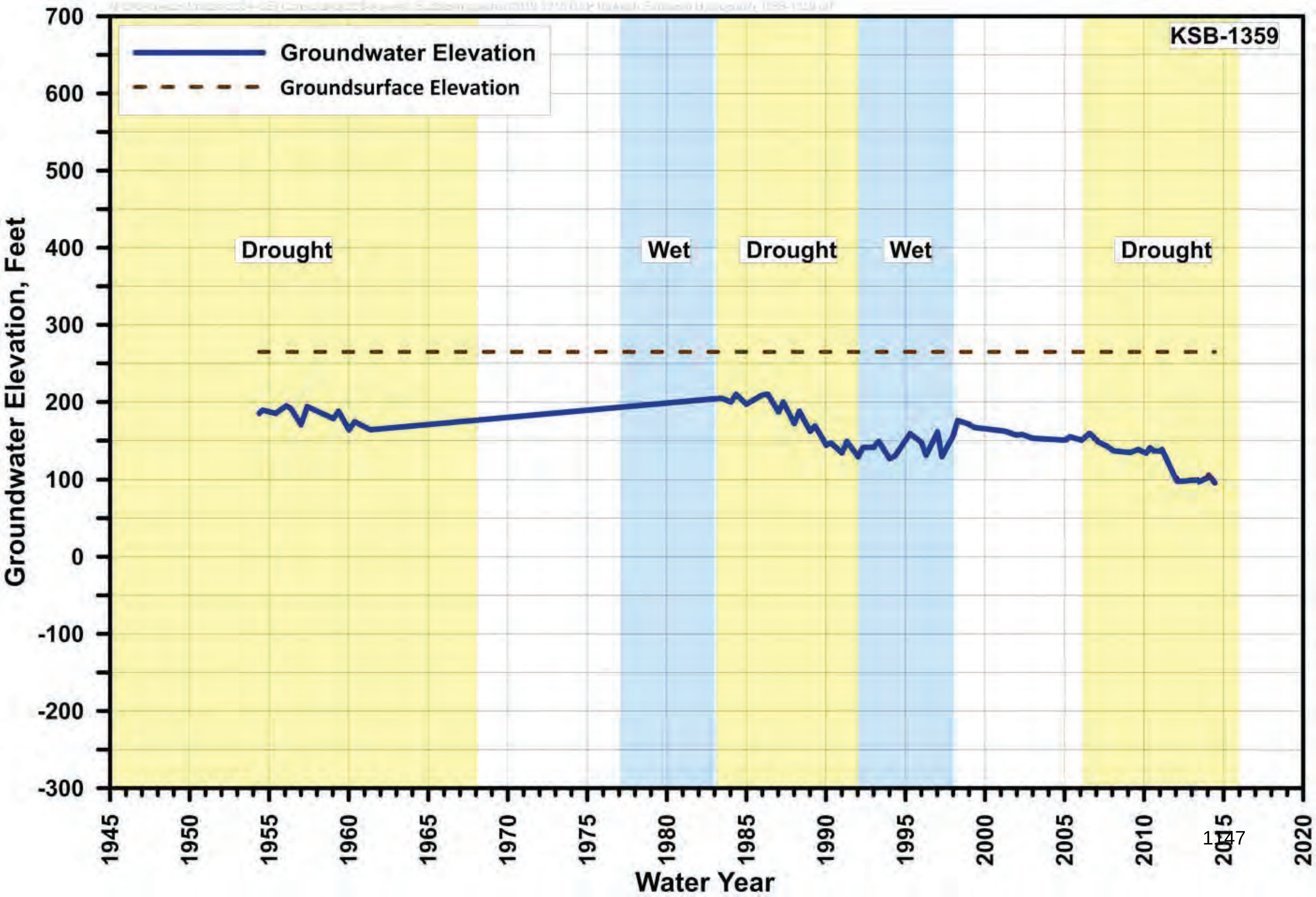

KSB-1222
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

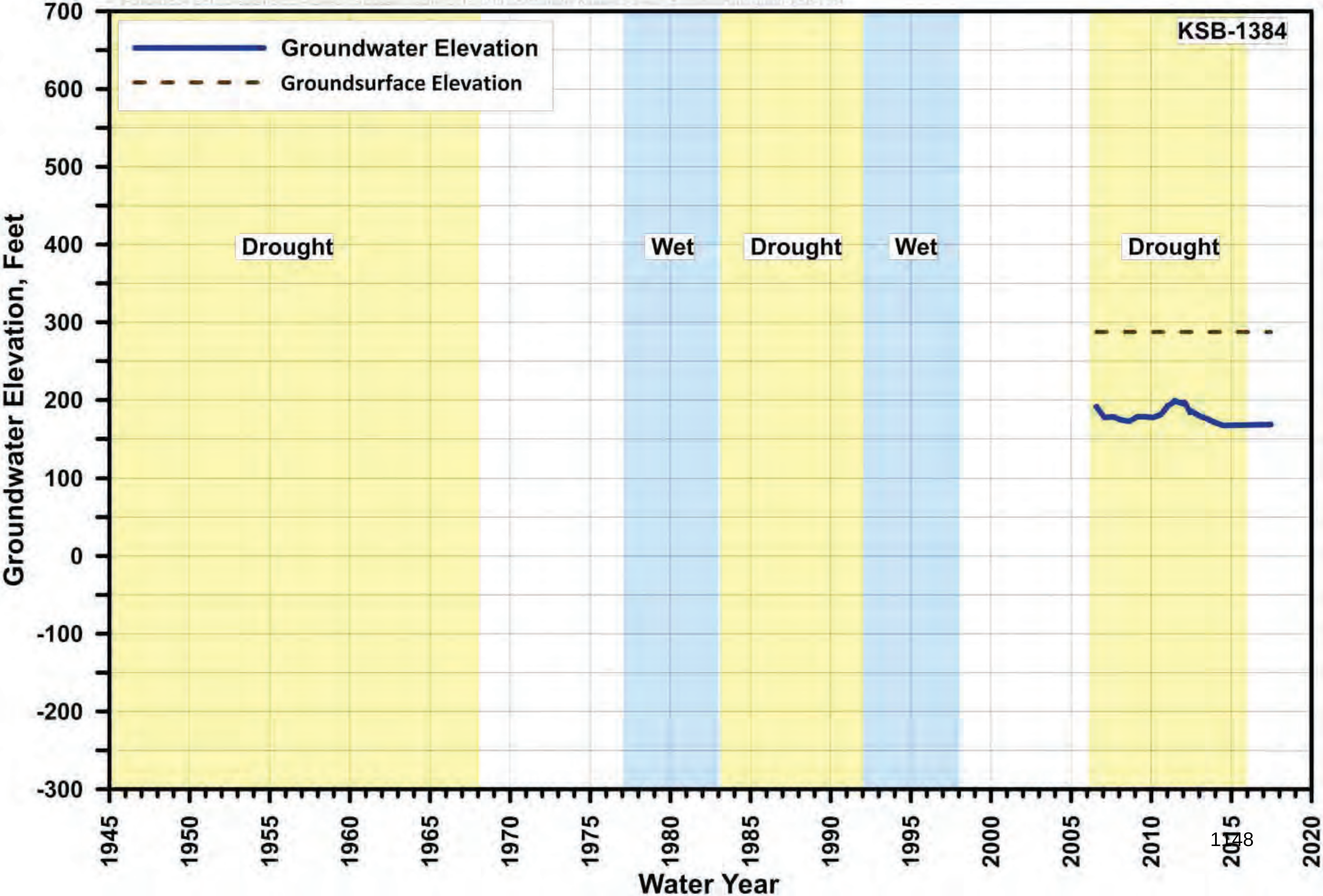


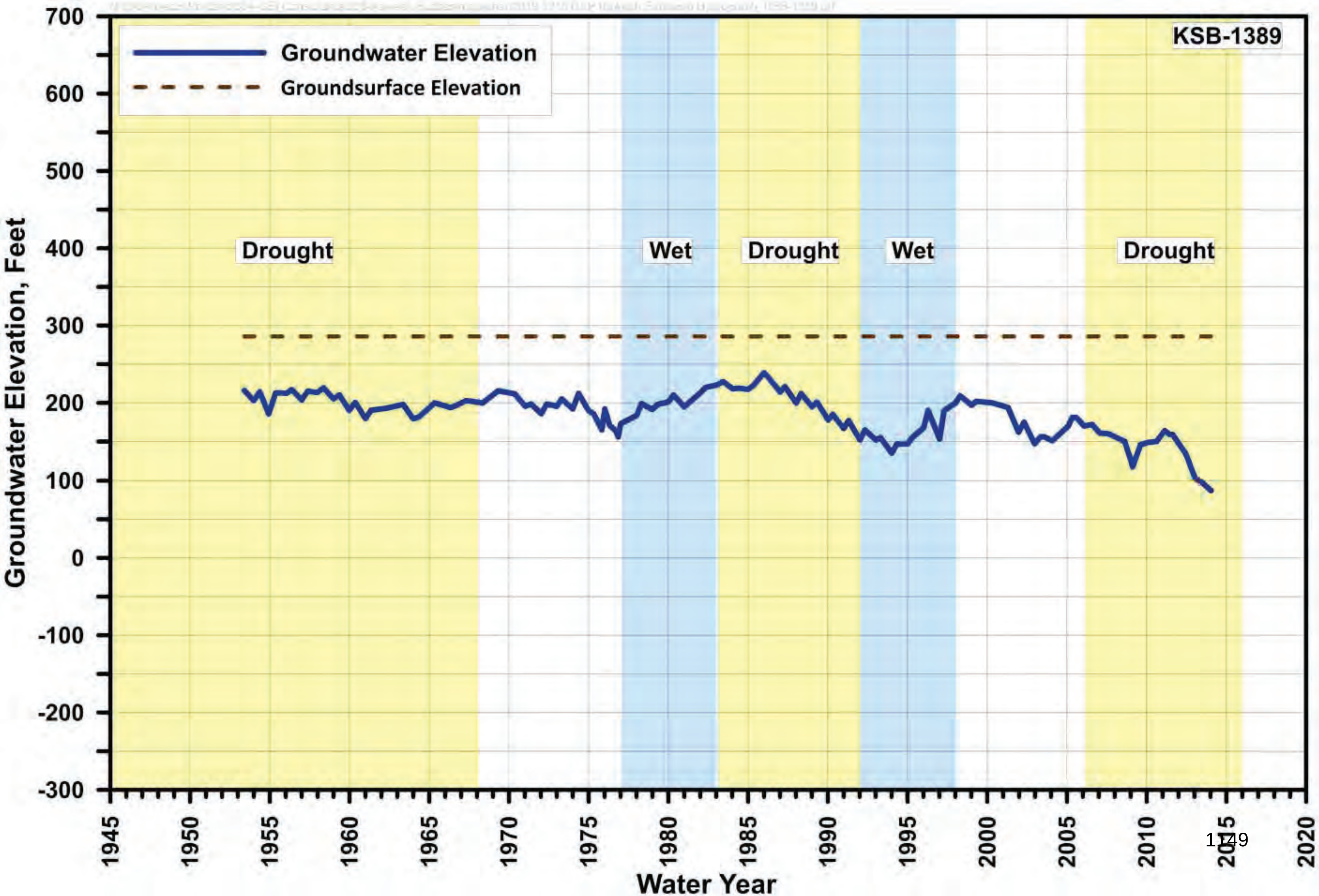
KSB-1226
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



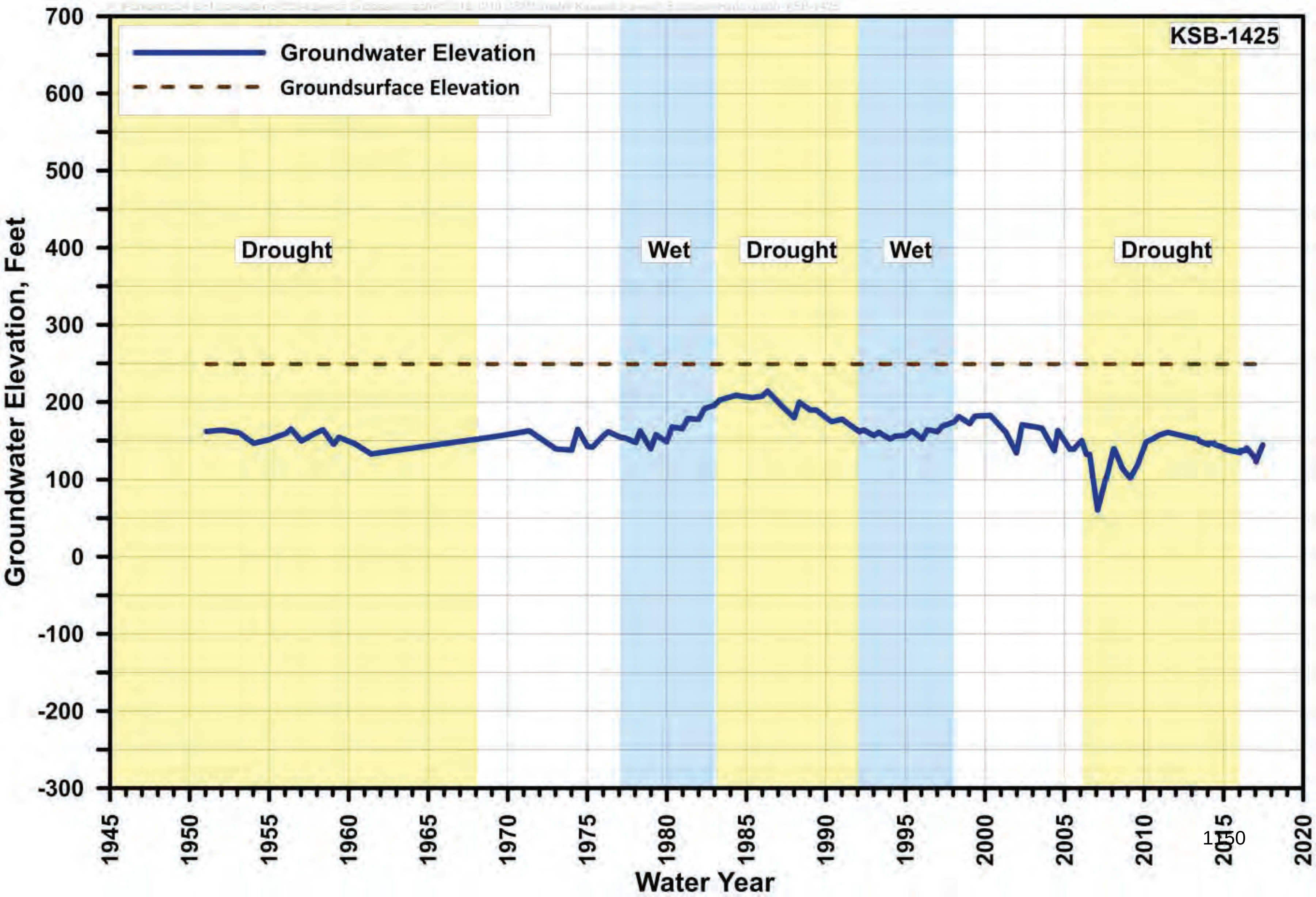
KSB-1259
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1359
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

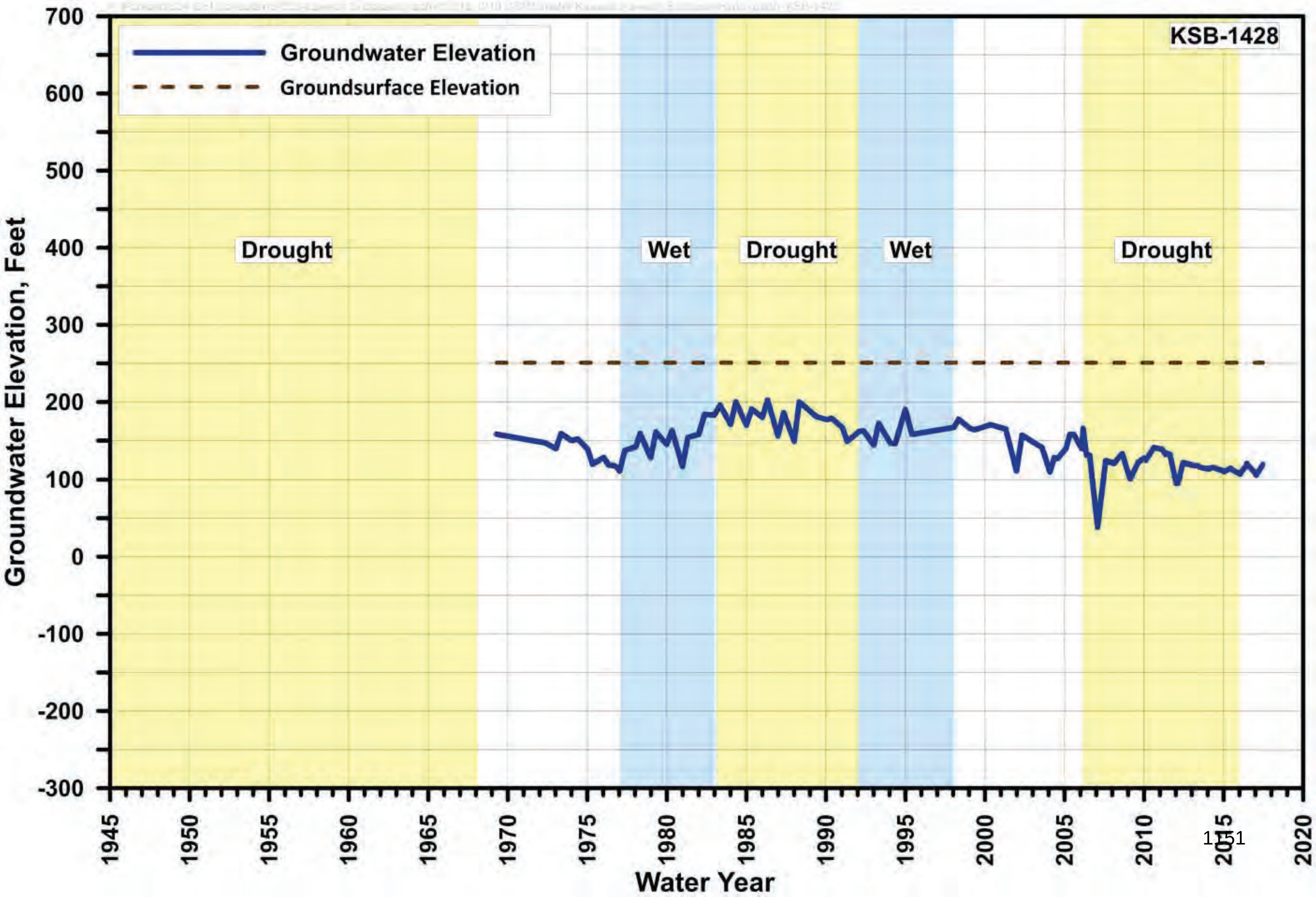

KSB-1384
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

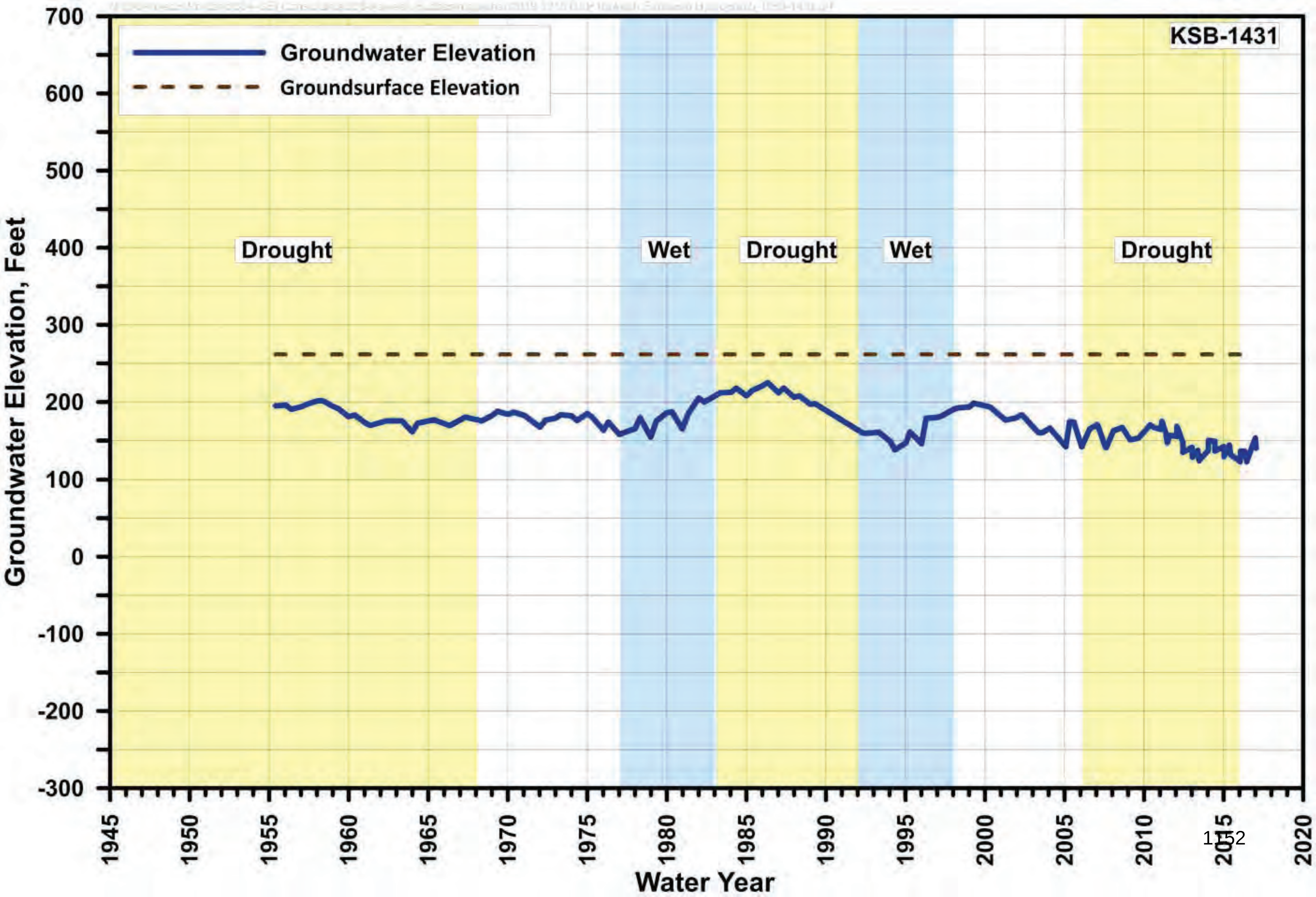


KSB-1389
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

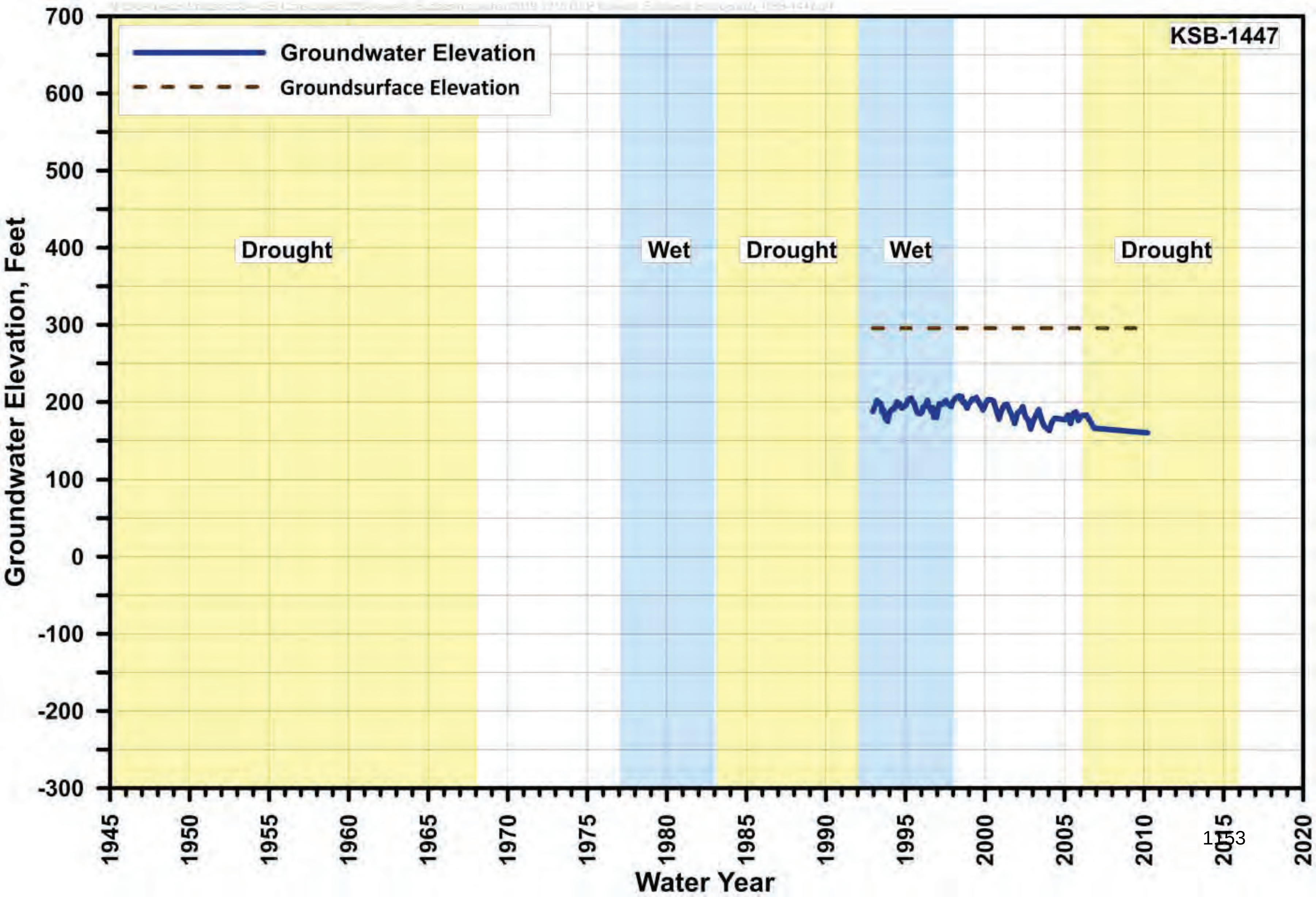


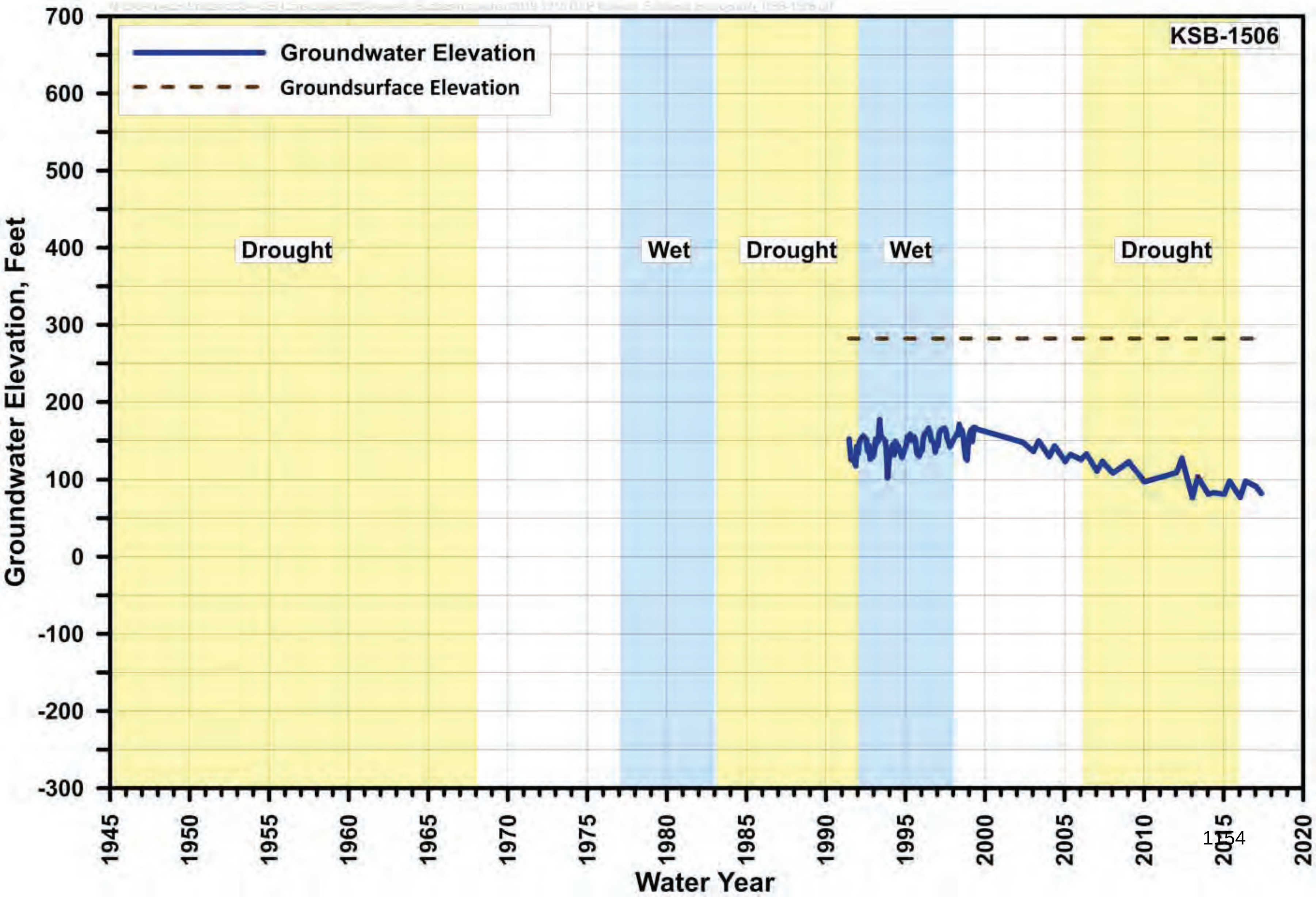
KSB-1425
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

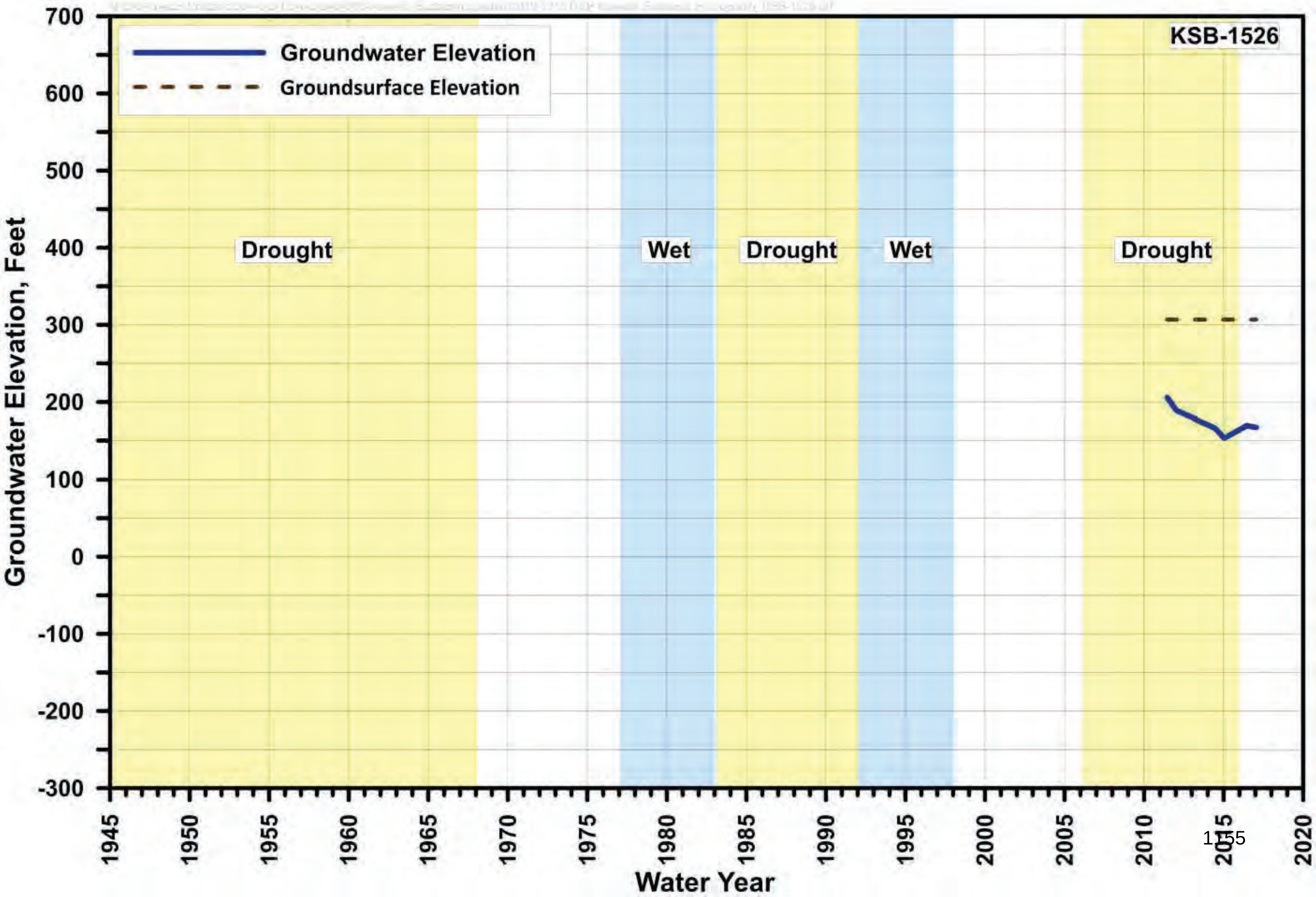

KSB-1428
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

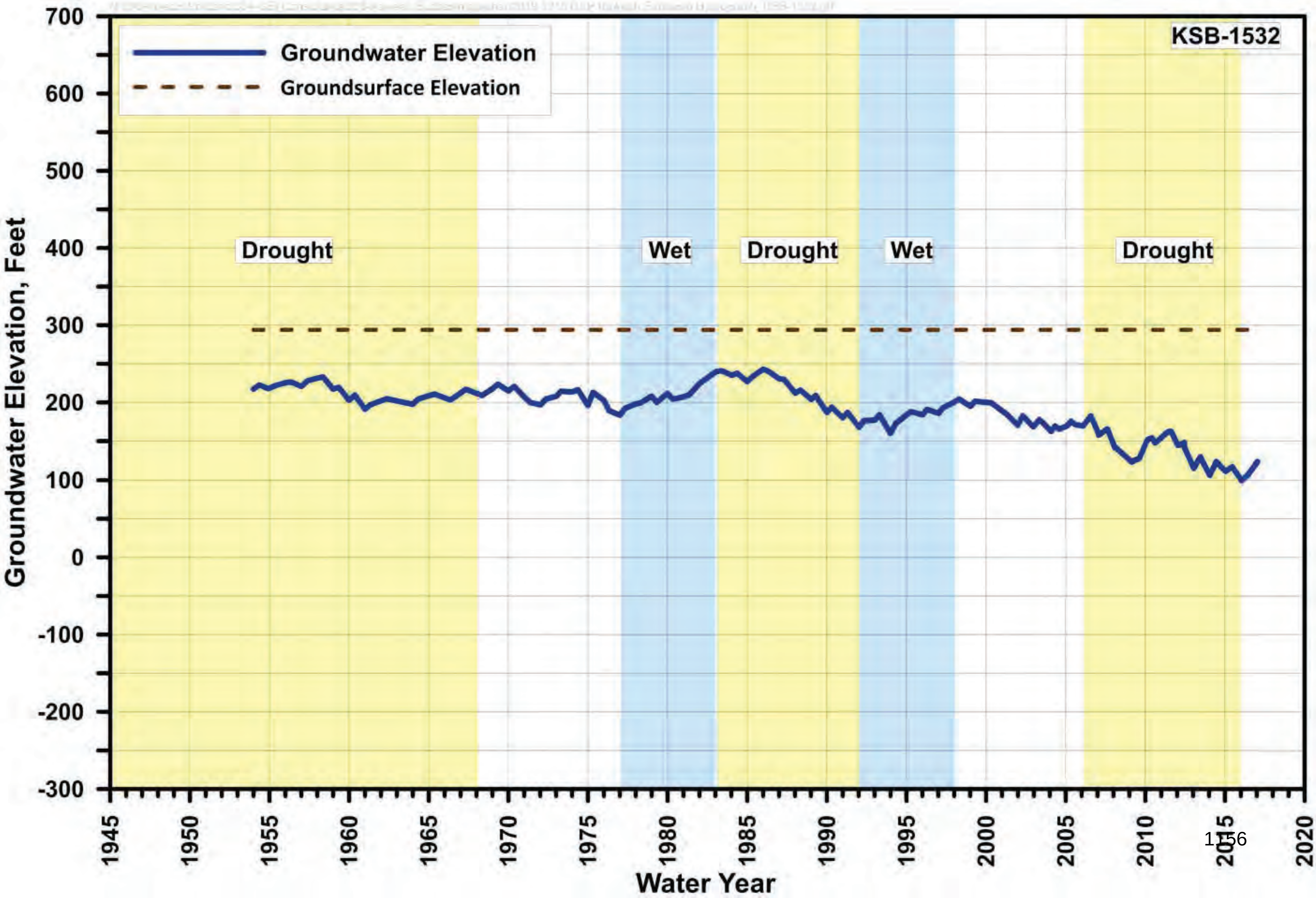


KSB-1431
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

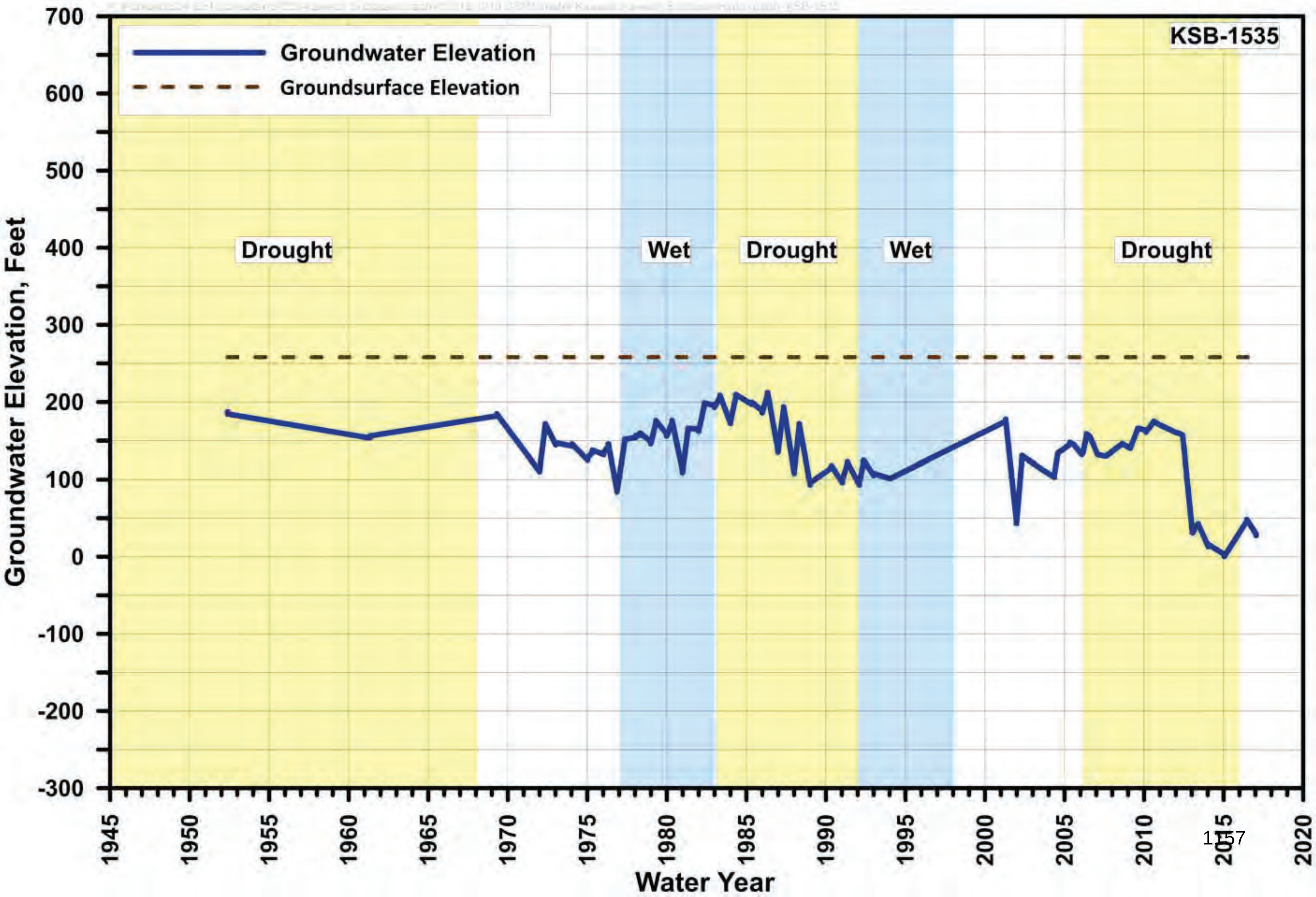

KSB-1447
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

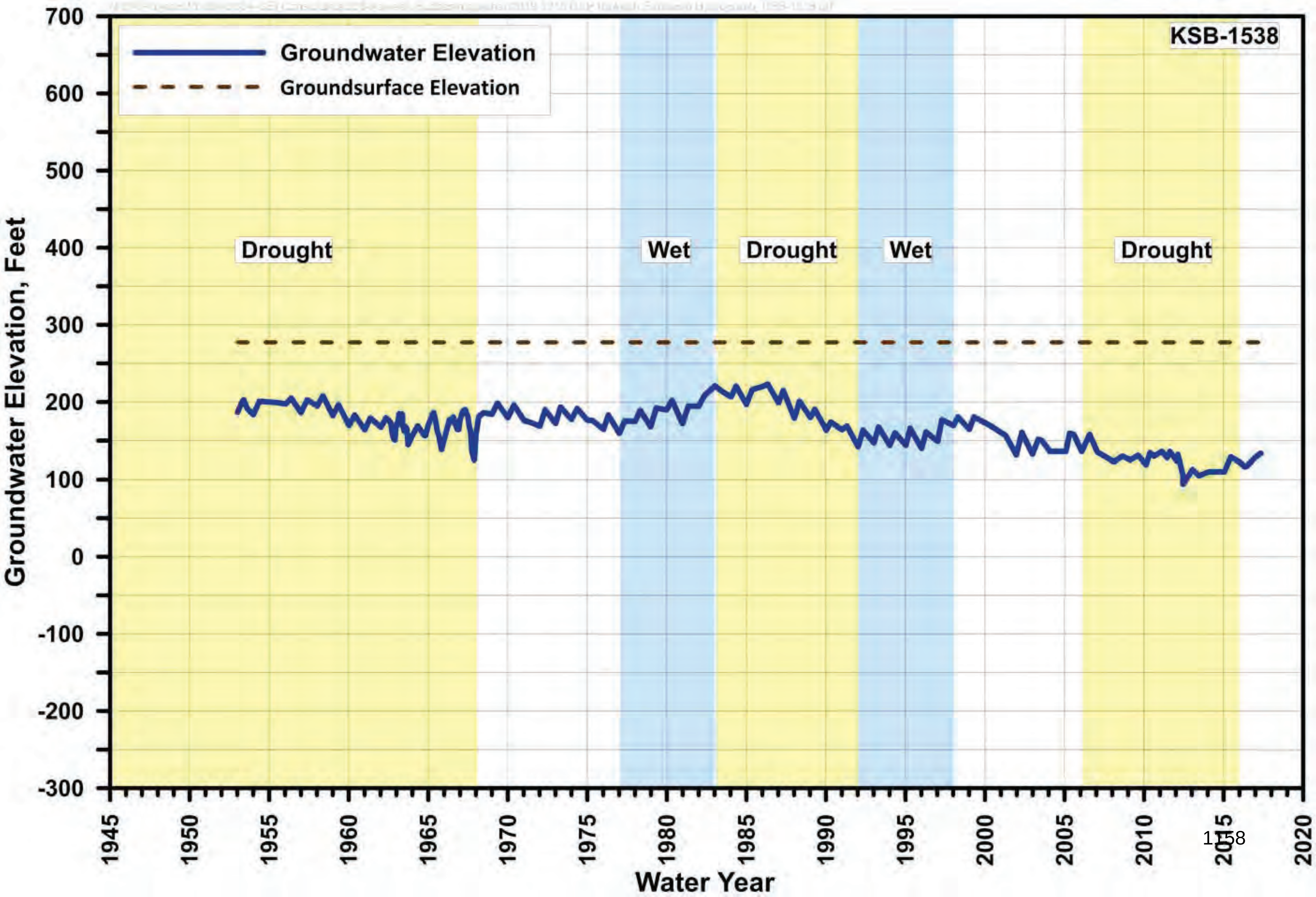

KSB-1506
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1526
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

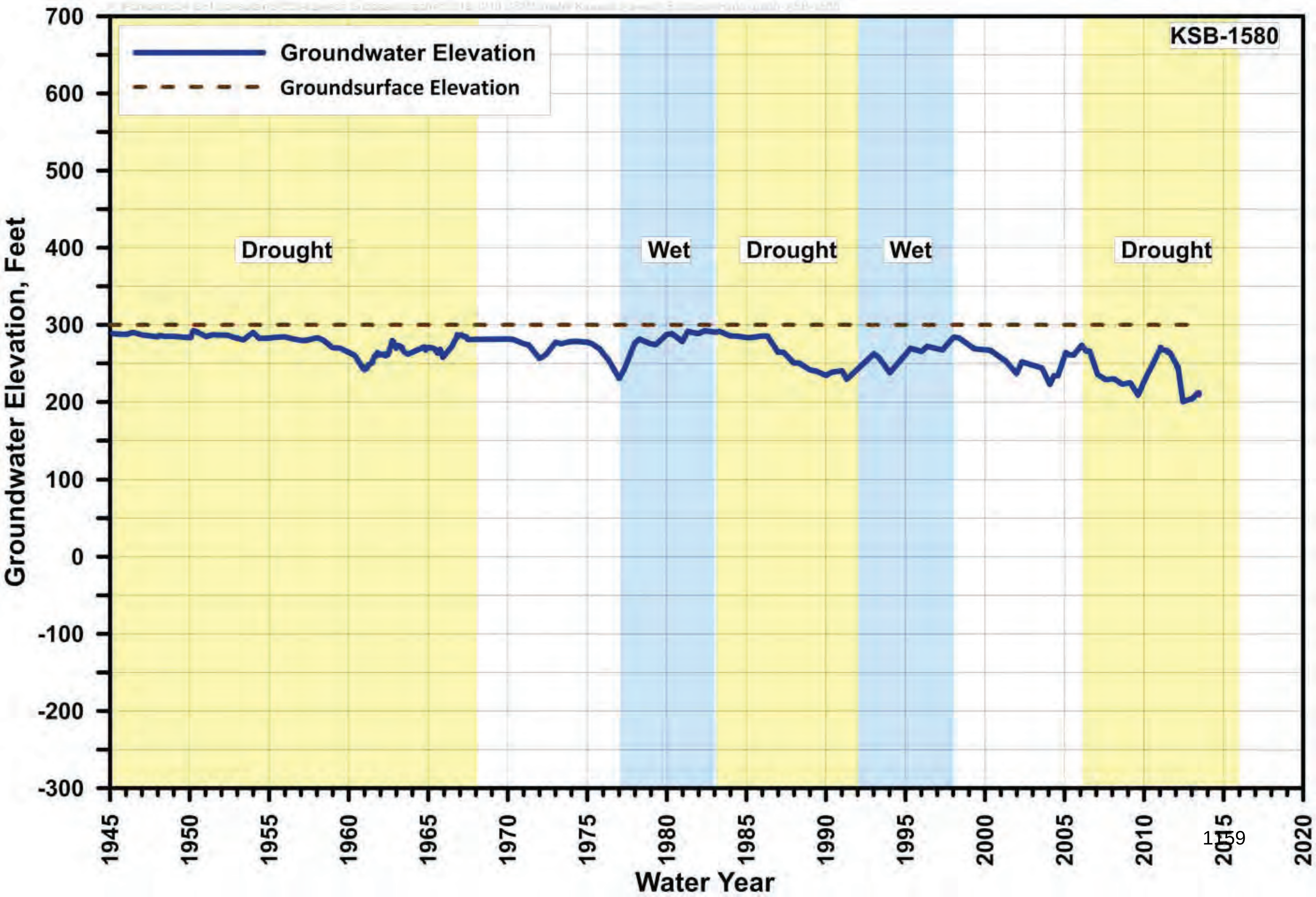


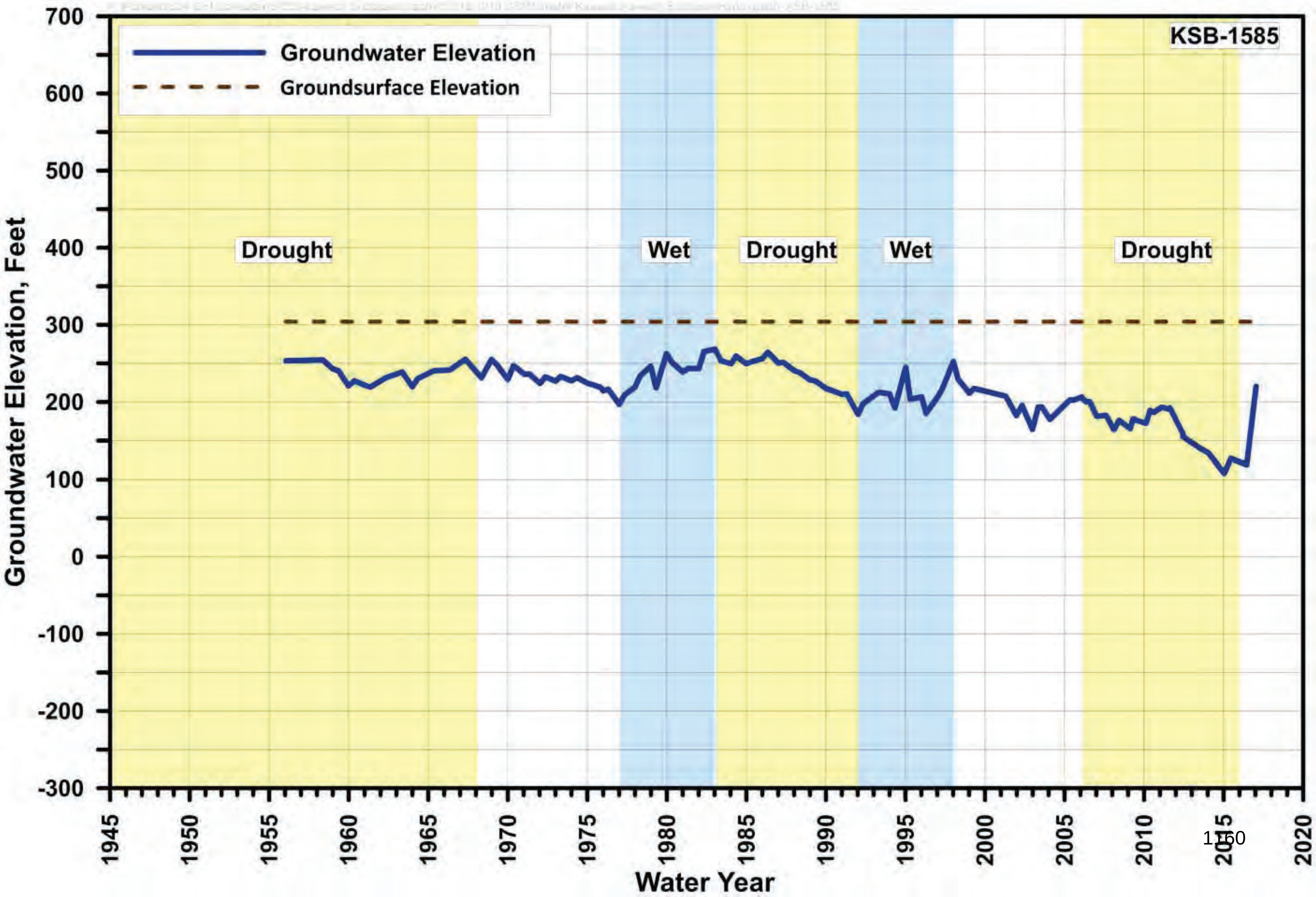
KSB-1532
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1535
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

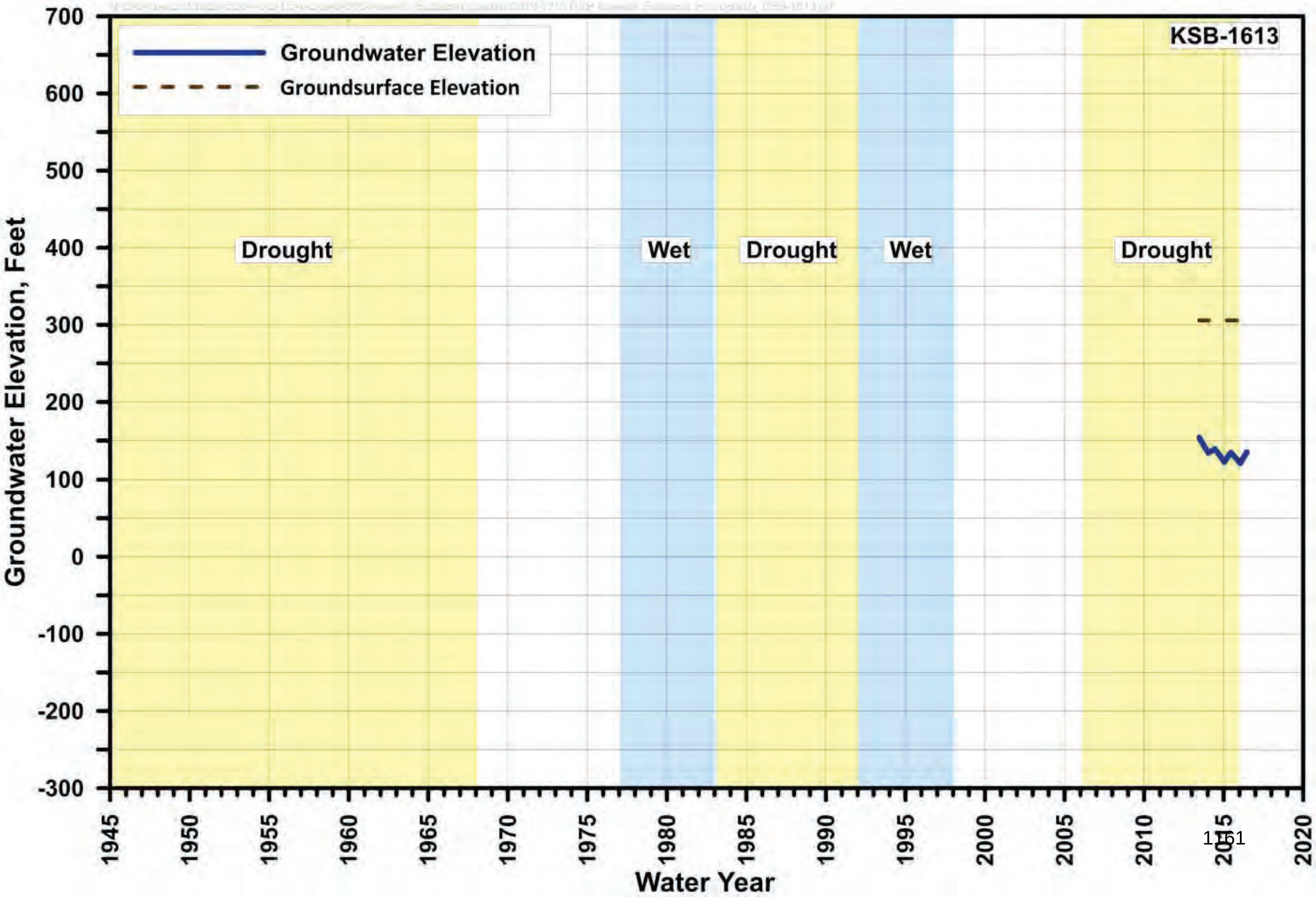


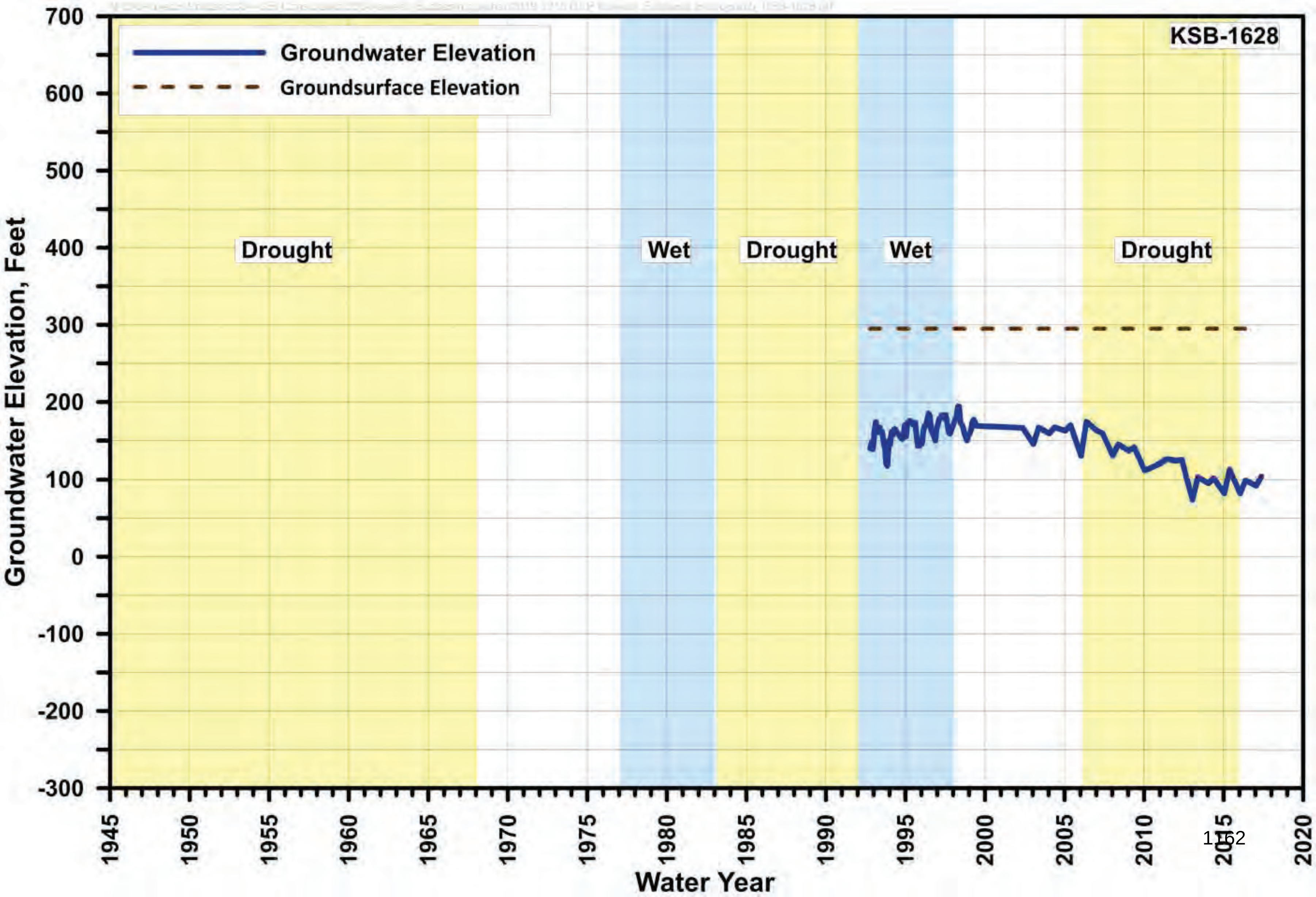
KSB-1538
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1580
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

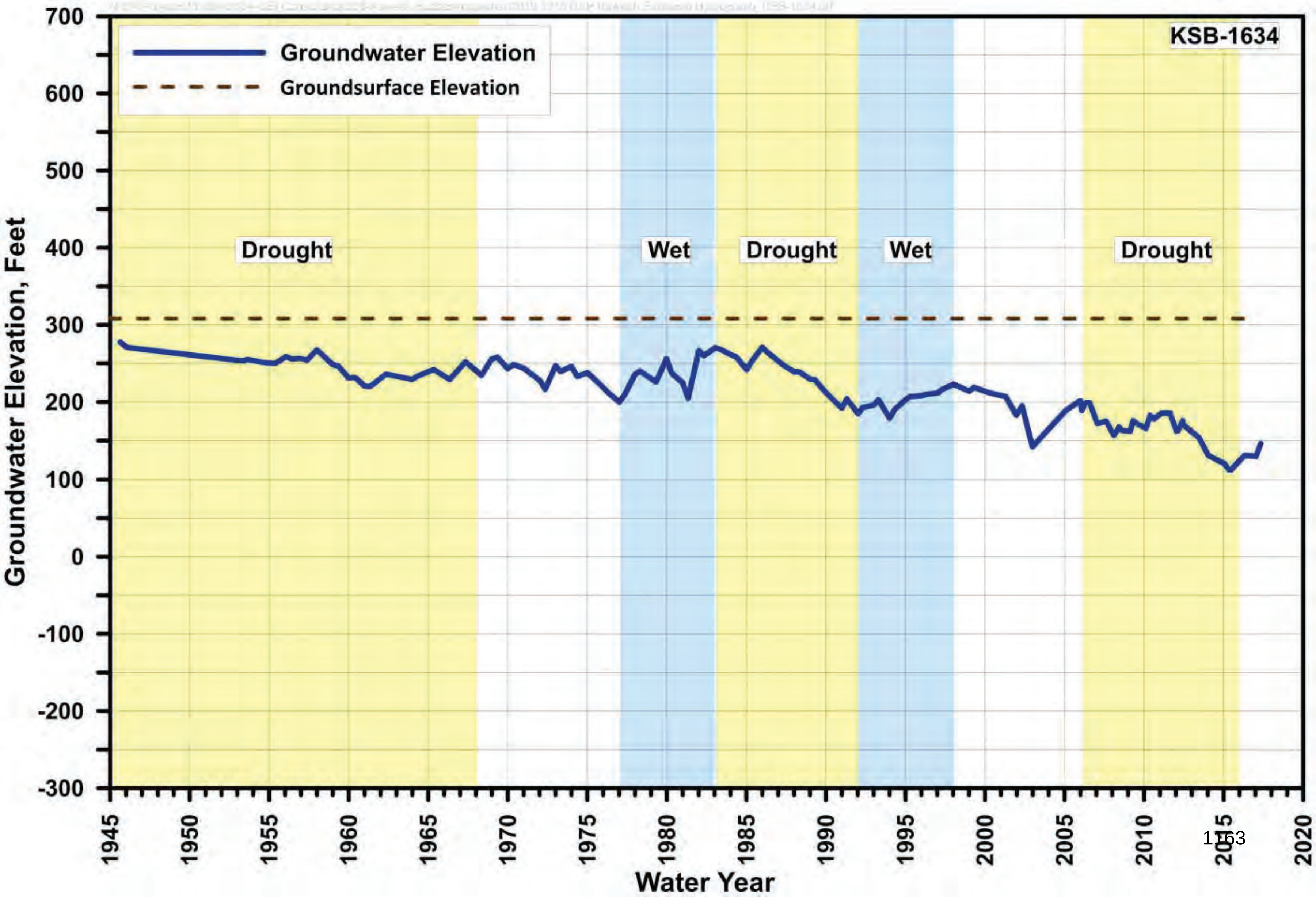


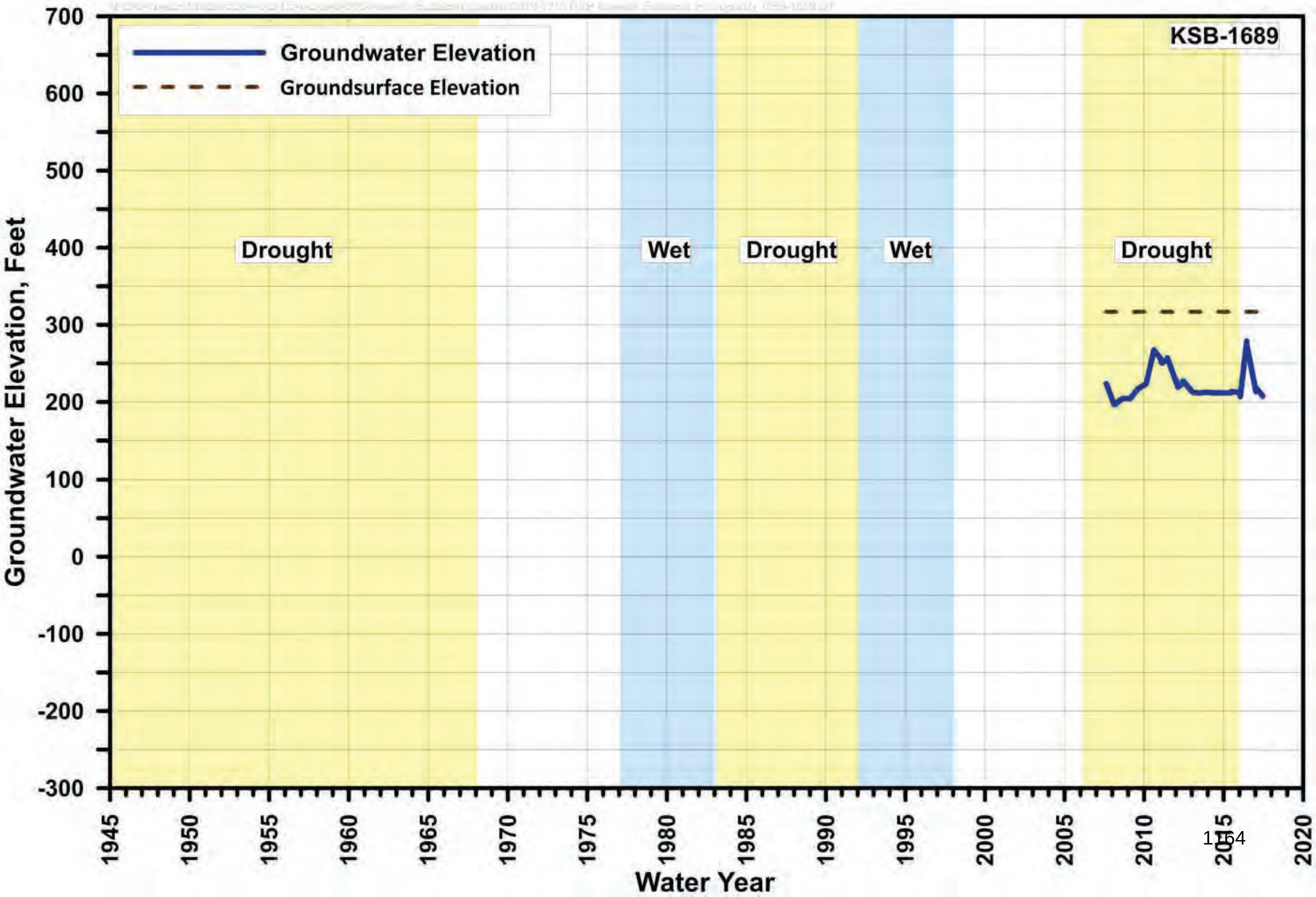
KSB-1585
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


KSB-1613
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

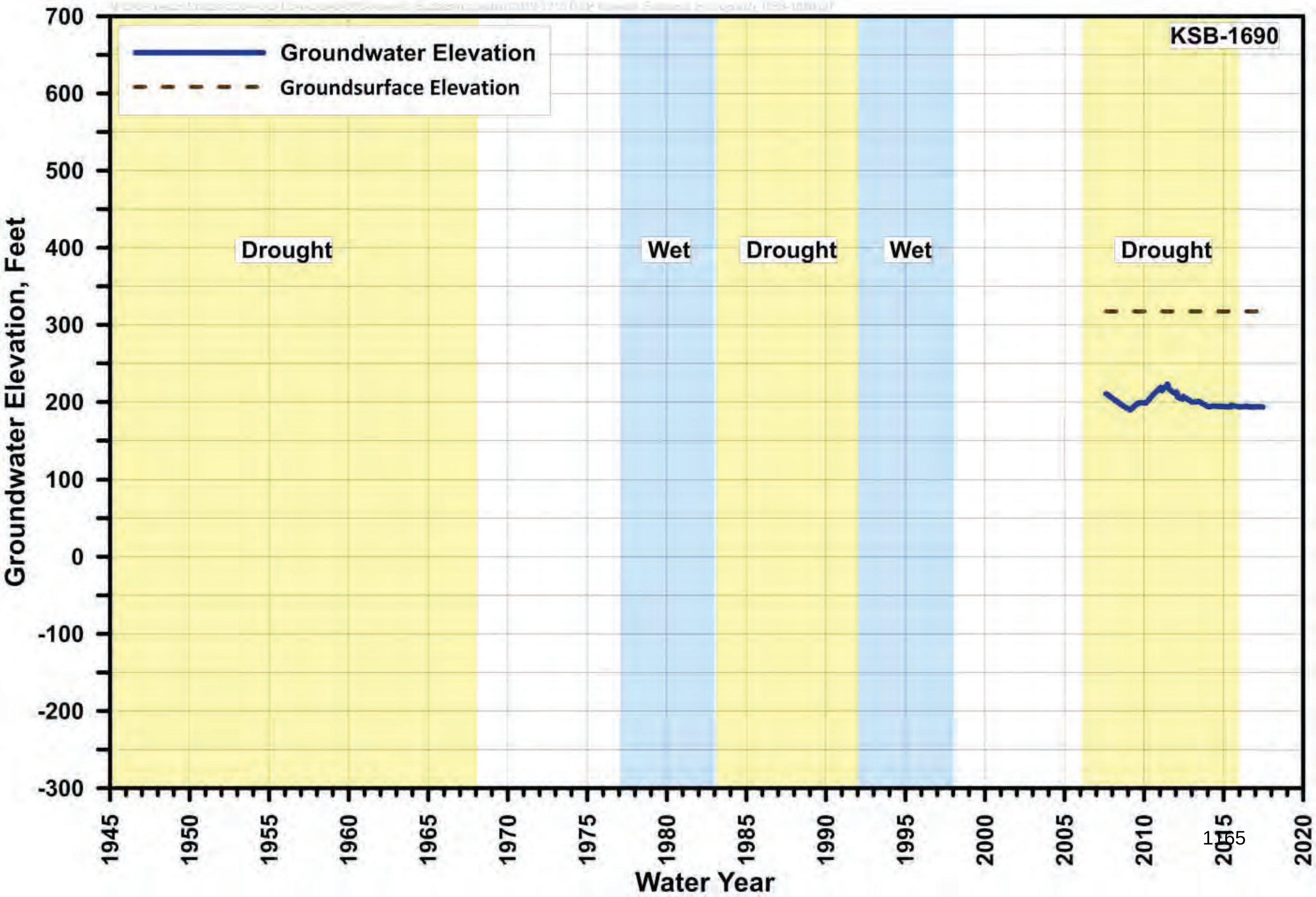


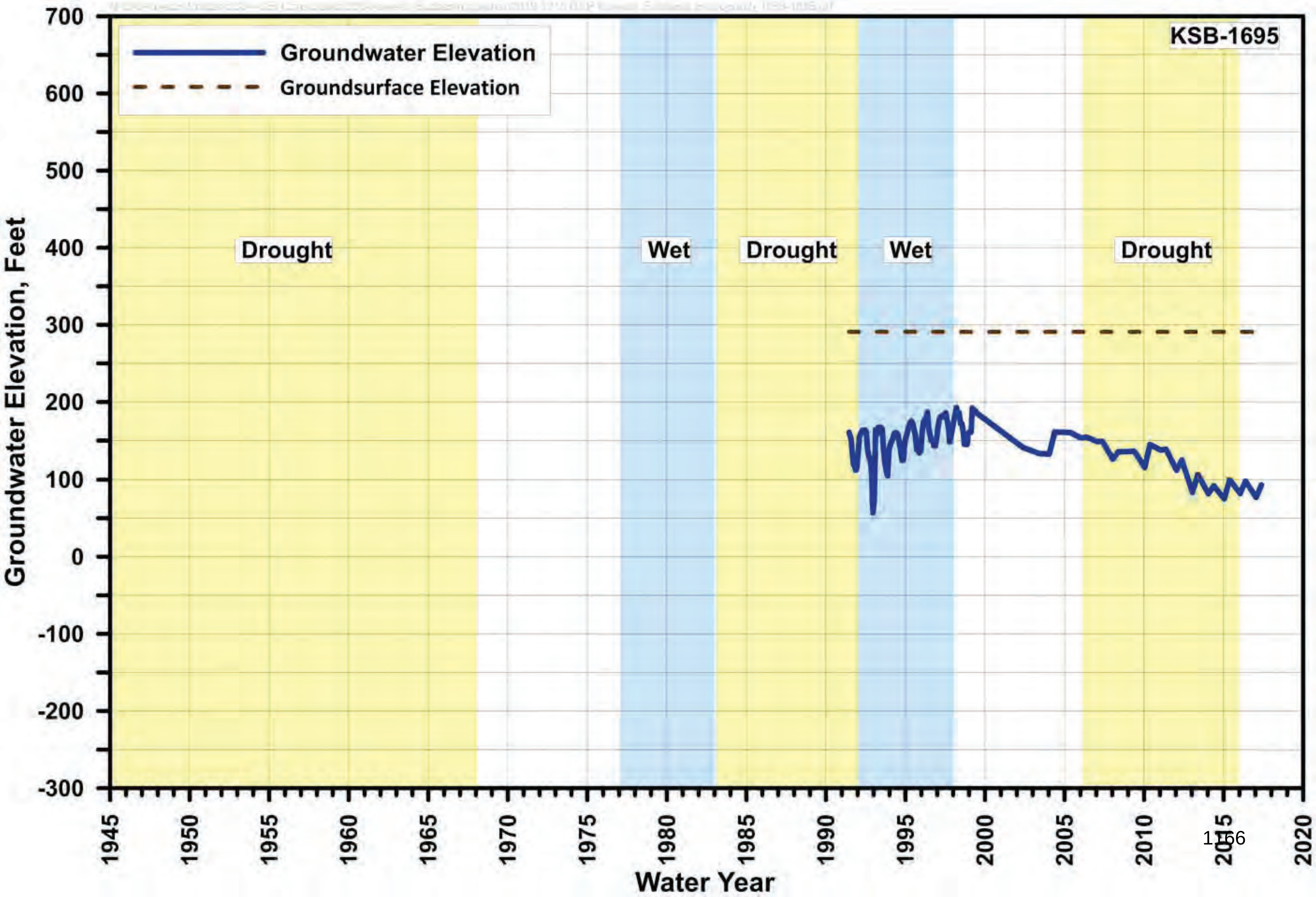
KSB-1628
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

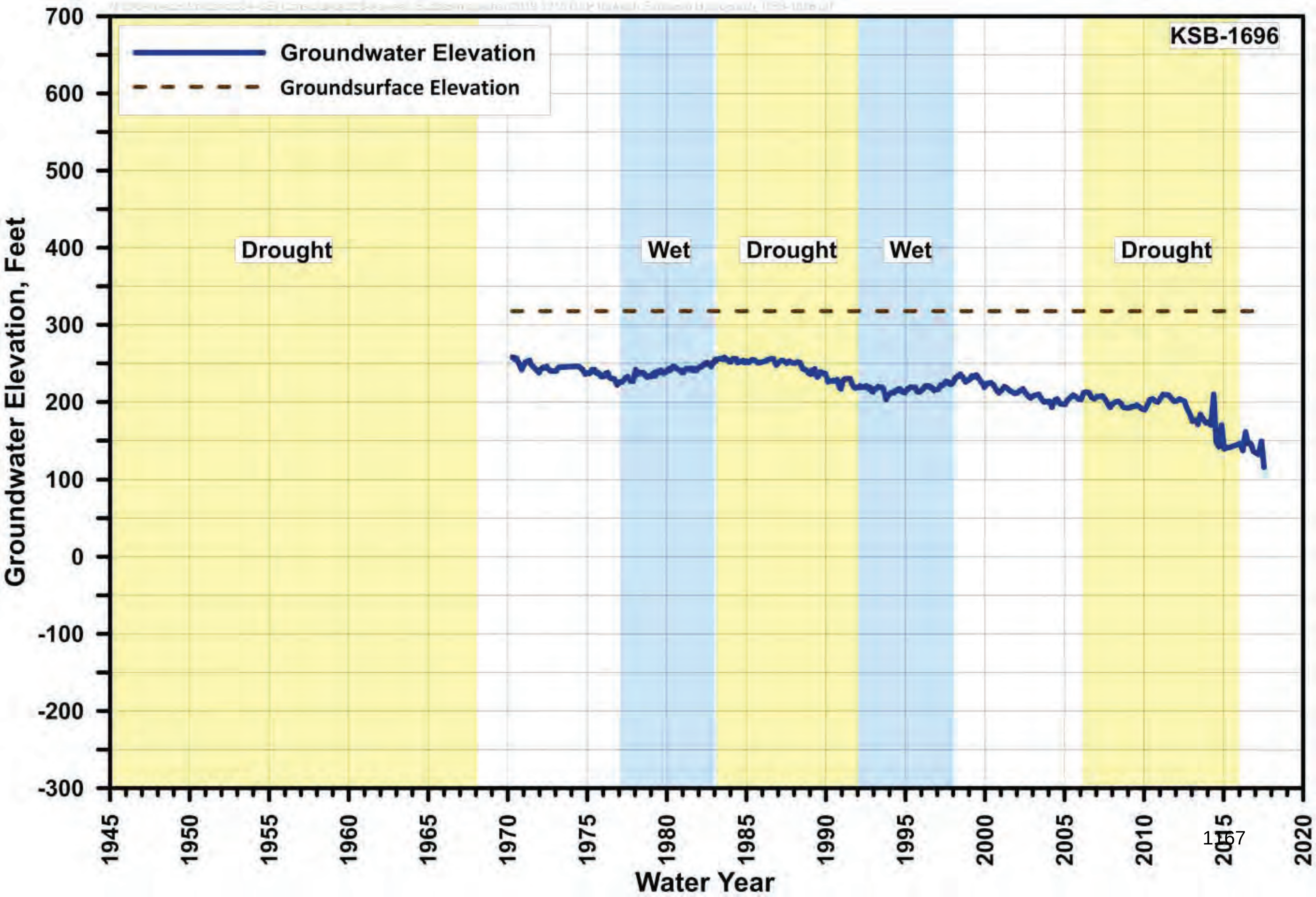

KSB-1634
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



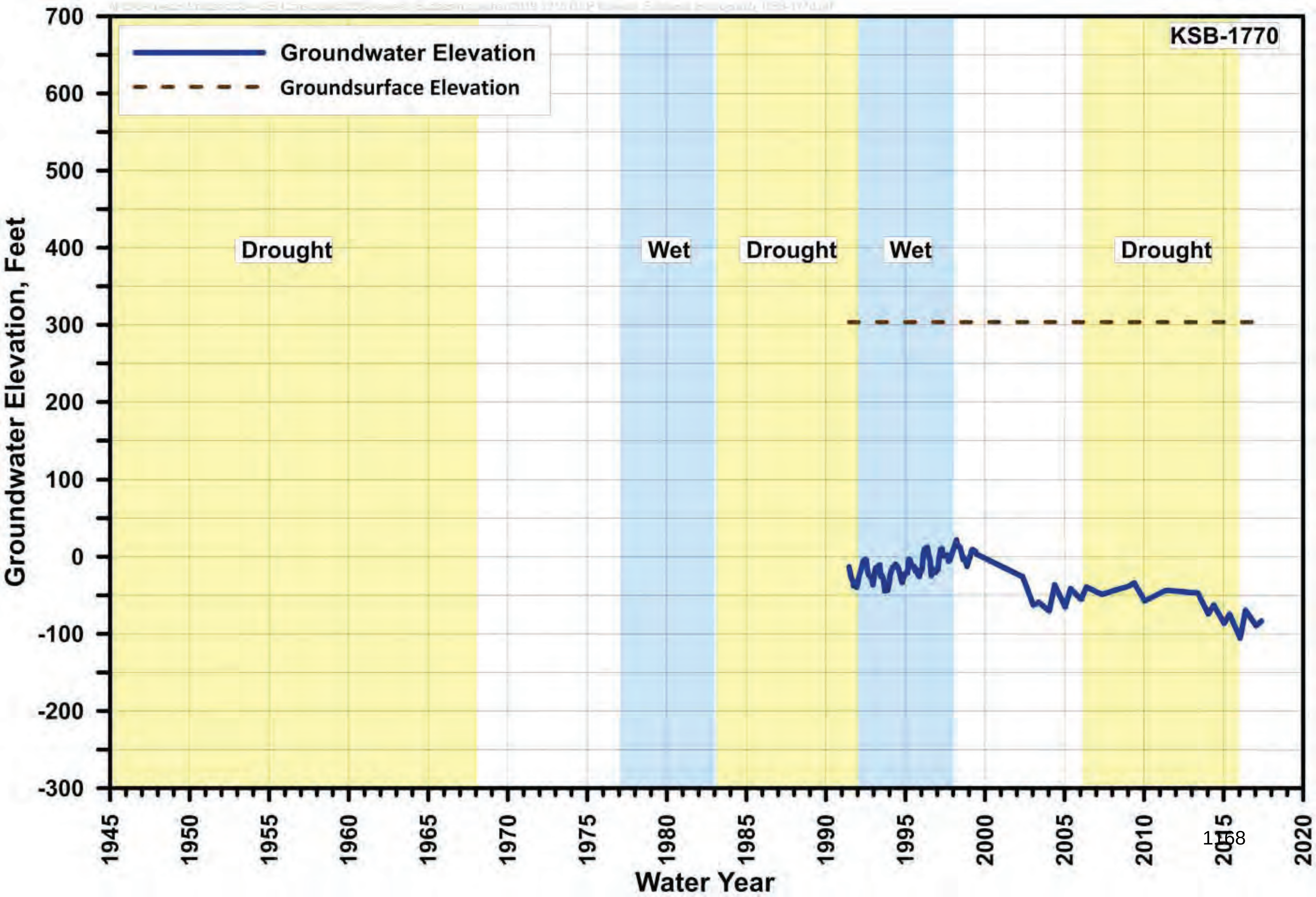
KSB-1689
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1690
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

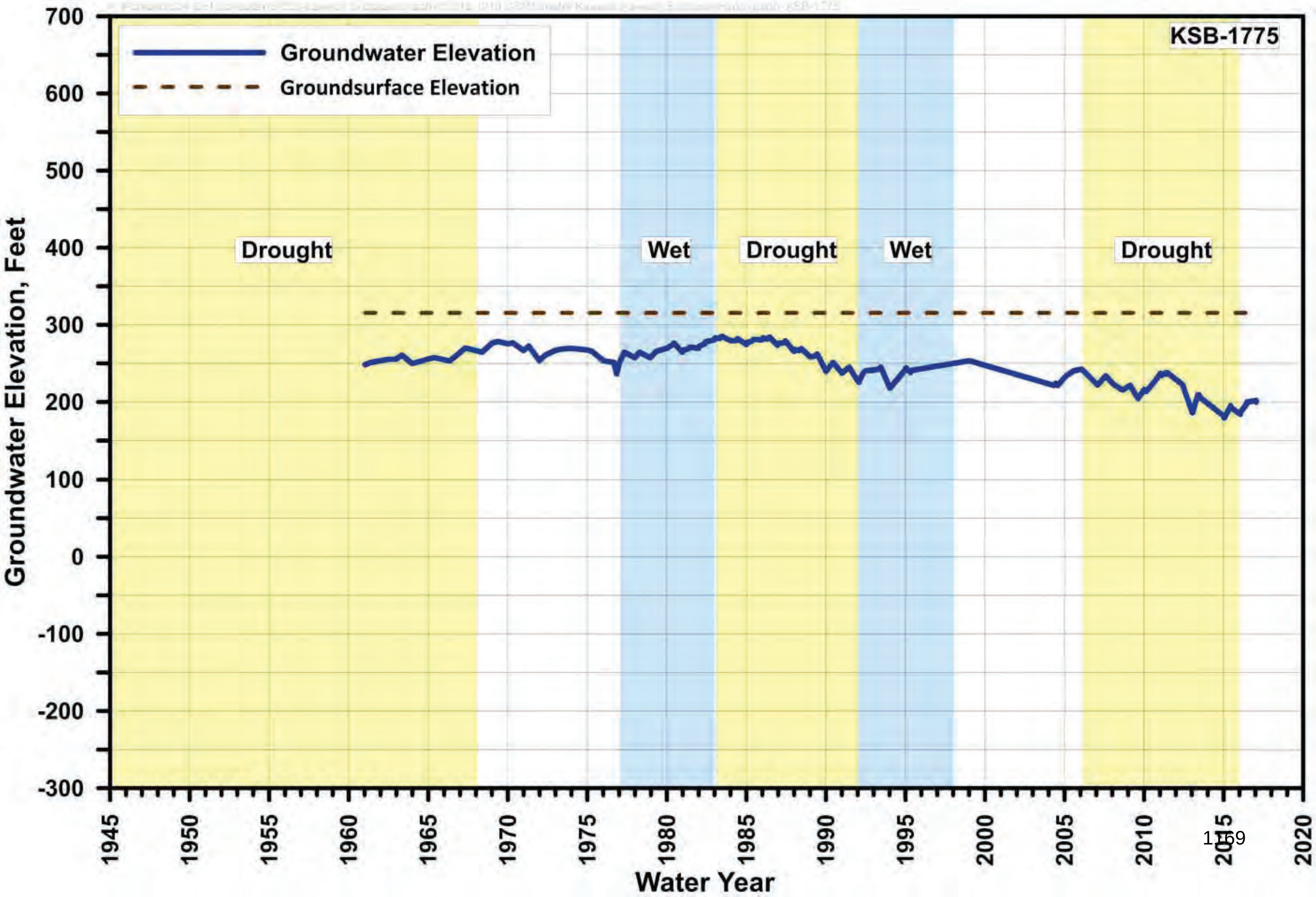

KSB-1695
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

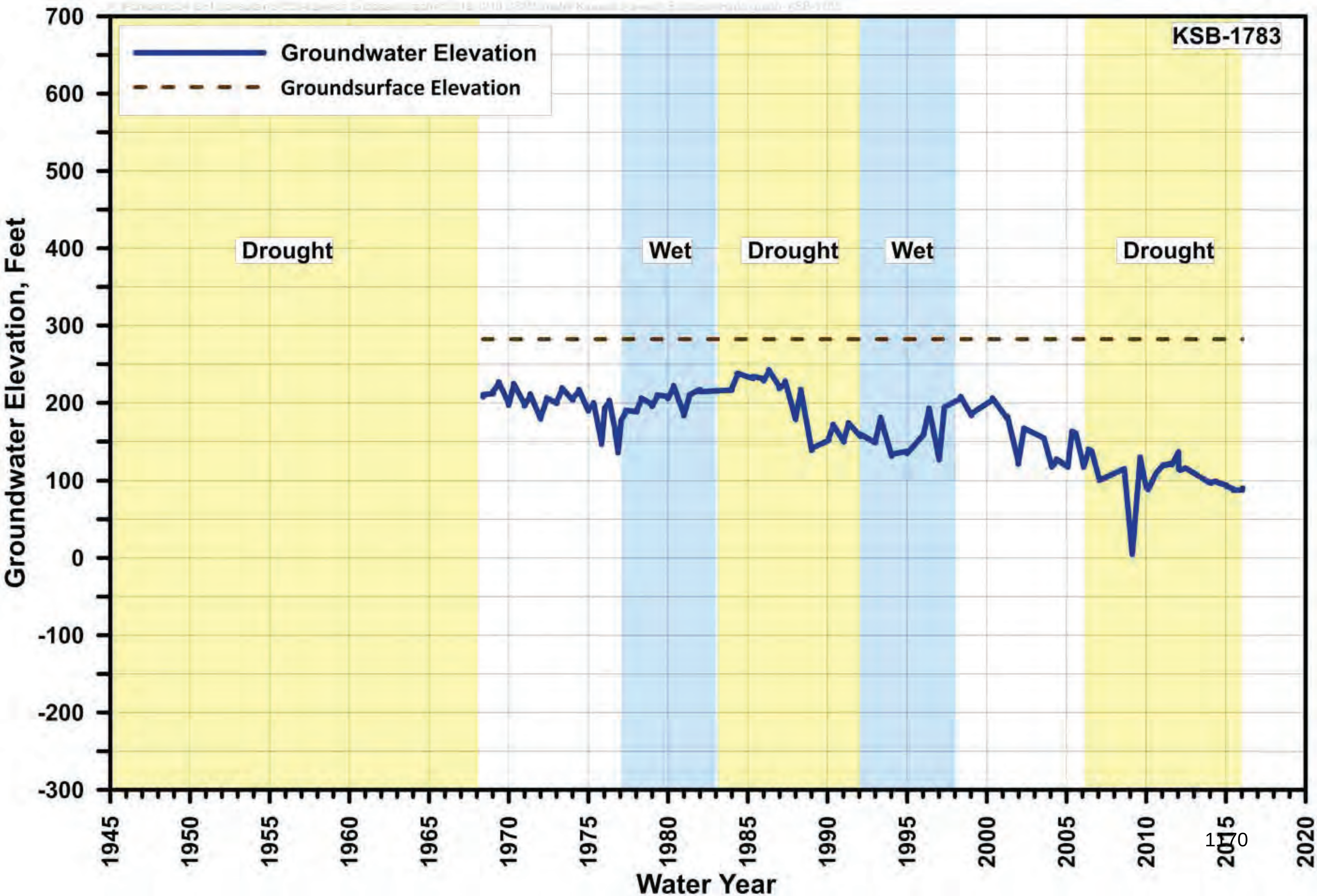


KSB-1696
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

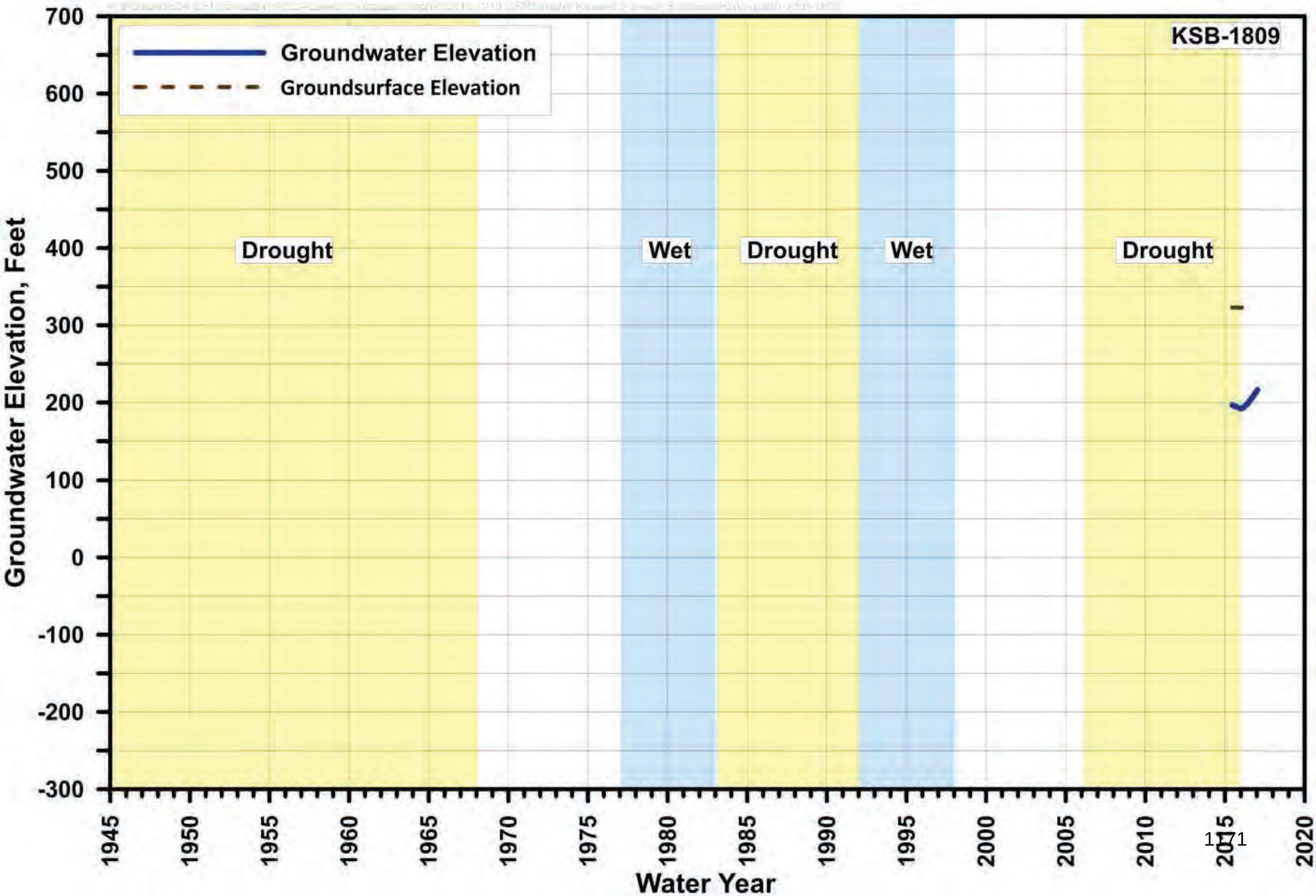


KSB-1770
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

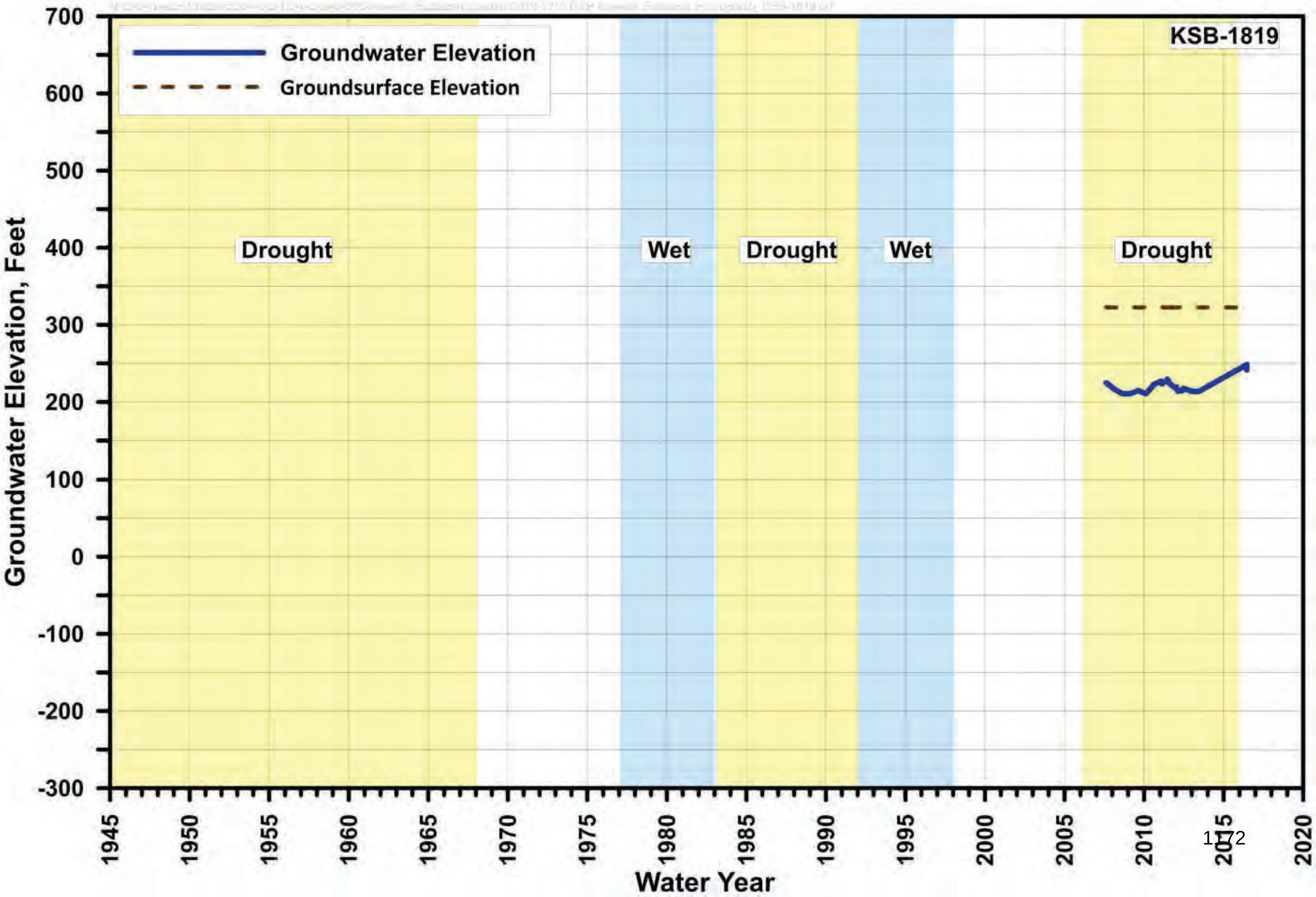

KSB-1775
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

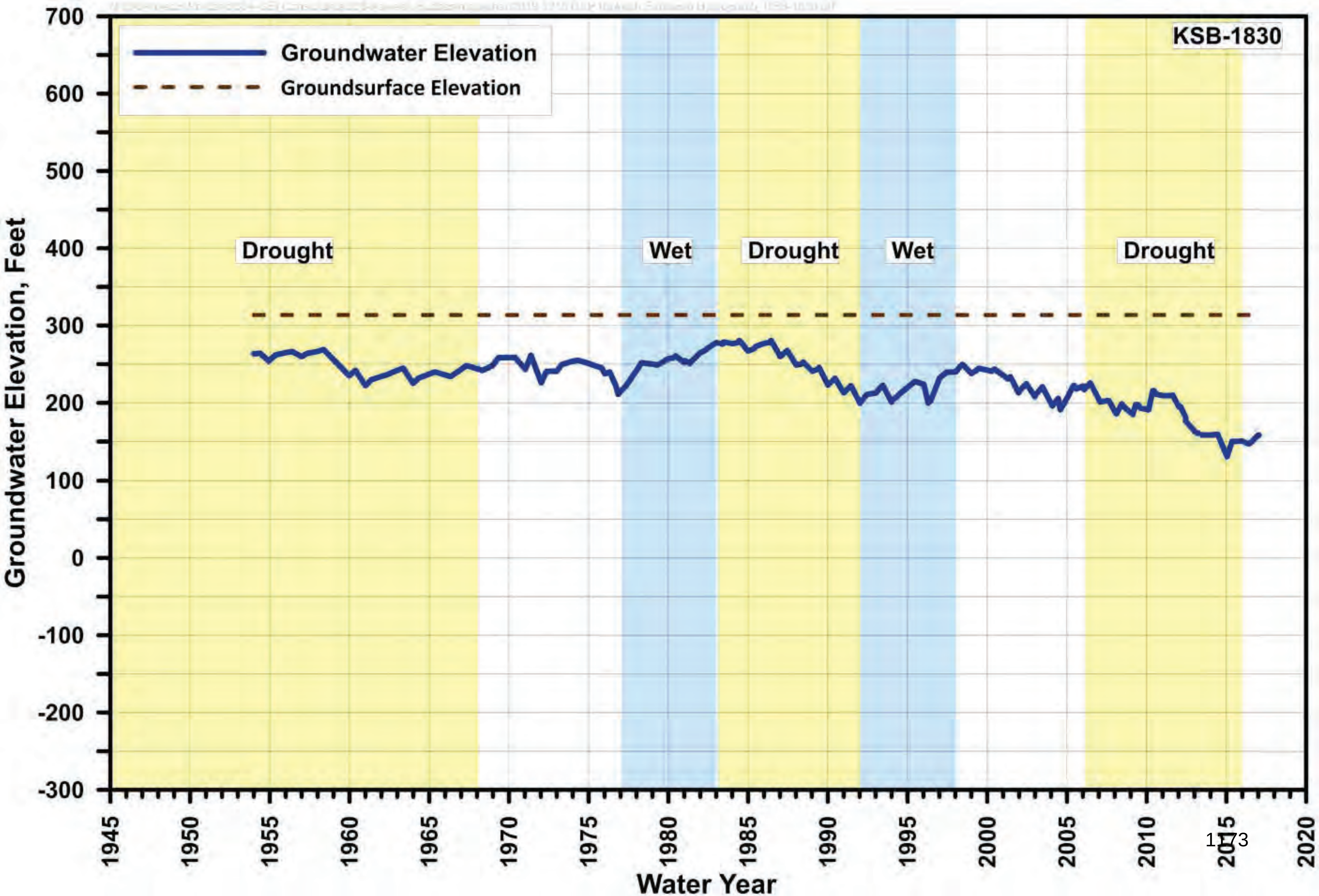


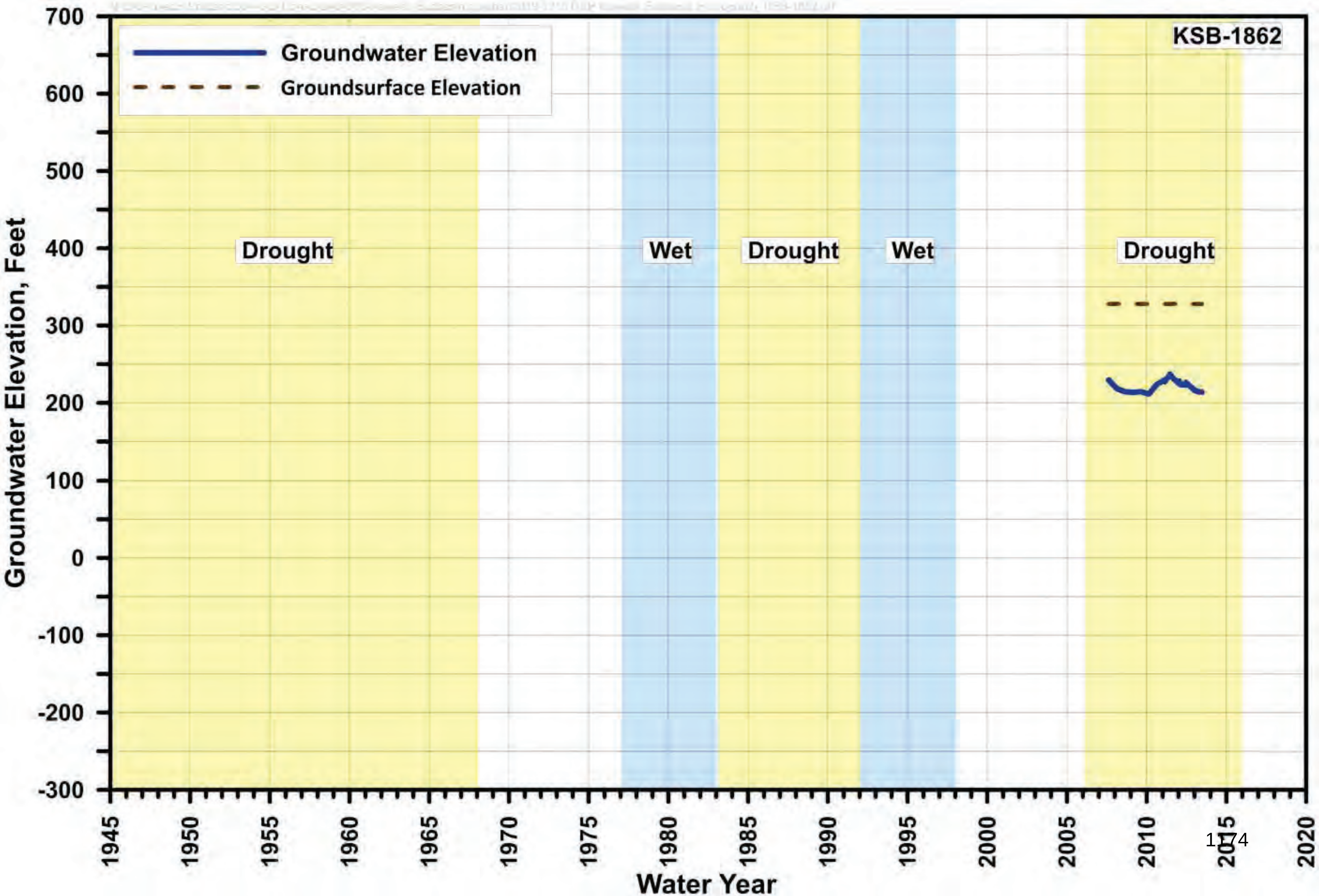
KSB-1783
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

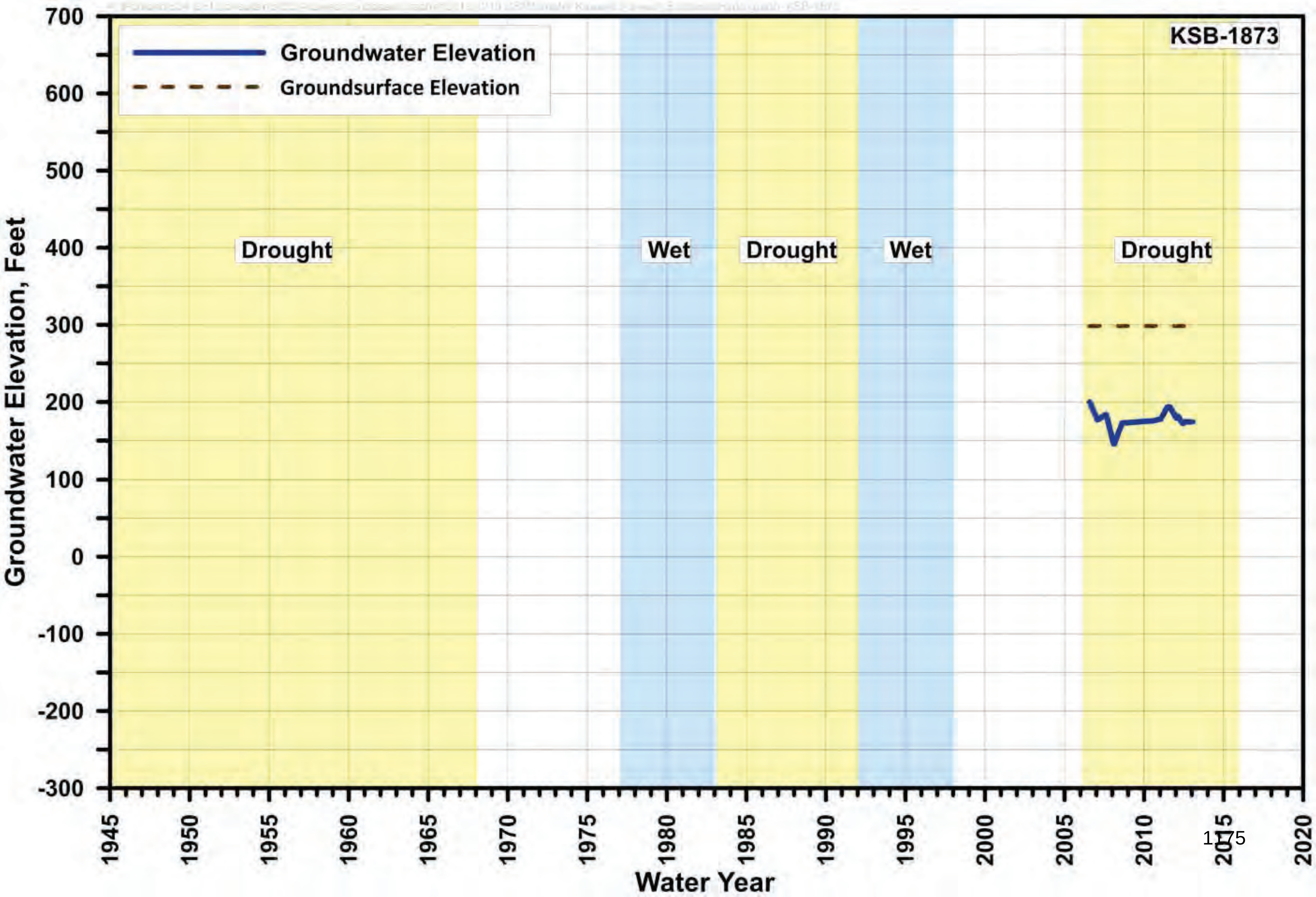


KSB-1809
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

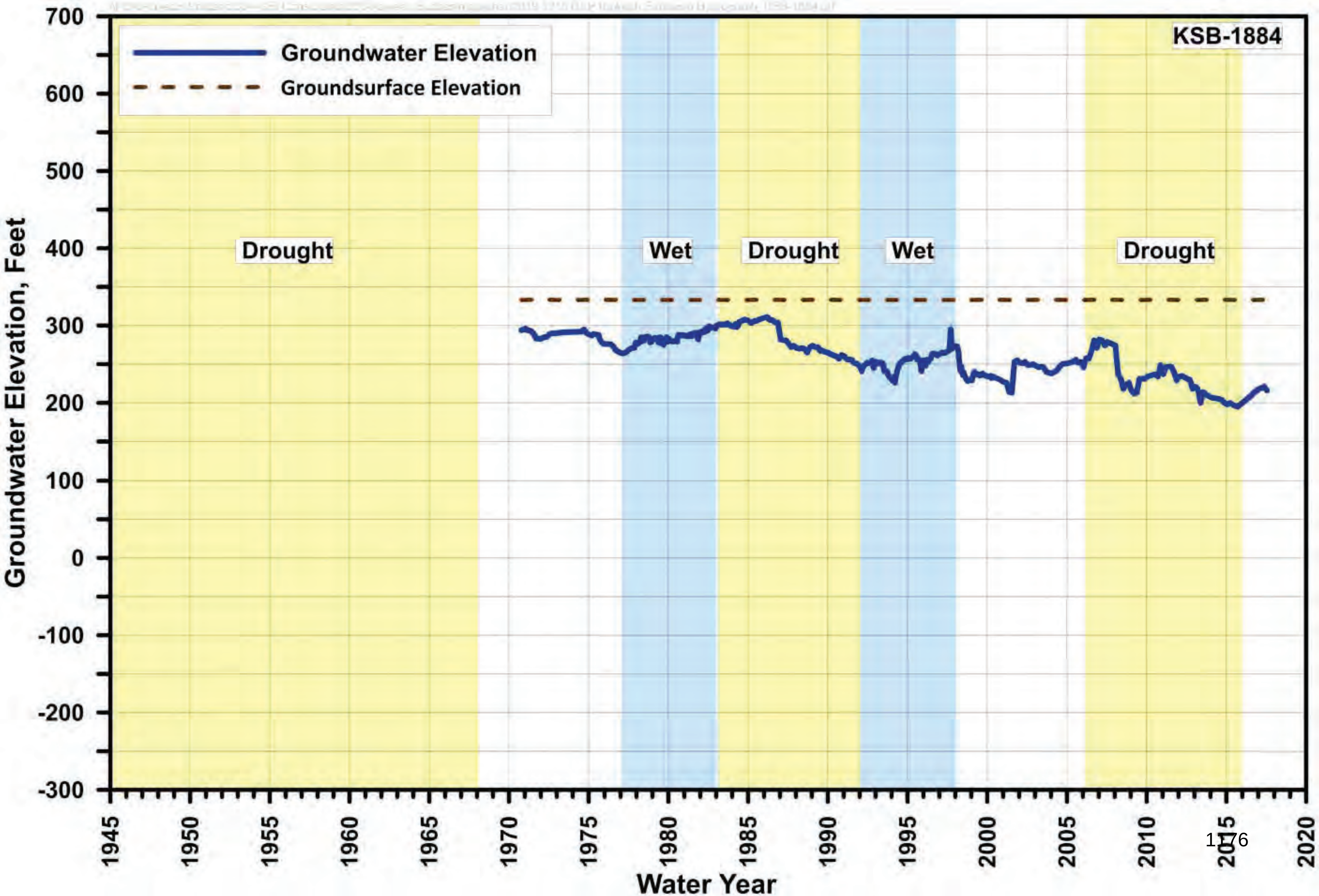

KSB-1819
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

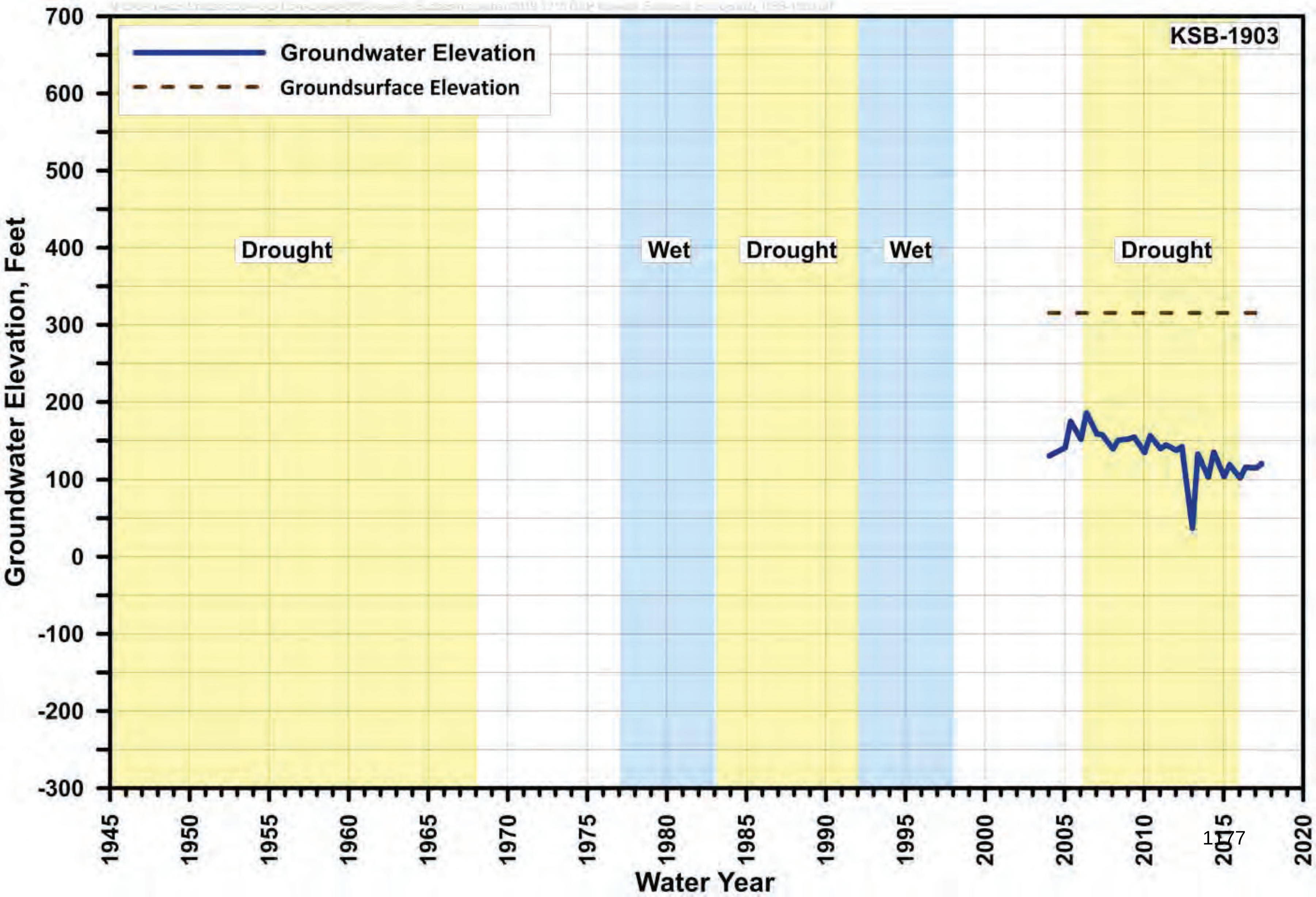

KSB-1830
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

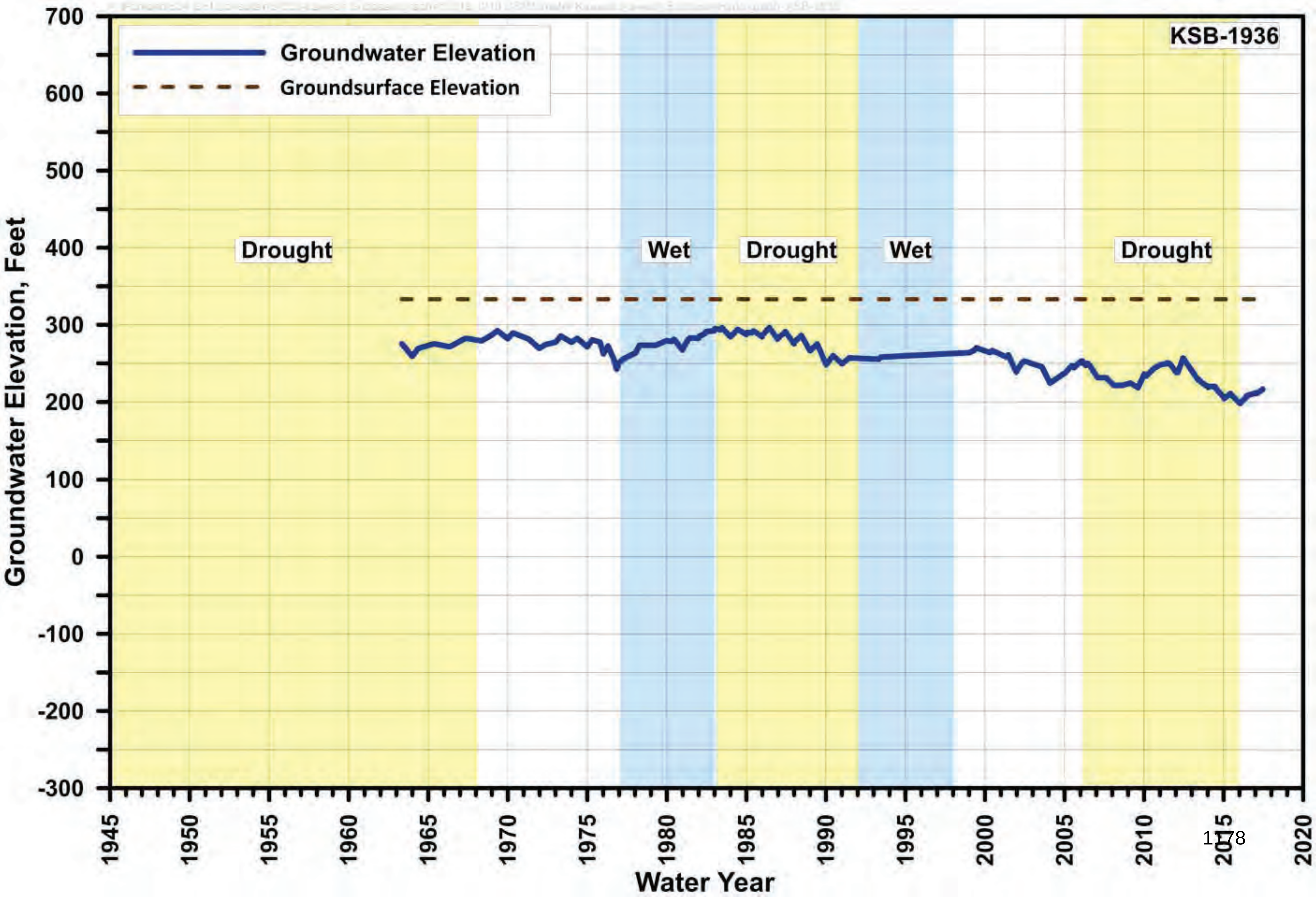

KSB-1862
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

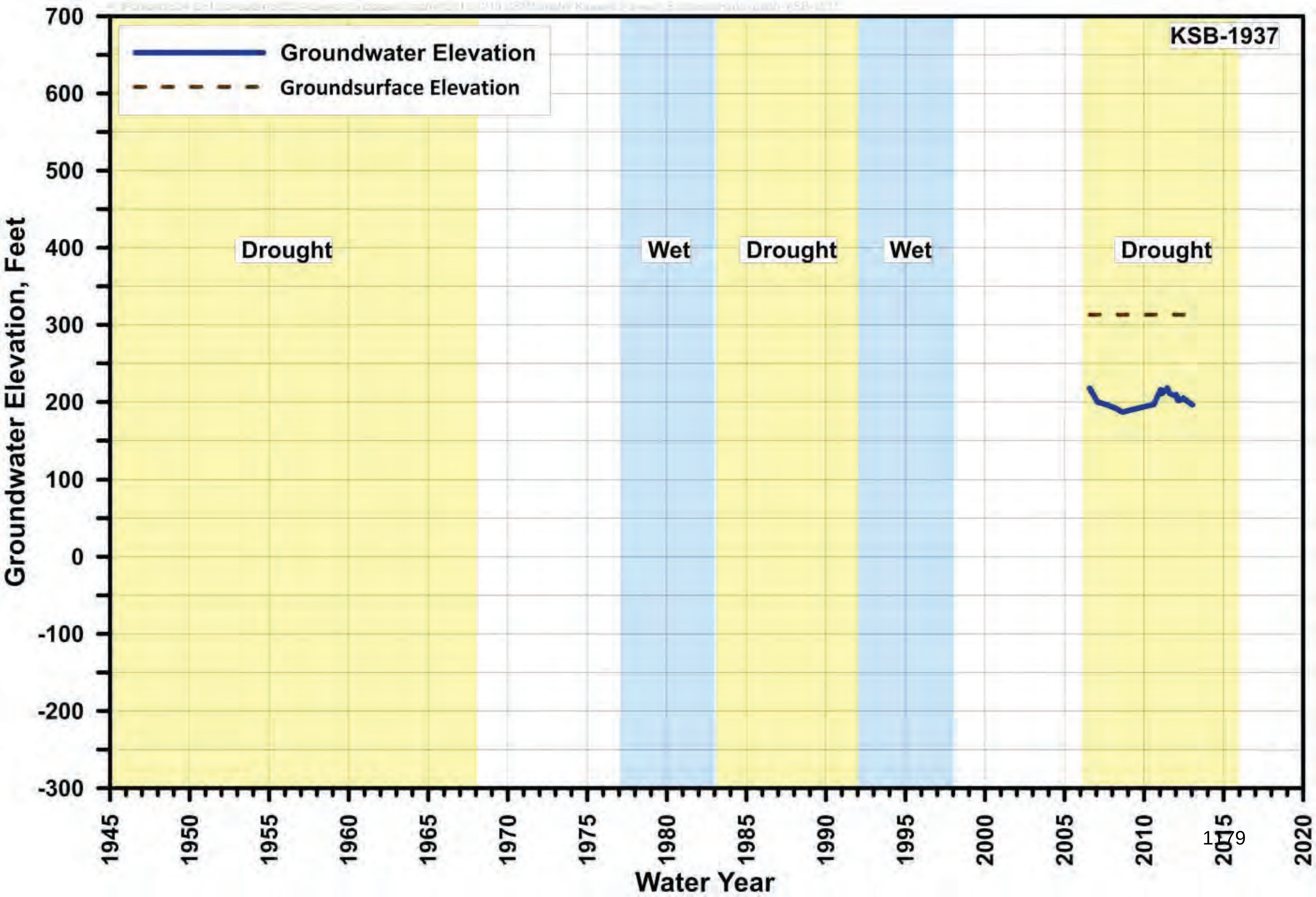


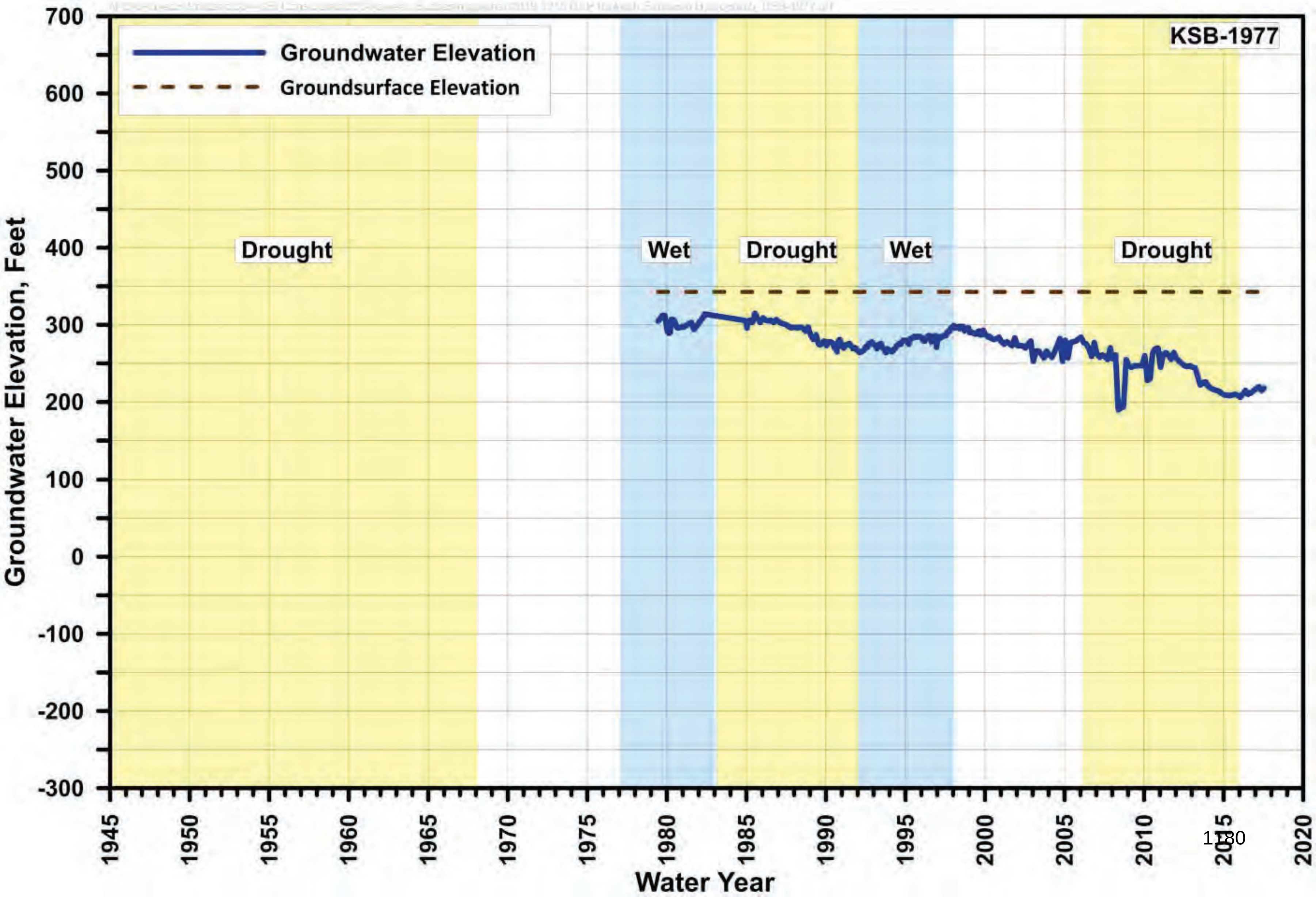
KSB-1873
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1884
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

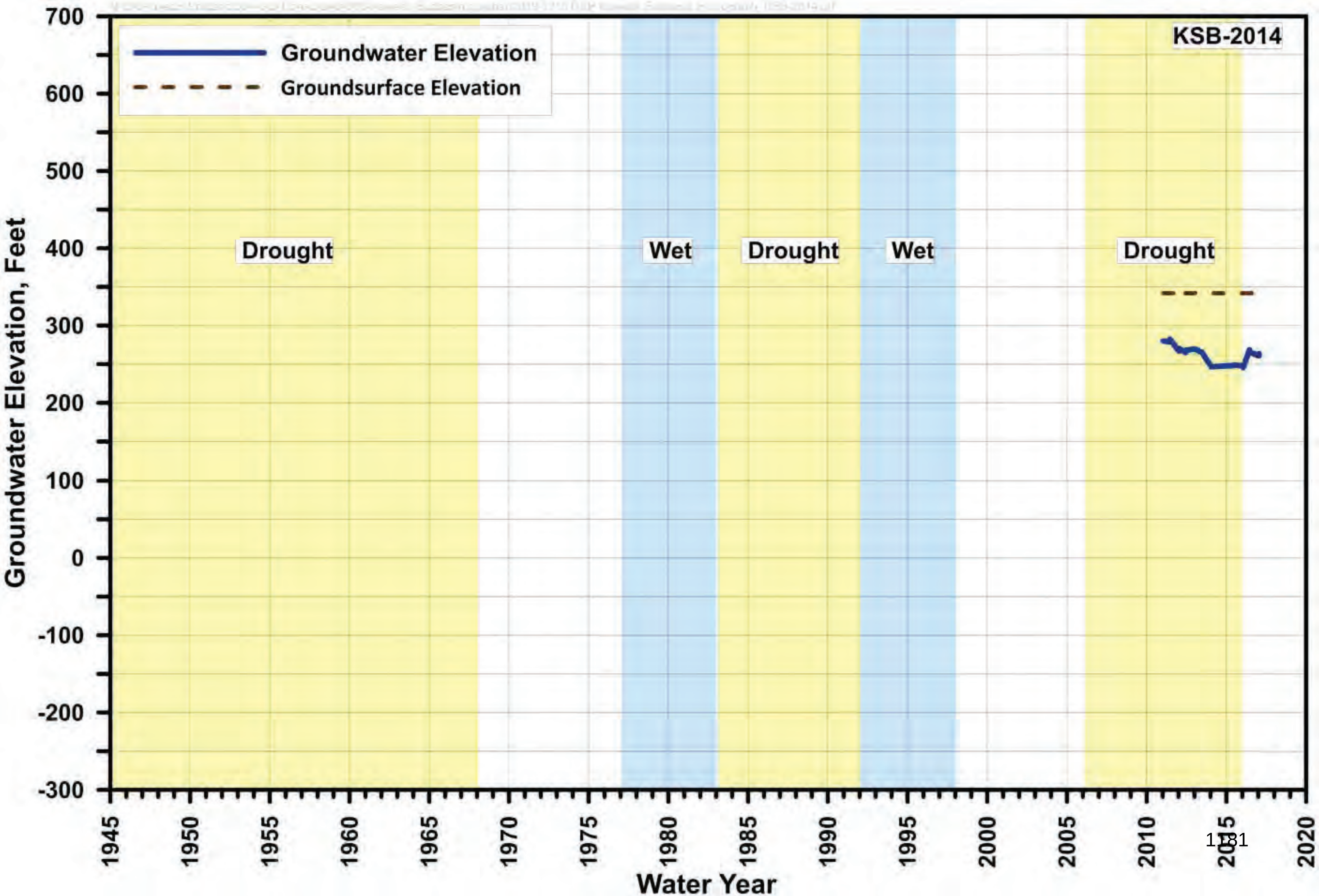

KSB-1903
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

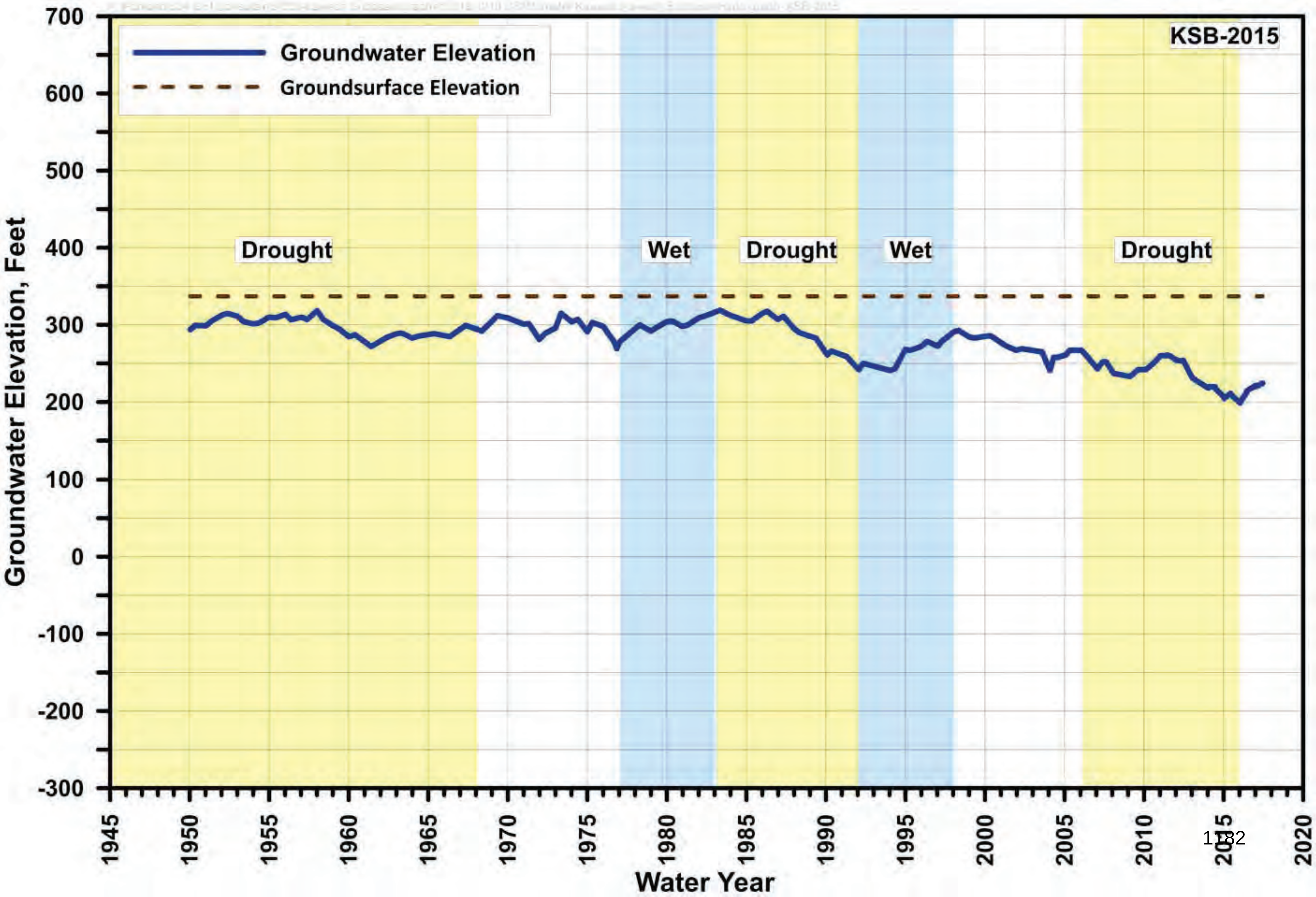

KSB-1936
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-1937
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

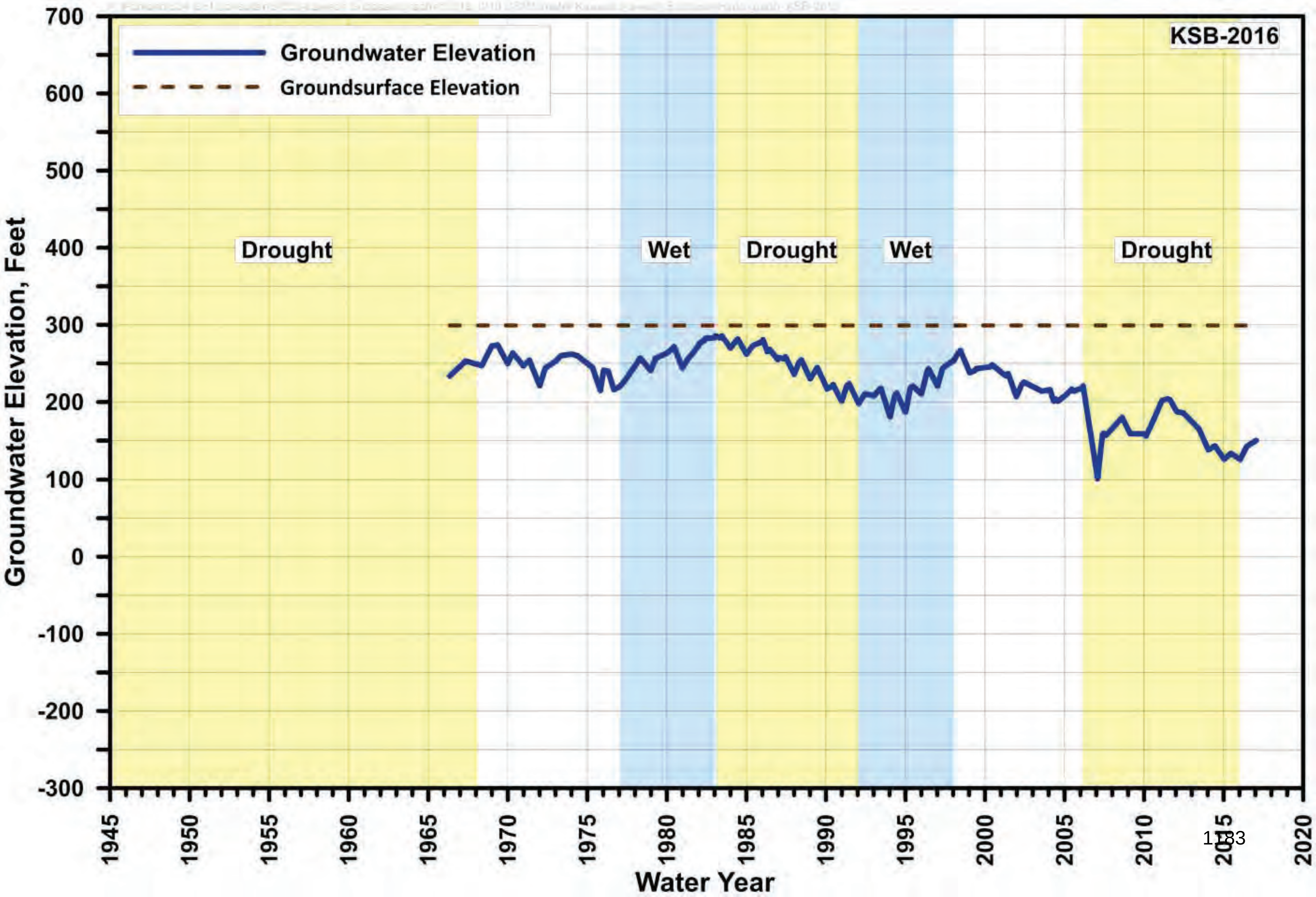


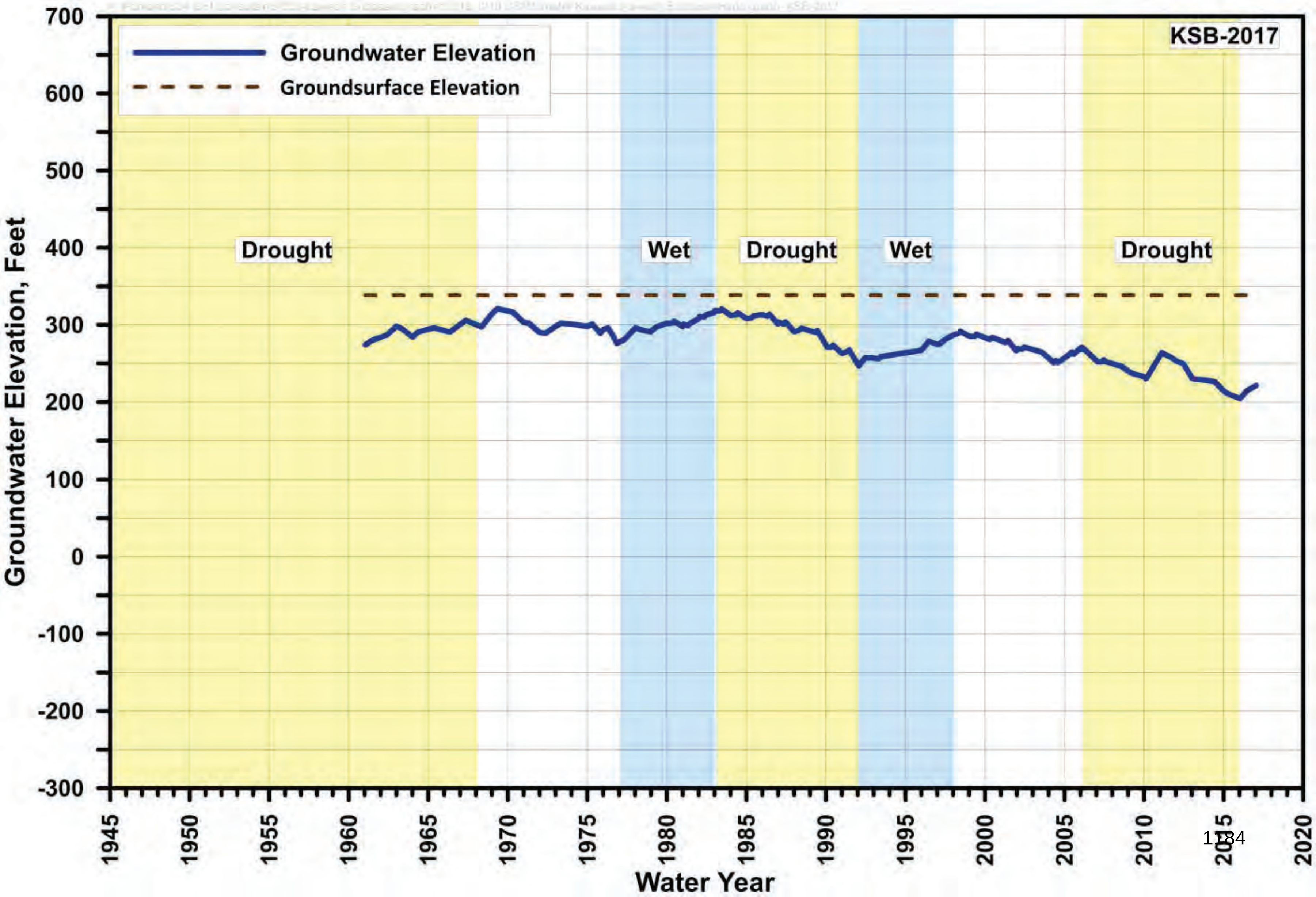
KSB-1977
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

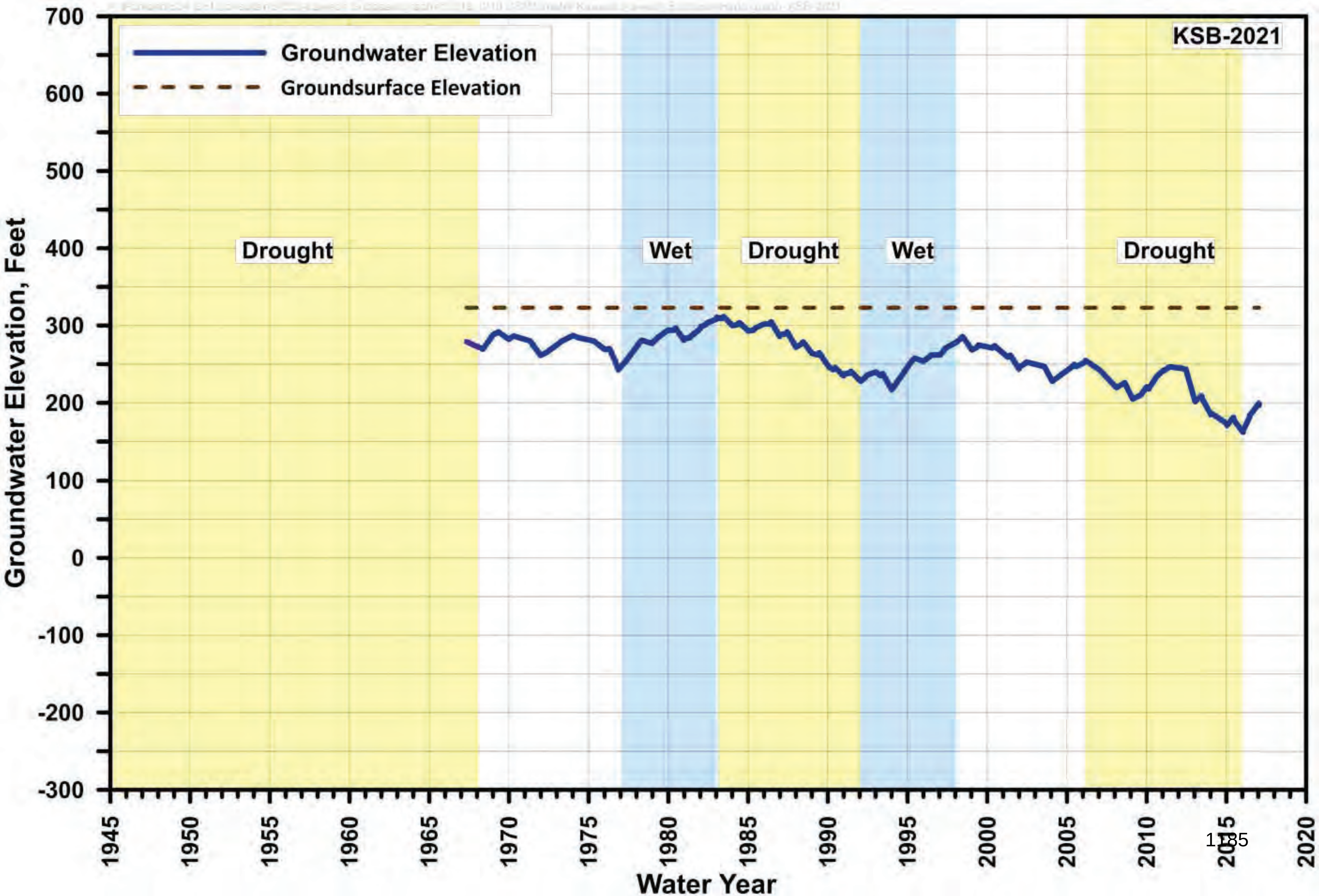

KSB-2014
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

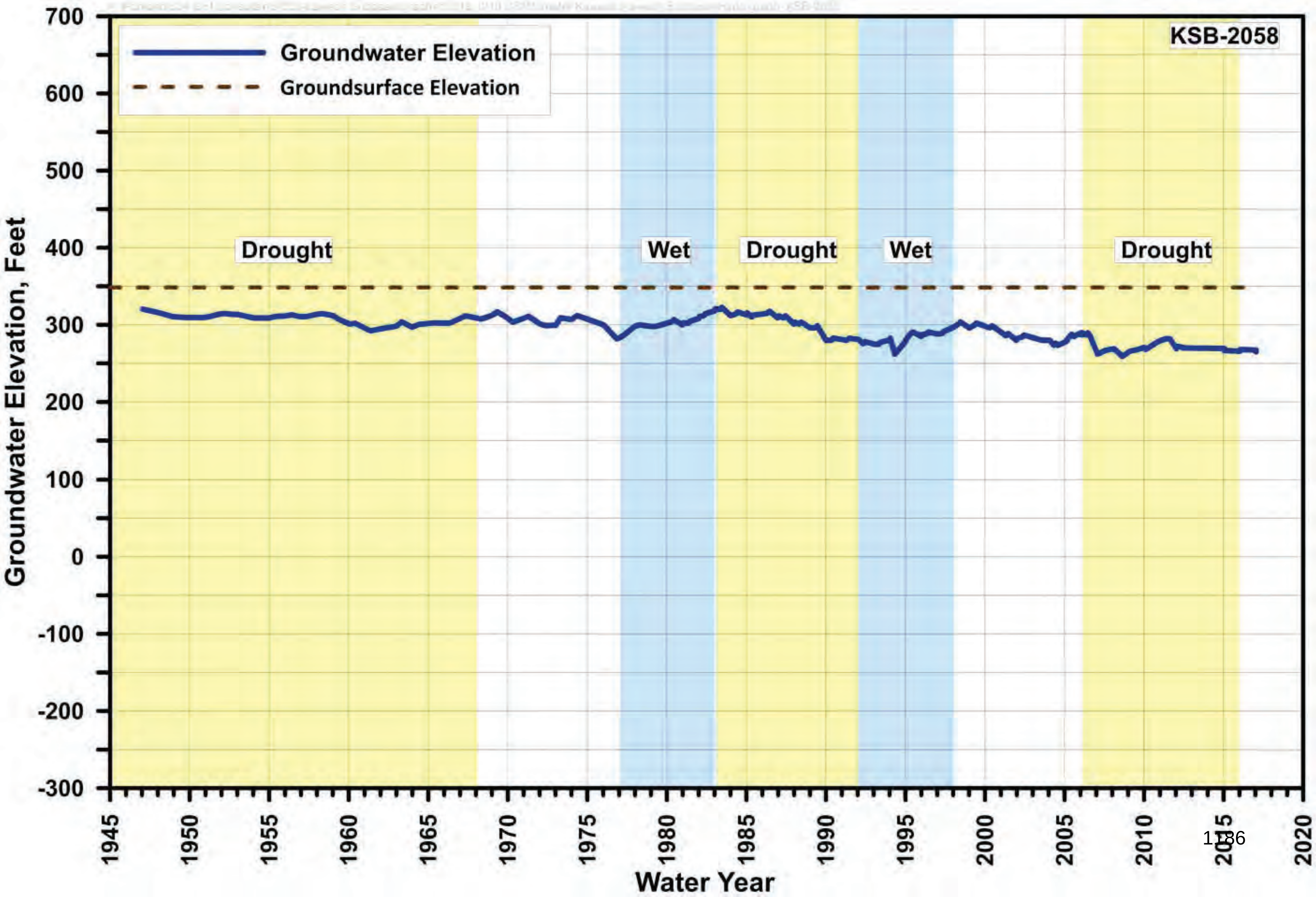


KSB-2015
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

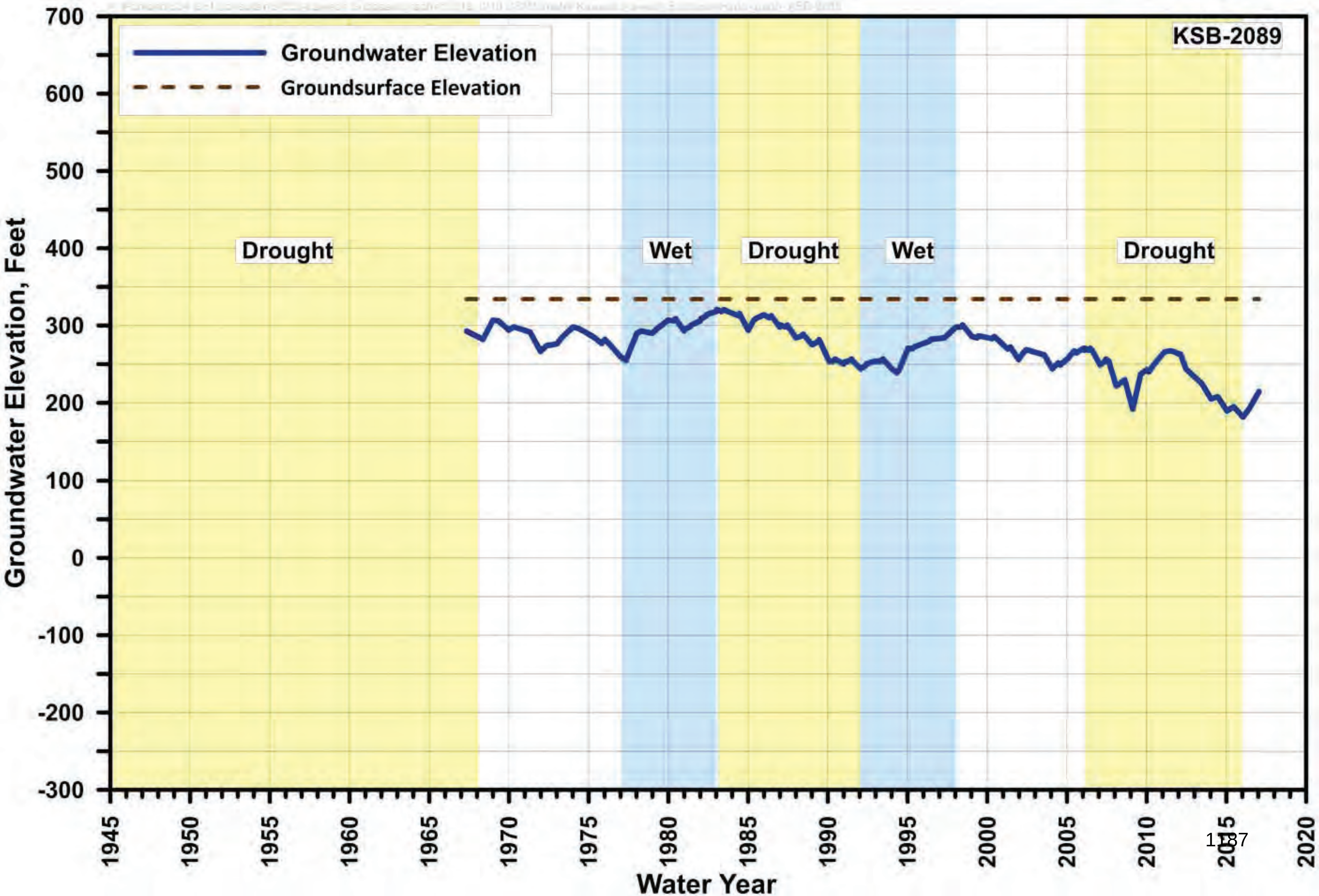

KSB-2016
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

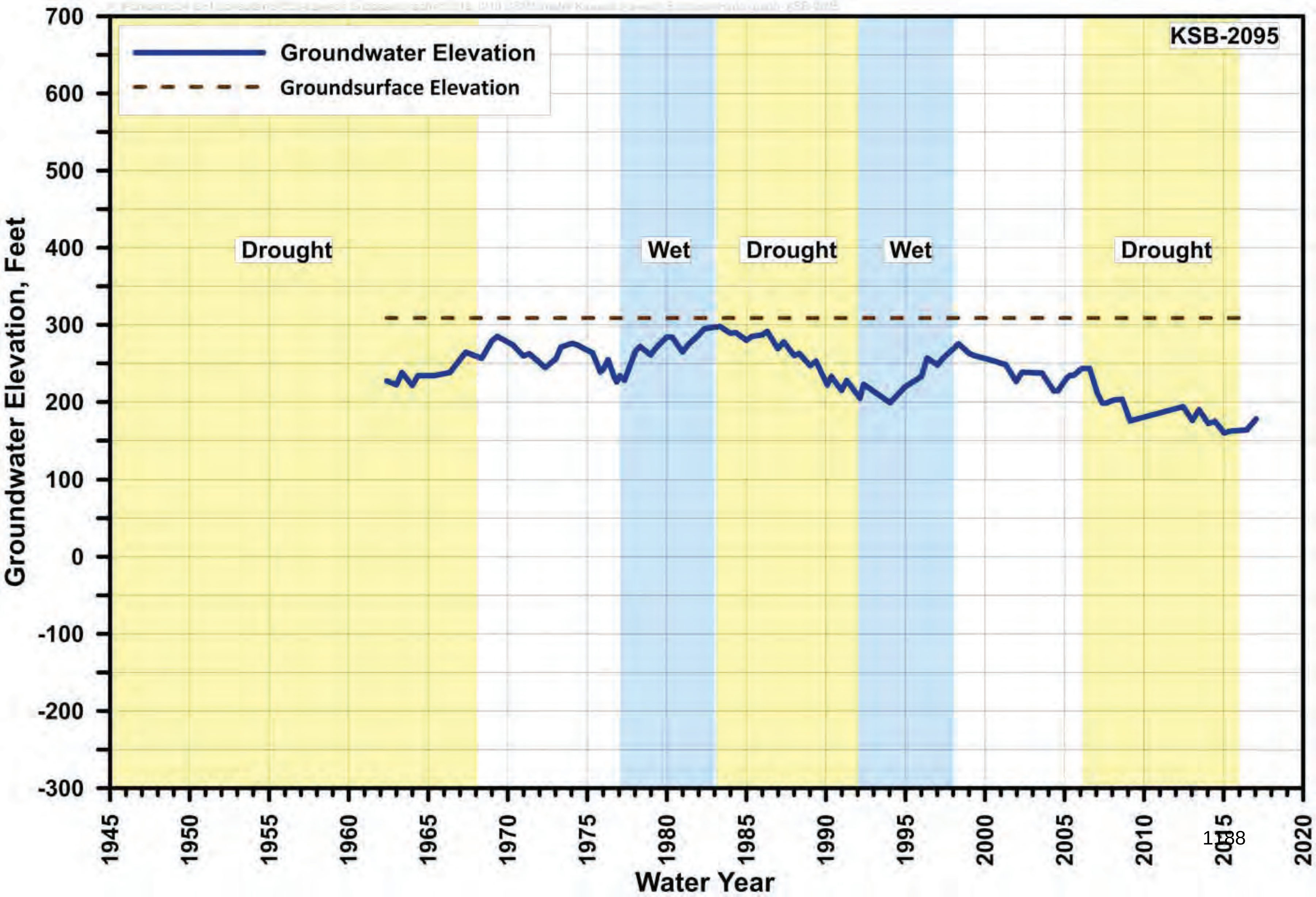

KSB-2017
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

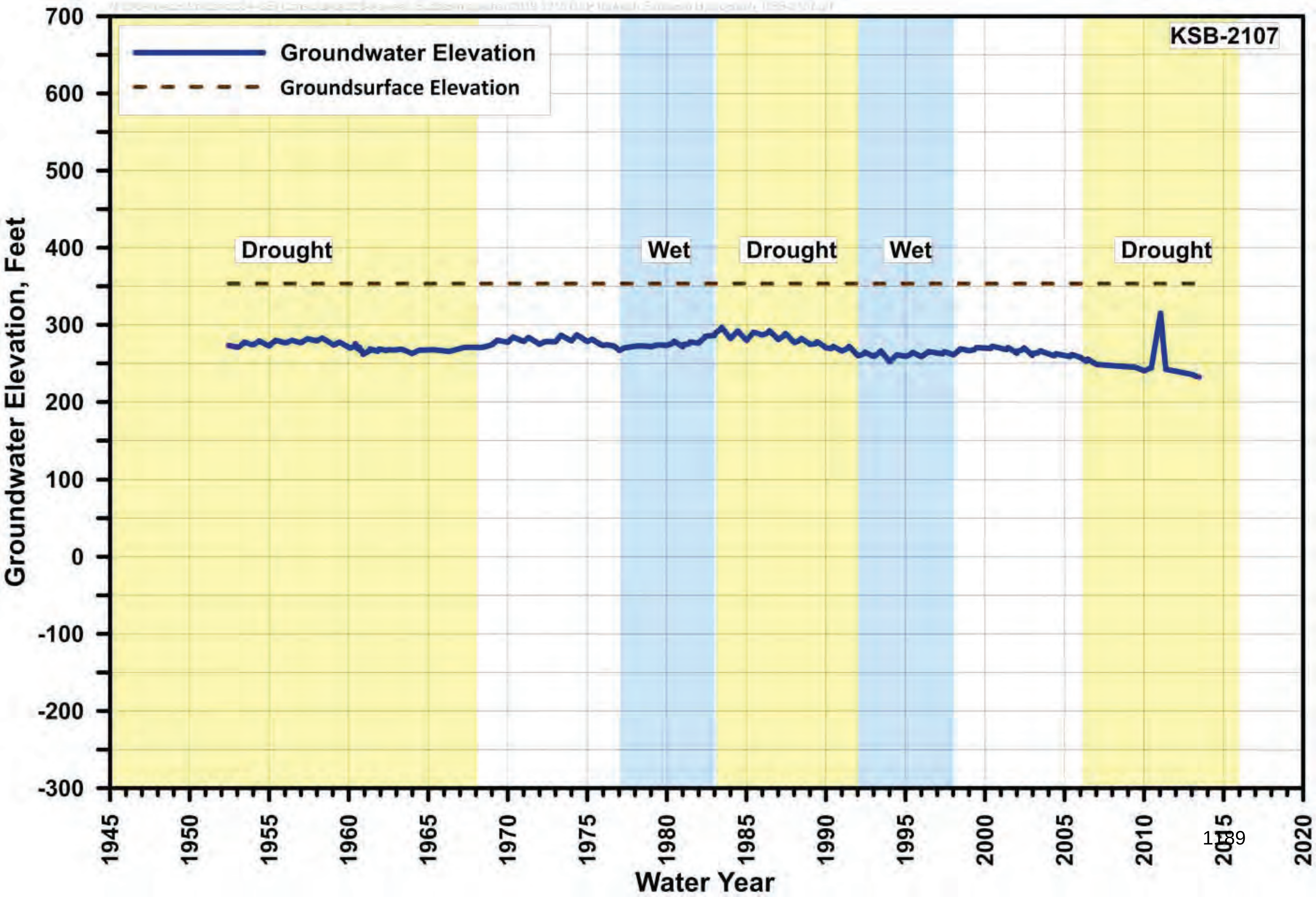

KSB-2021
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

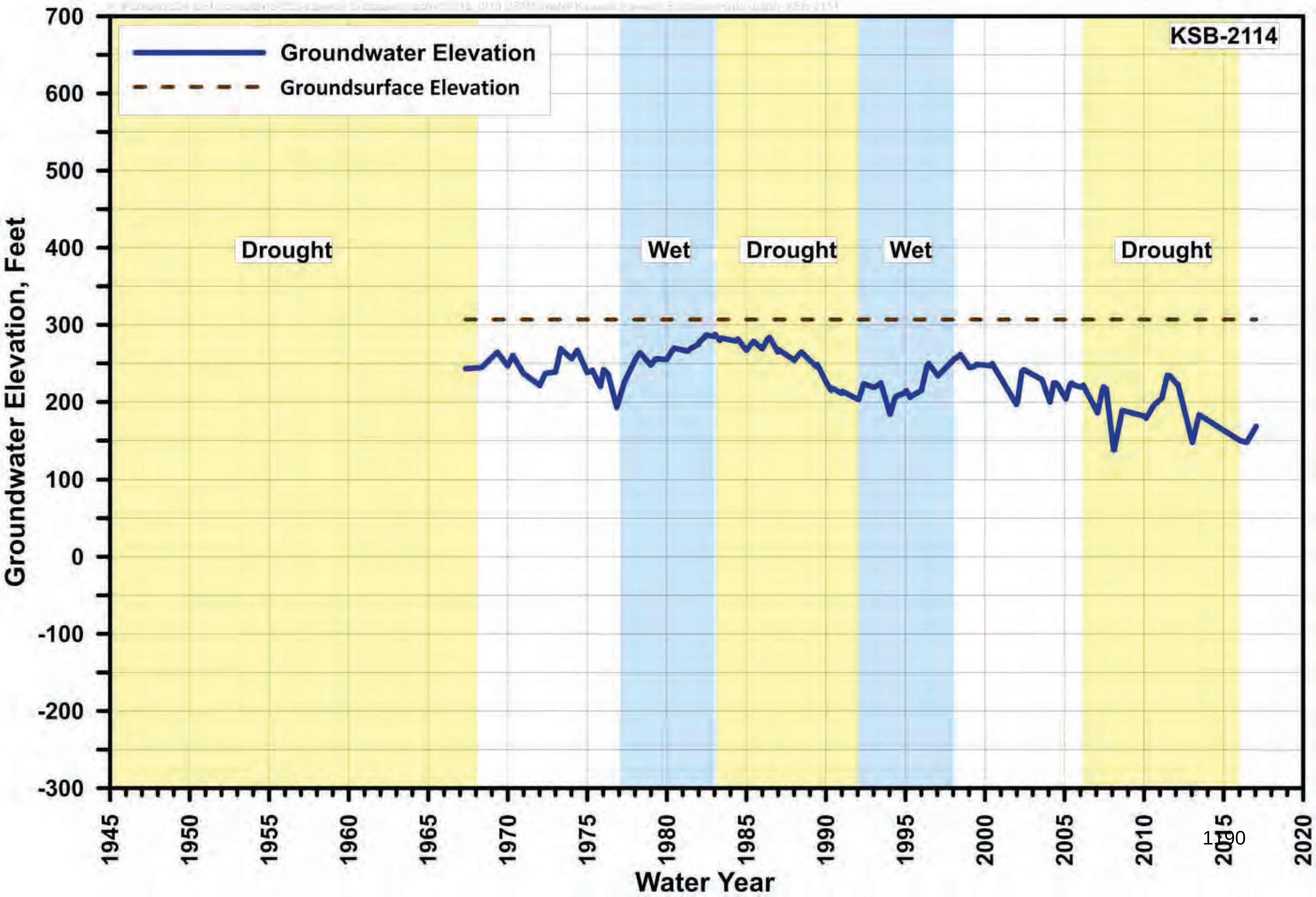


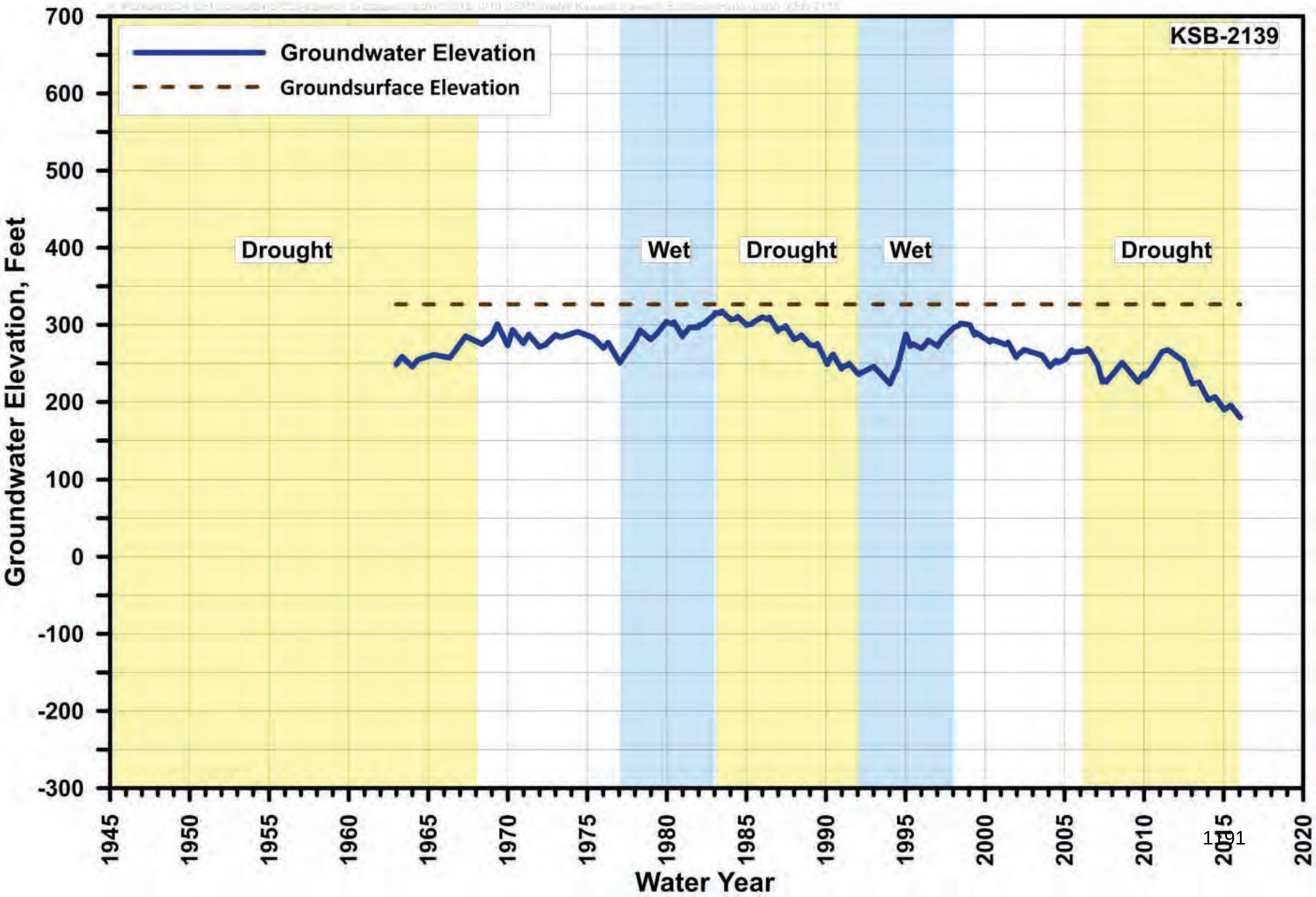
KSB-2058
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-2089
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

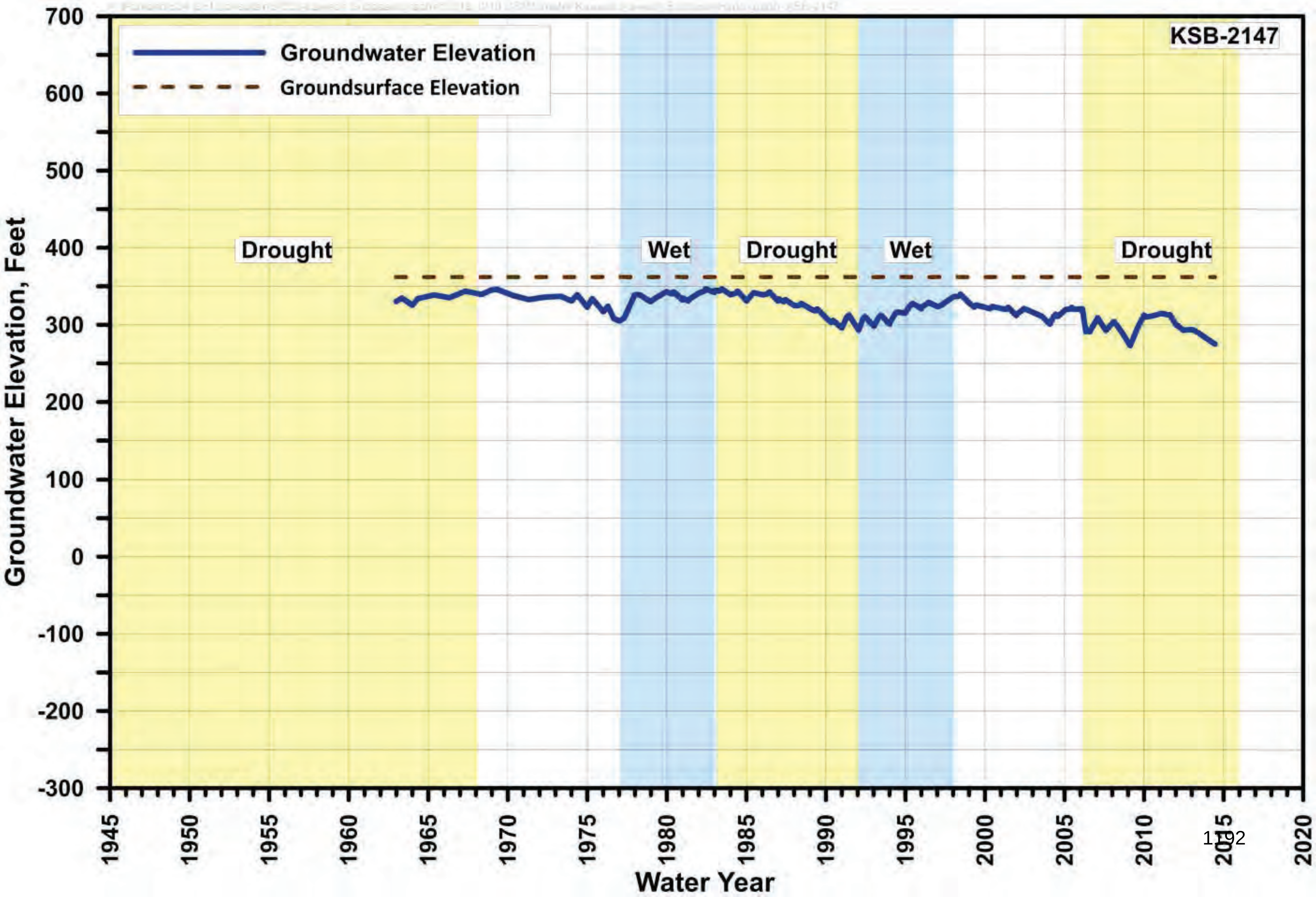

KSB-2095
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

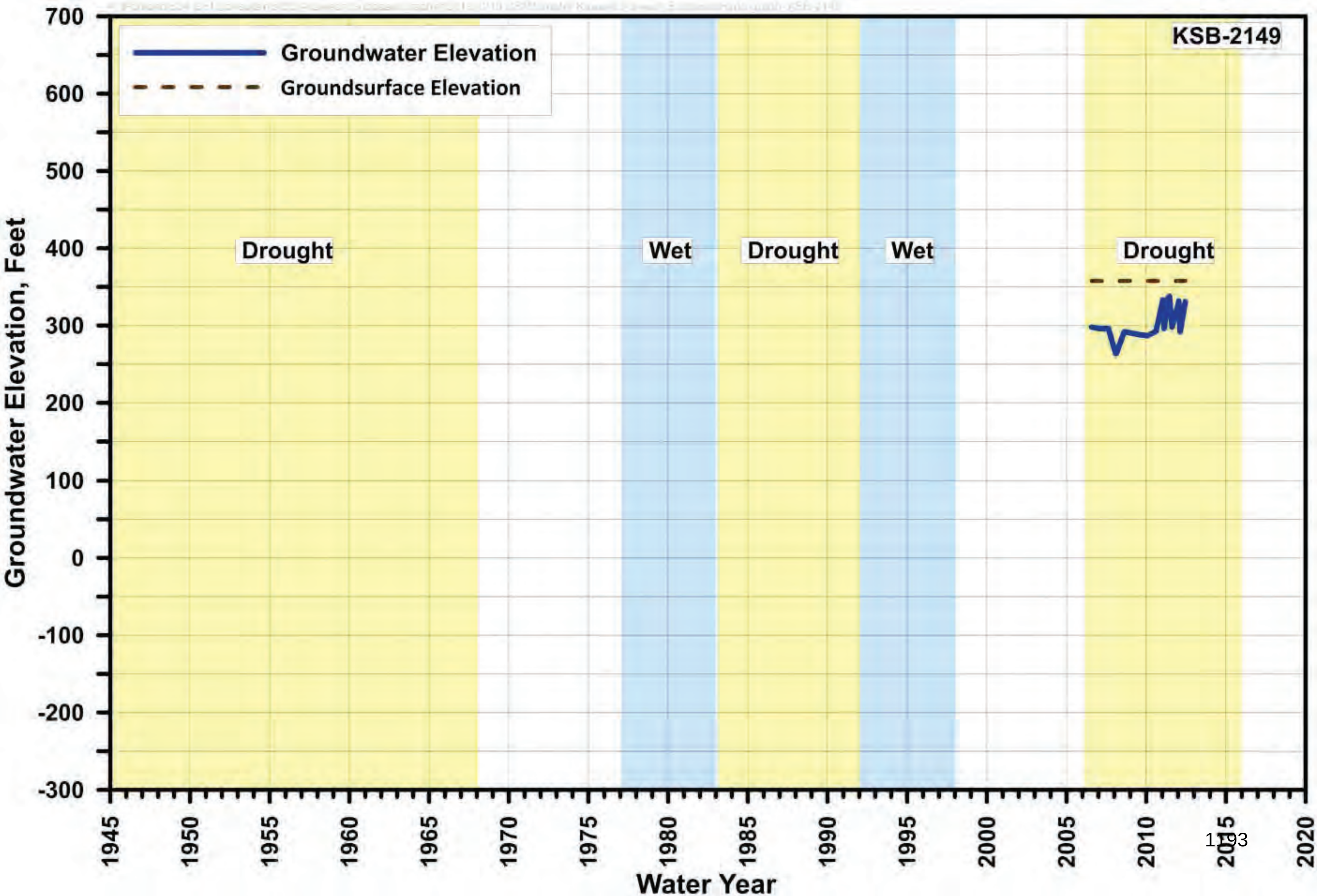

KSB-2107
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

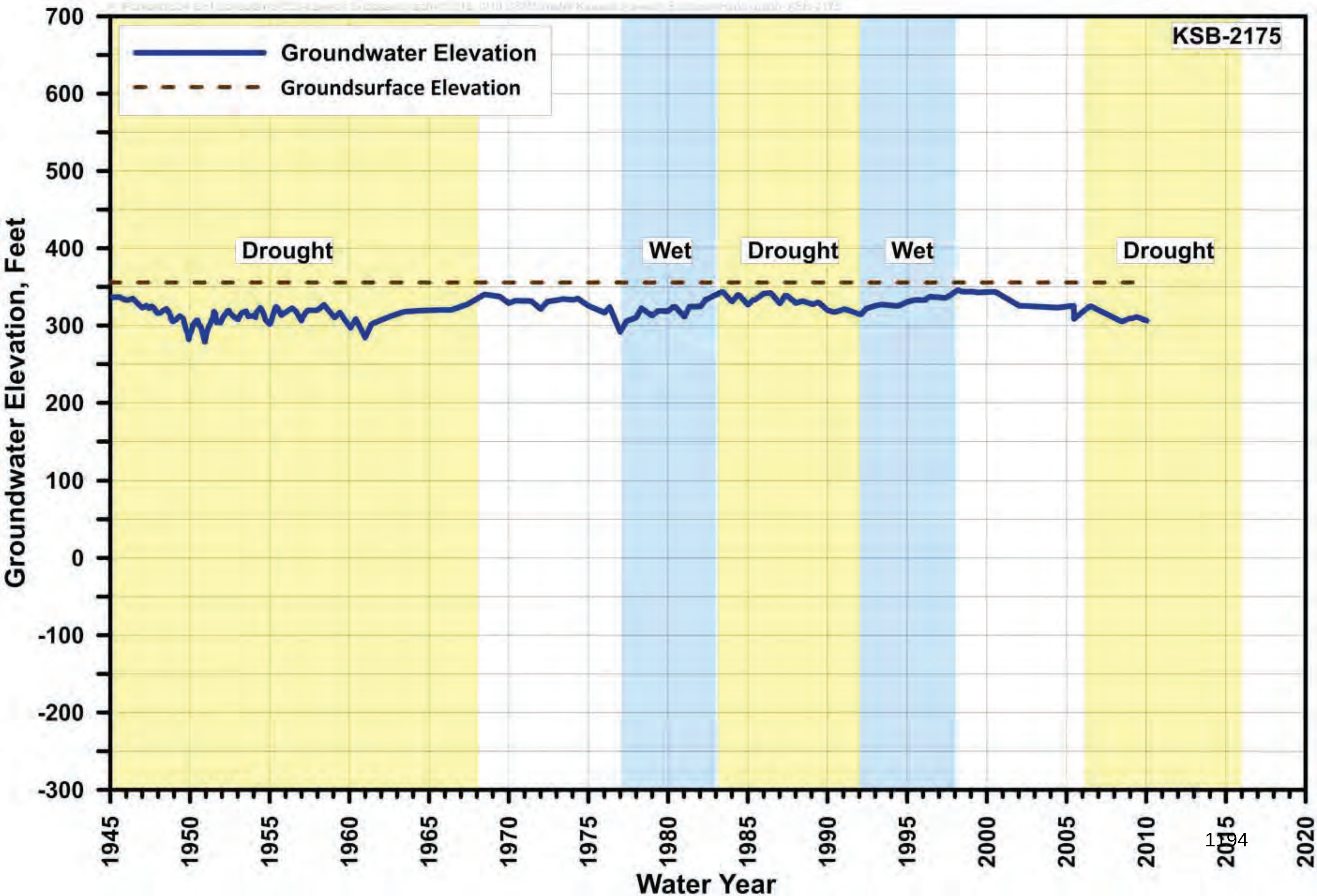

KSB-2114
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

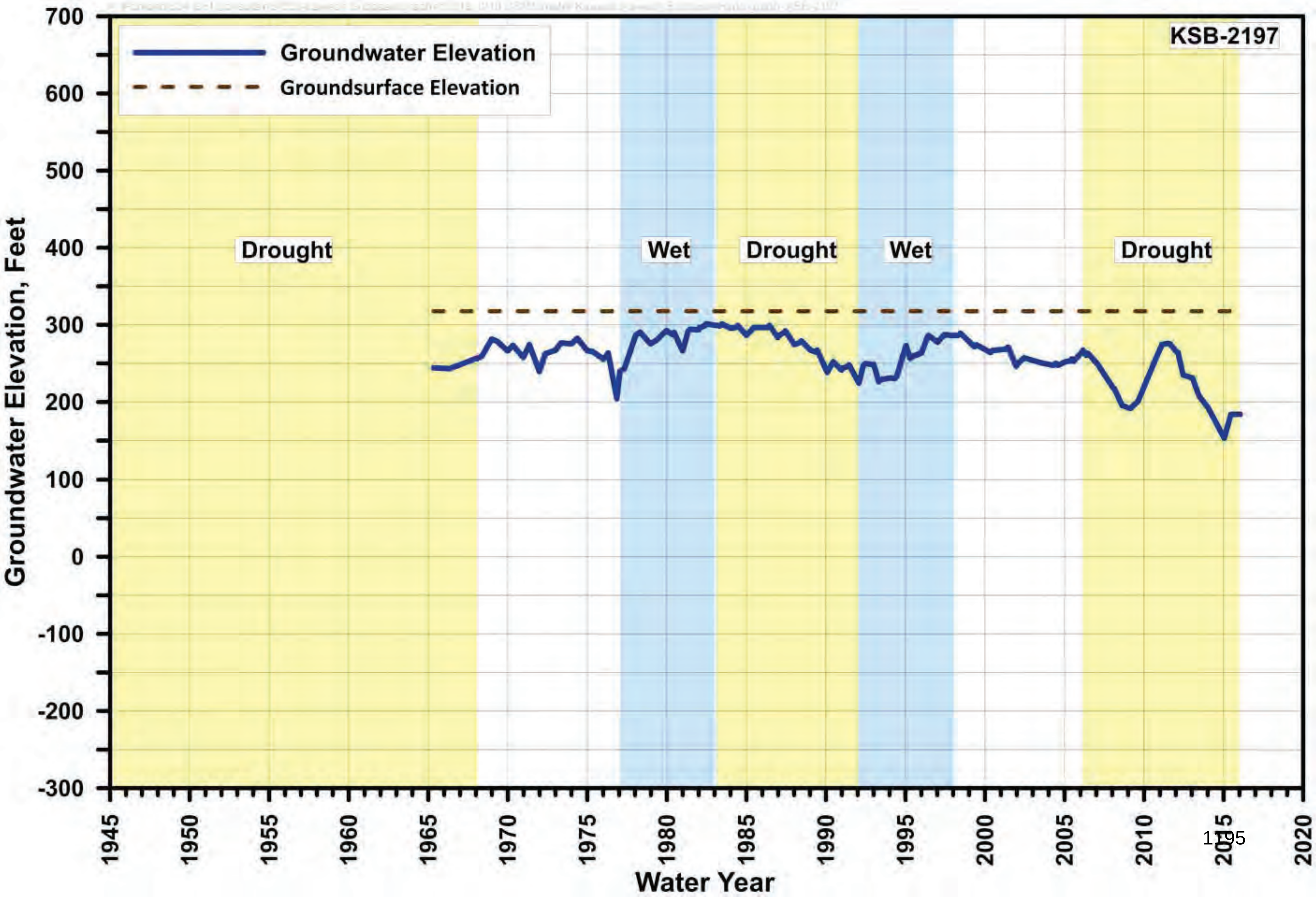


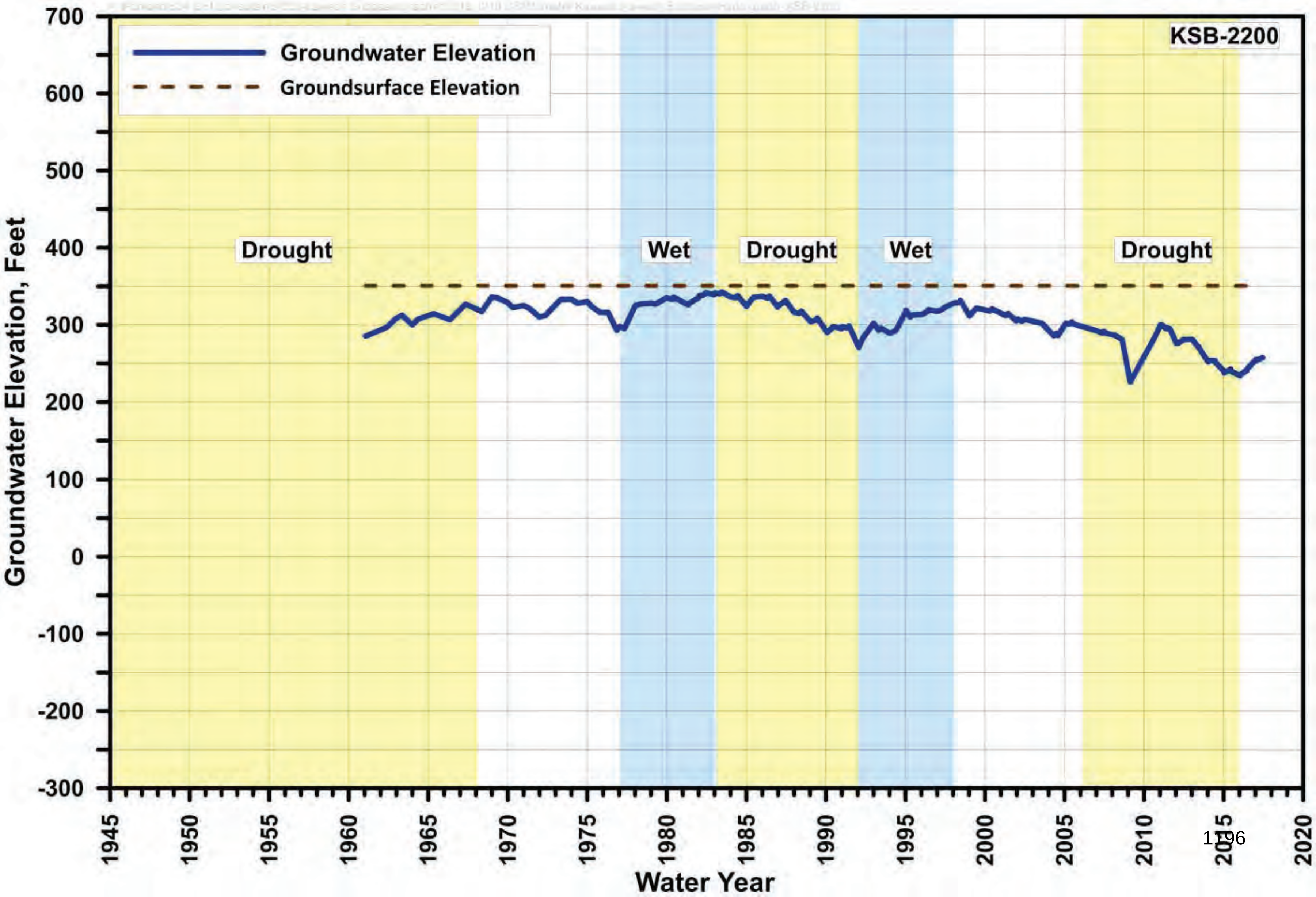
KSB-2139
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-2147
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

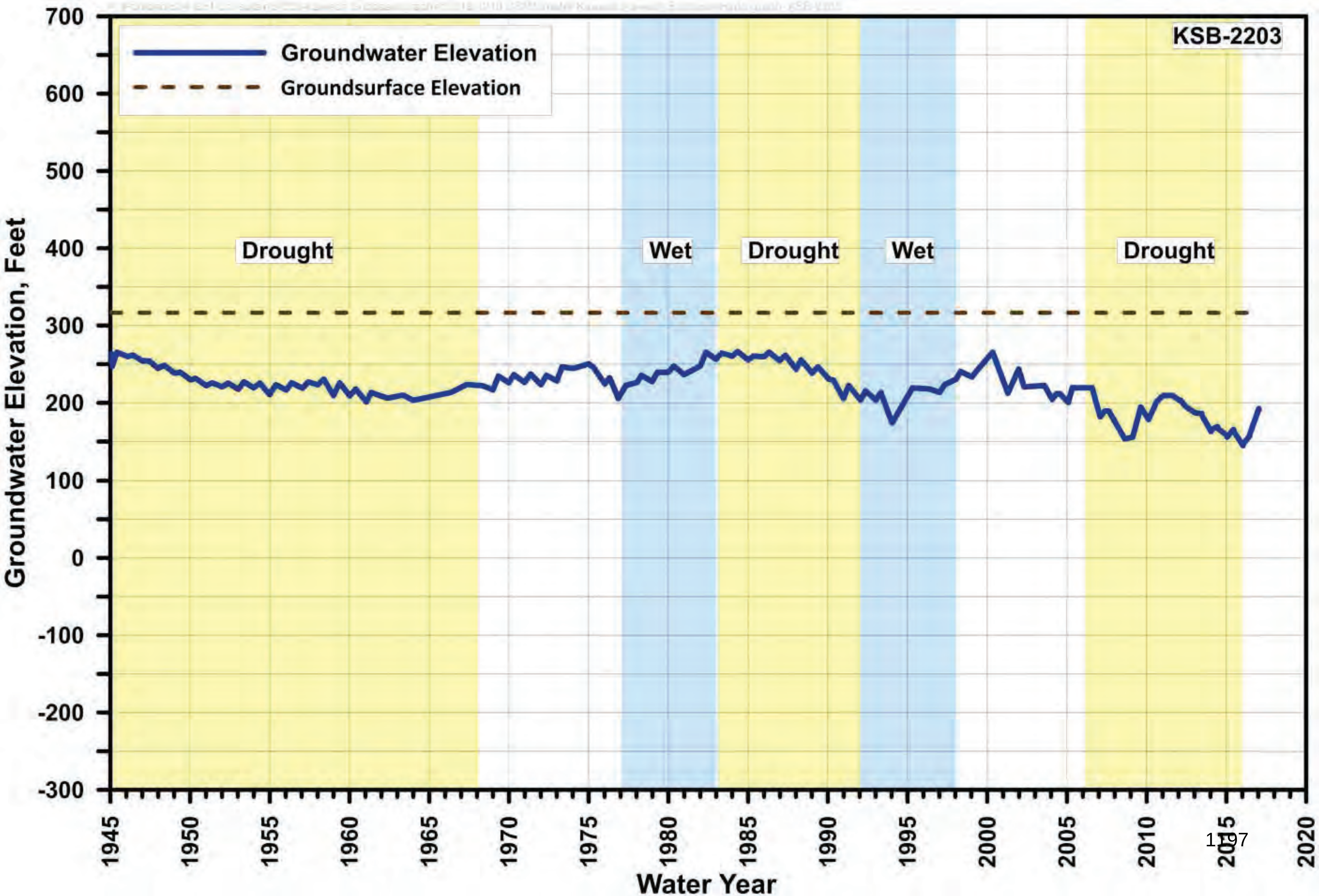

KSB-2149
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

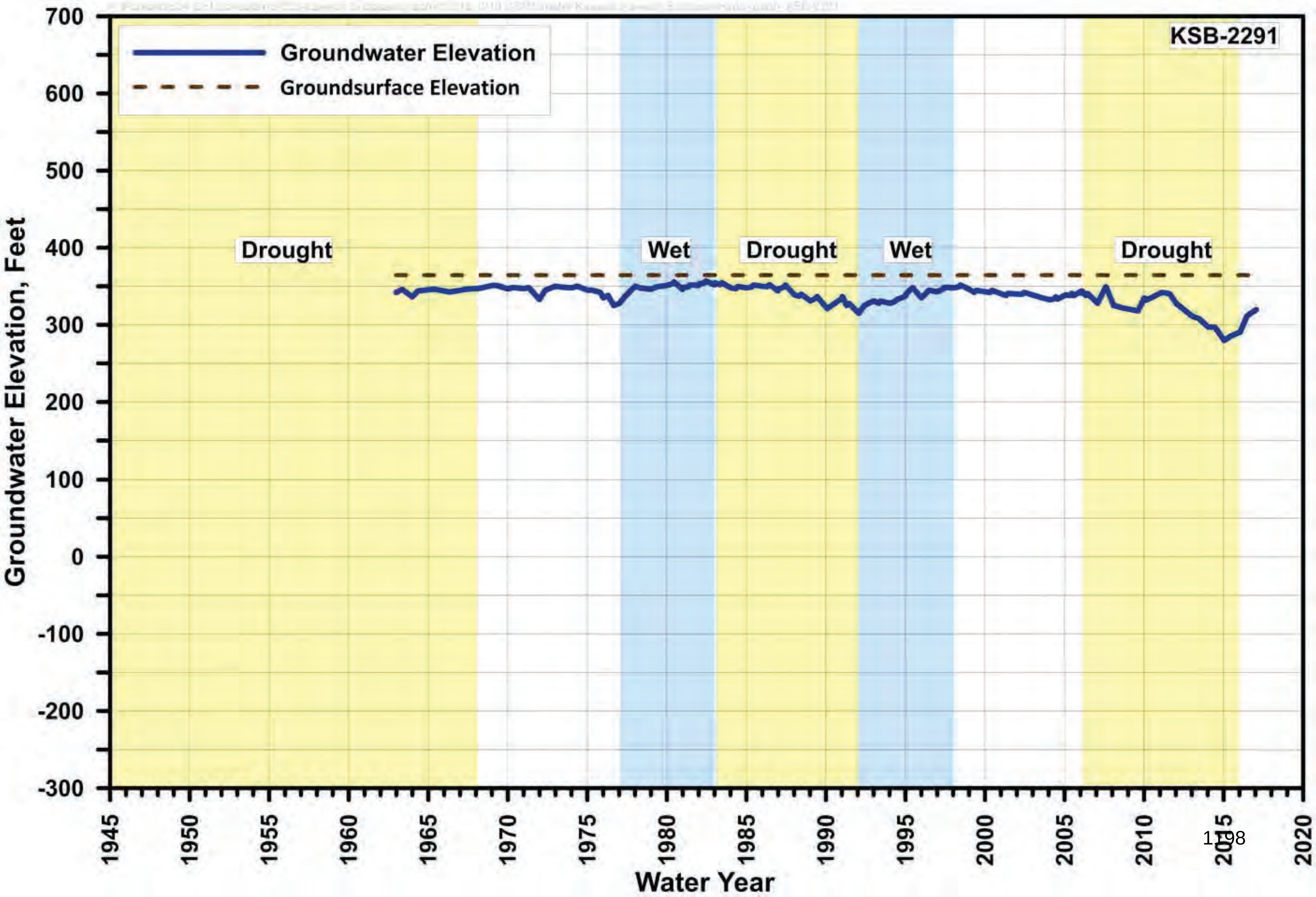

KSB-2175
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

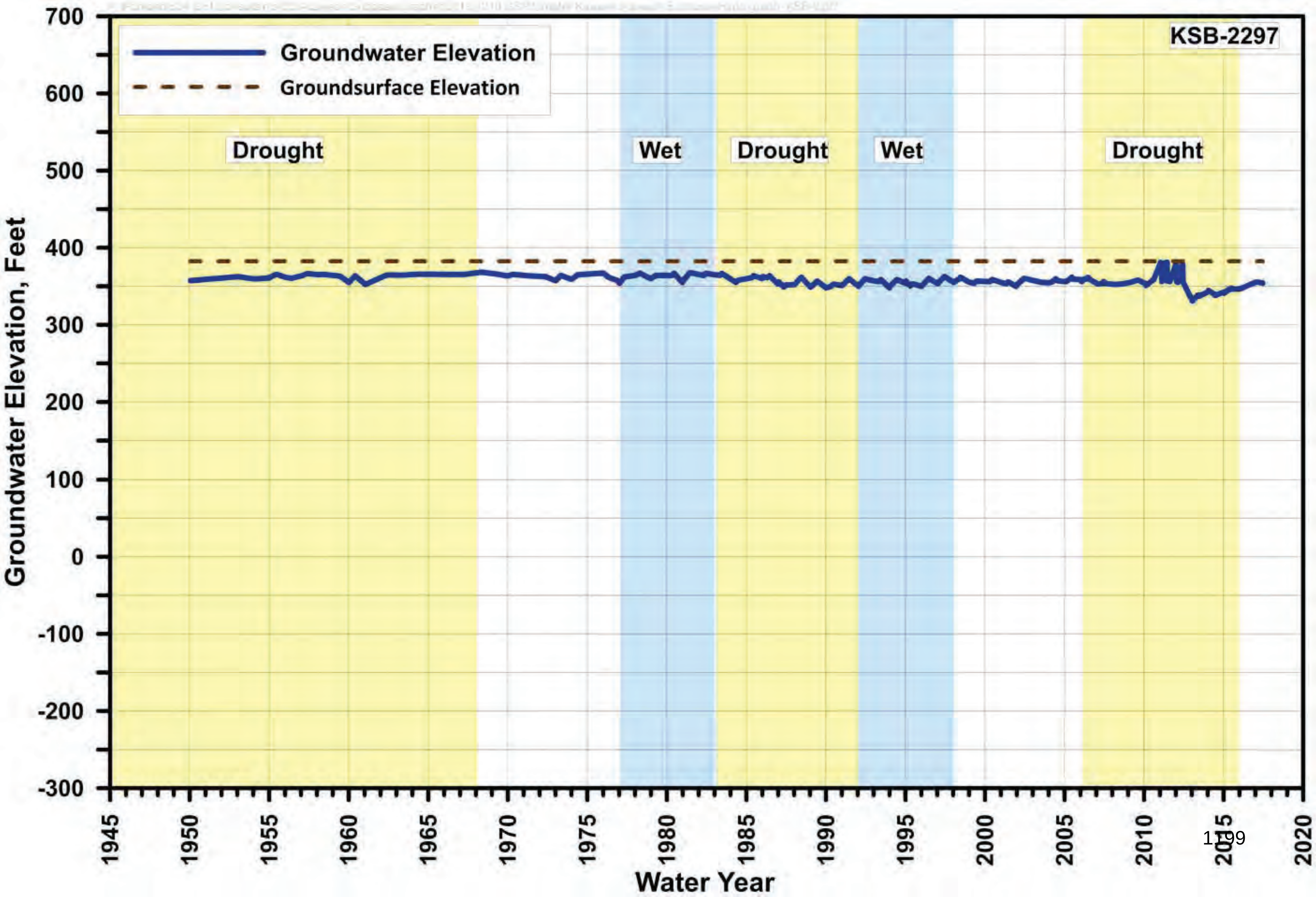

KSB-2197
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020



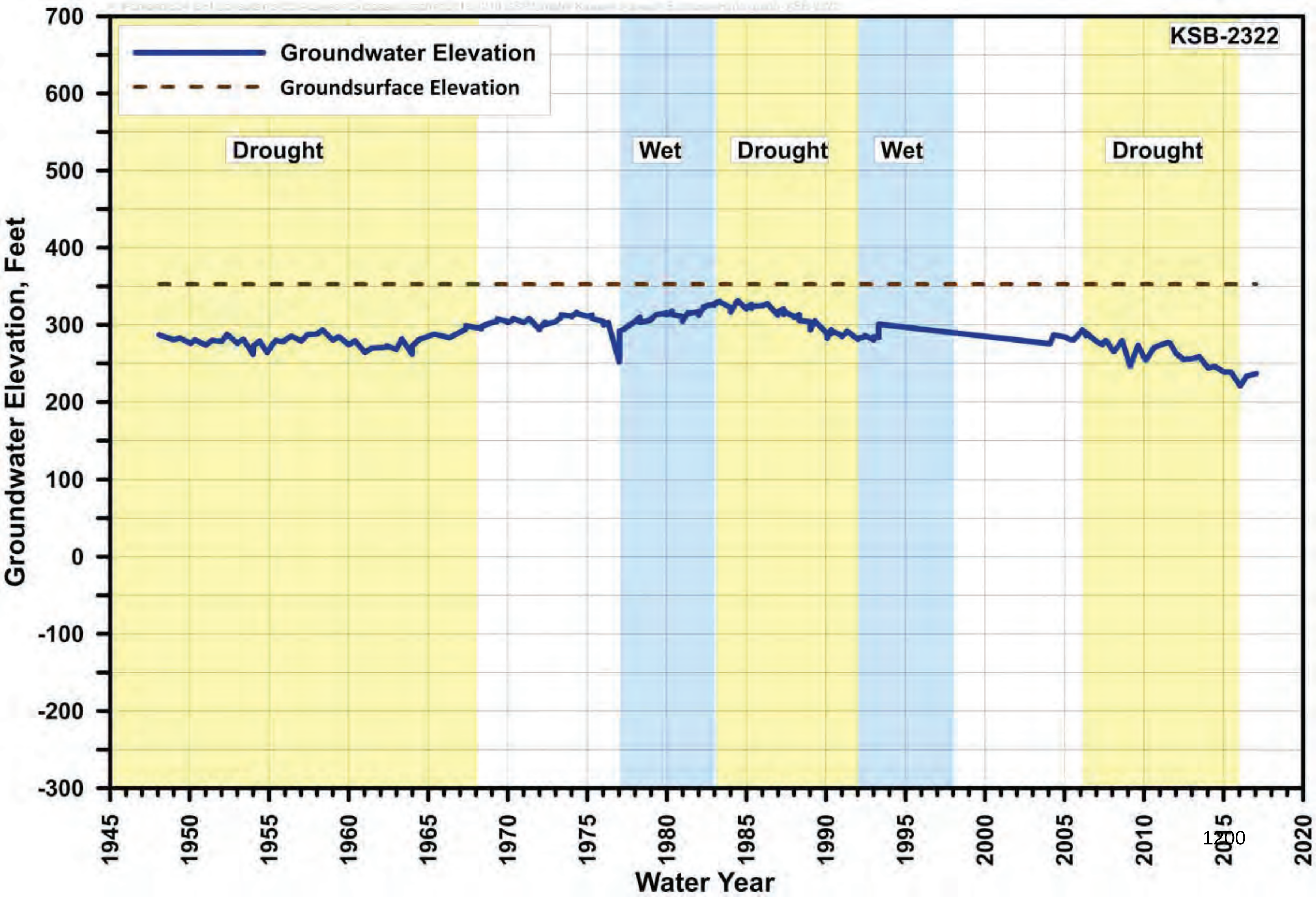
KSB-2200
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

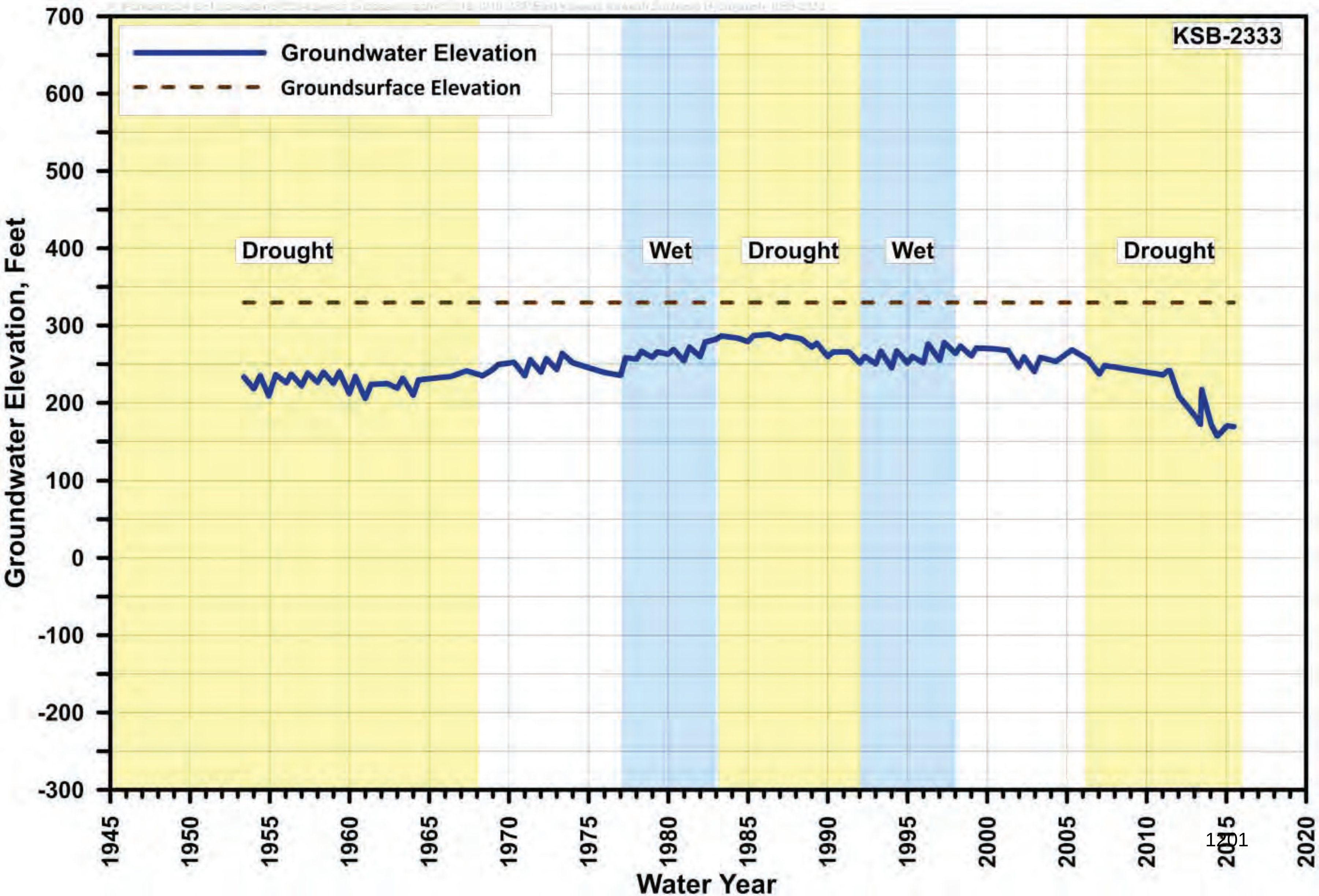

KSB-2203
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

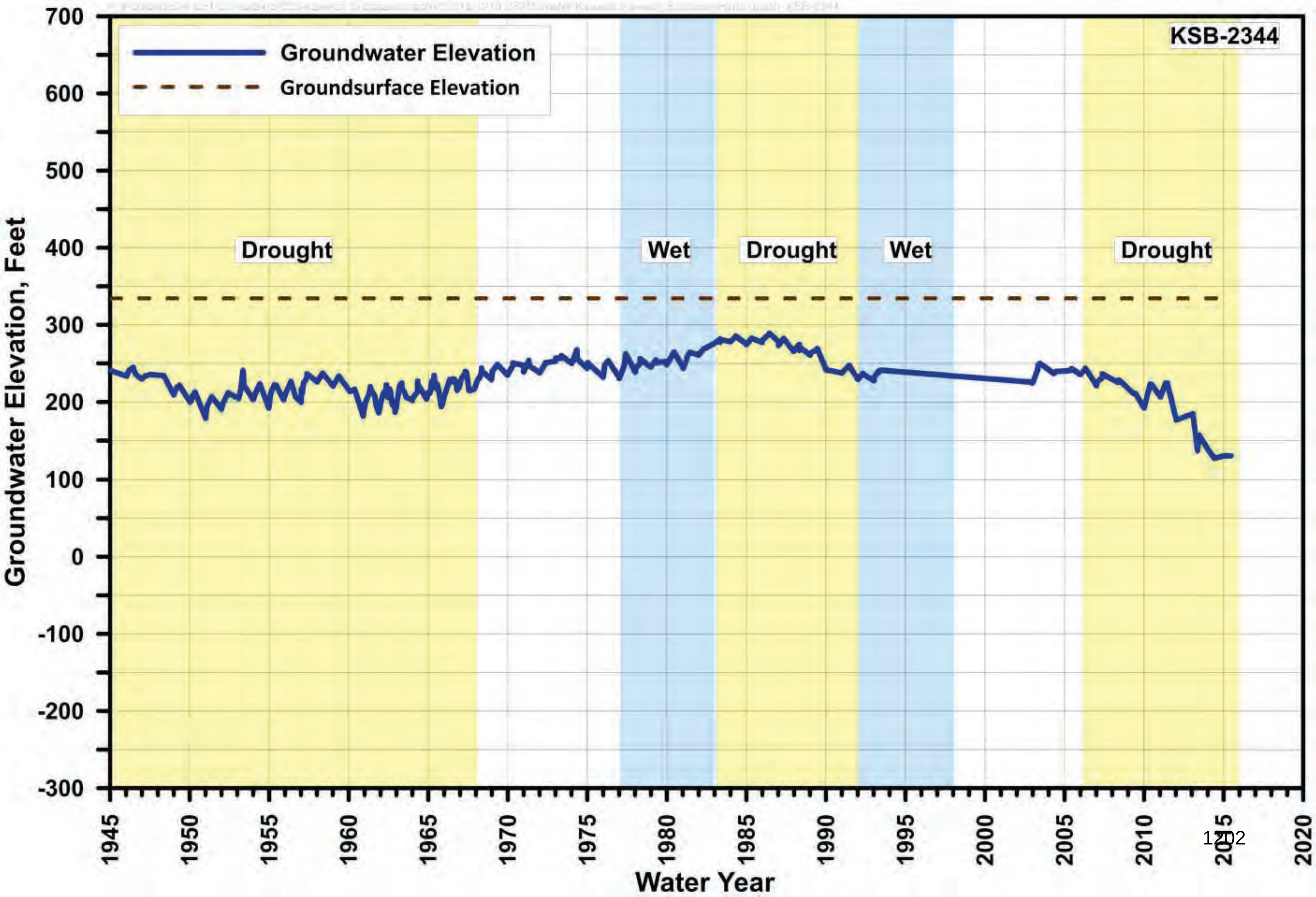

KSB-2291
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



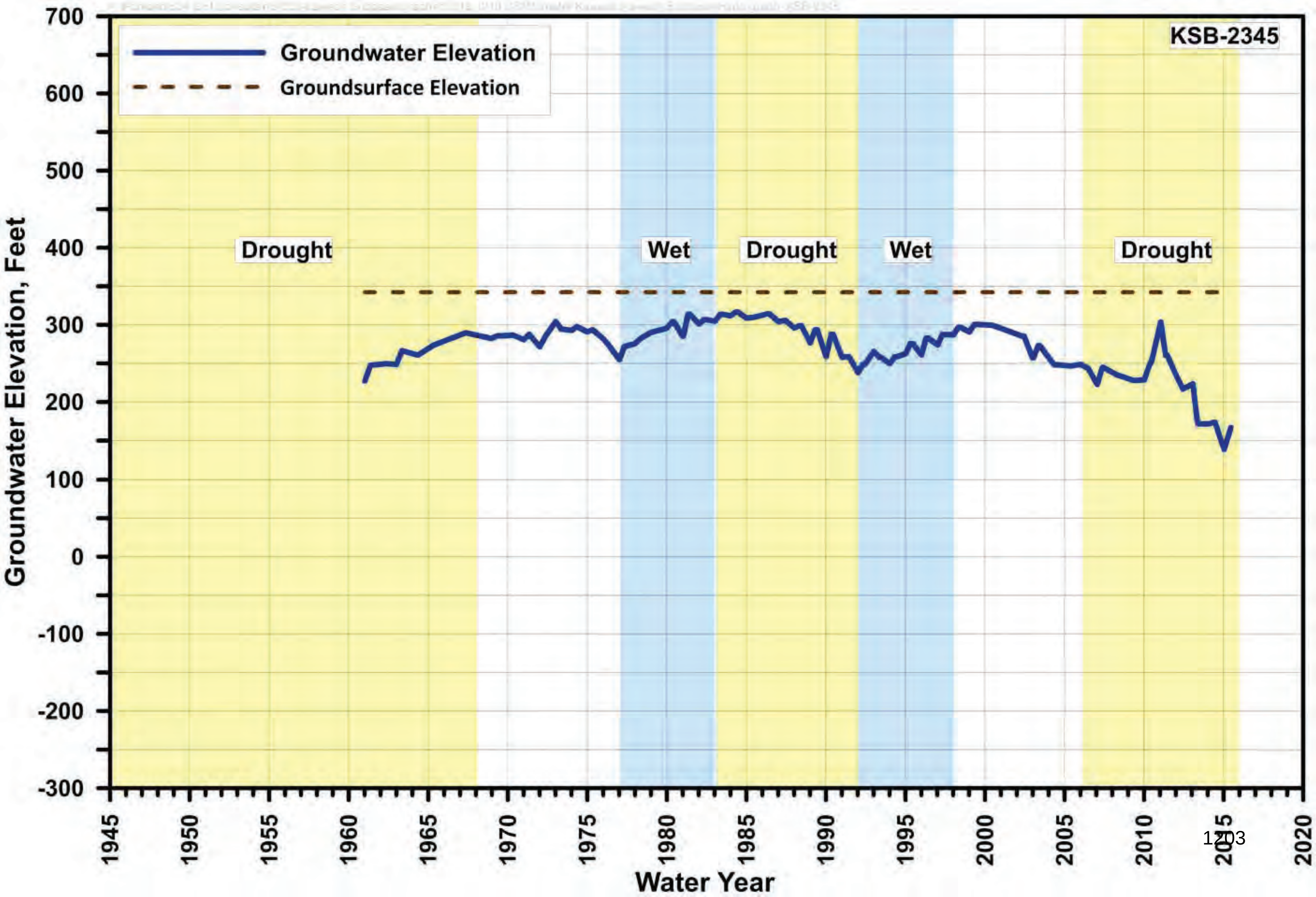
KSB-2297
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

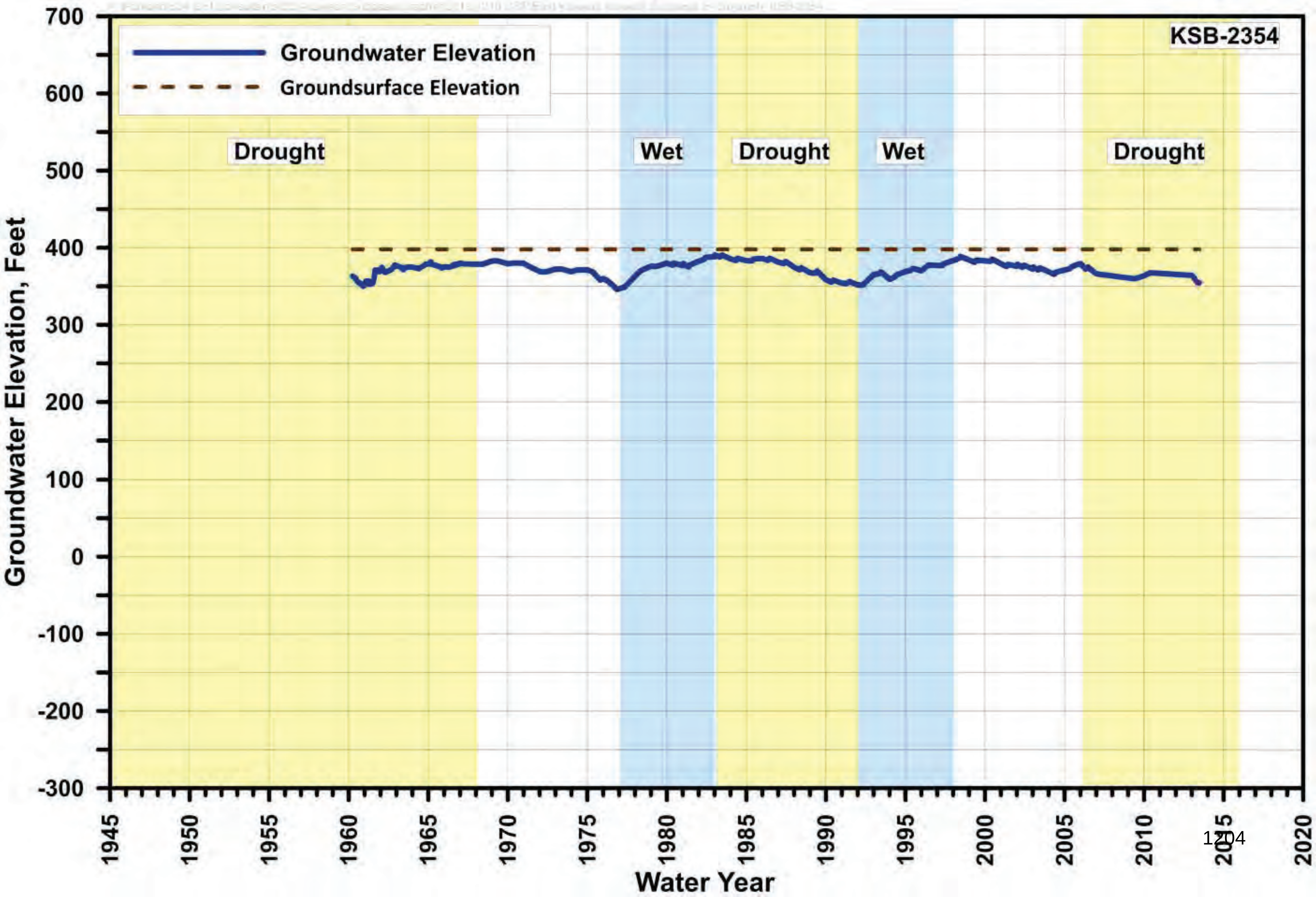

KSB-2322
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

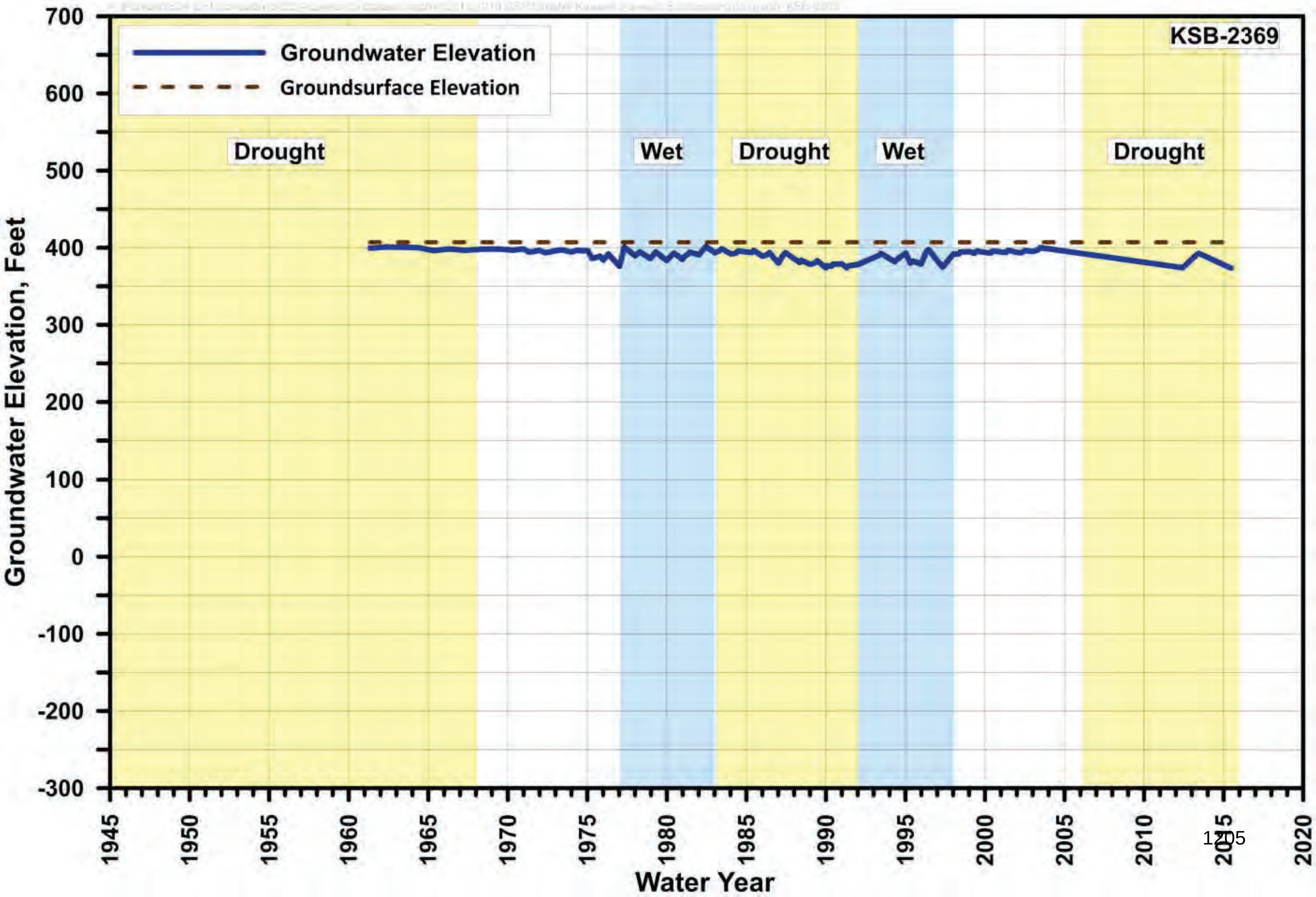

KSB-2333
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

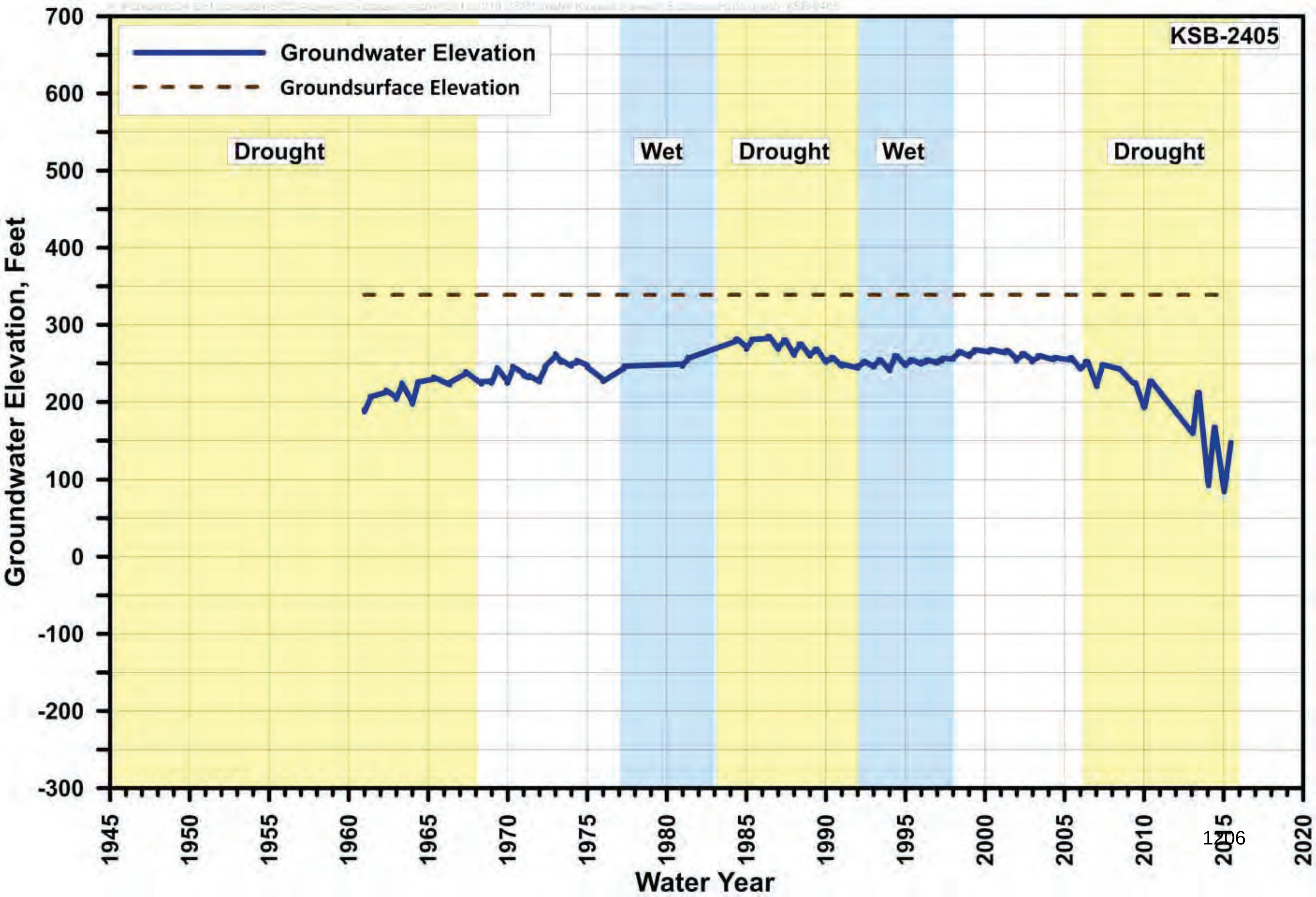


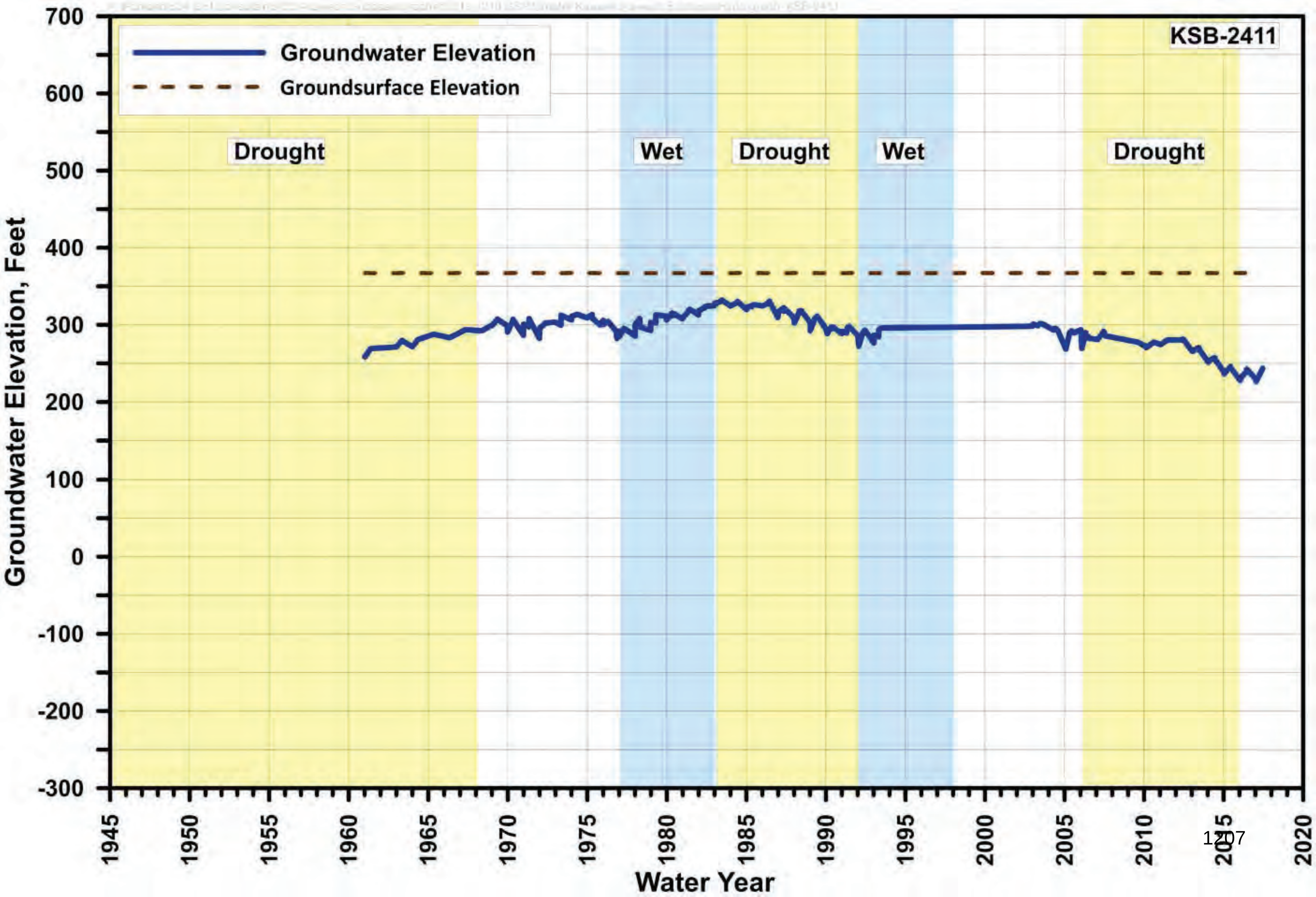
KSB-2344
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

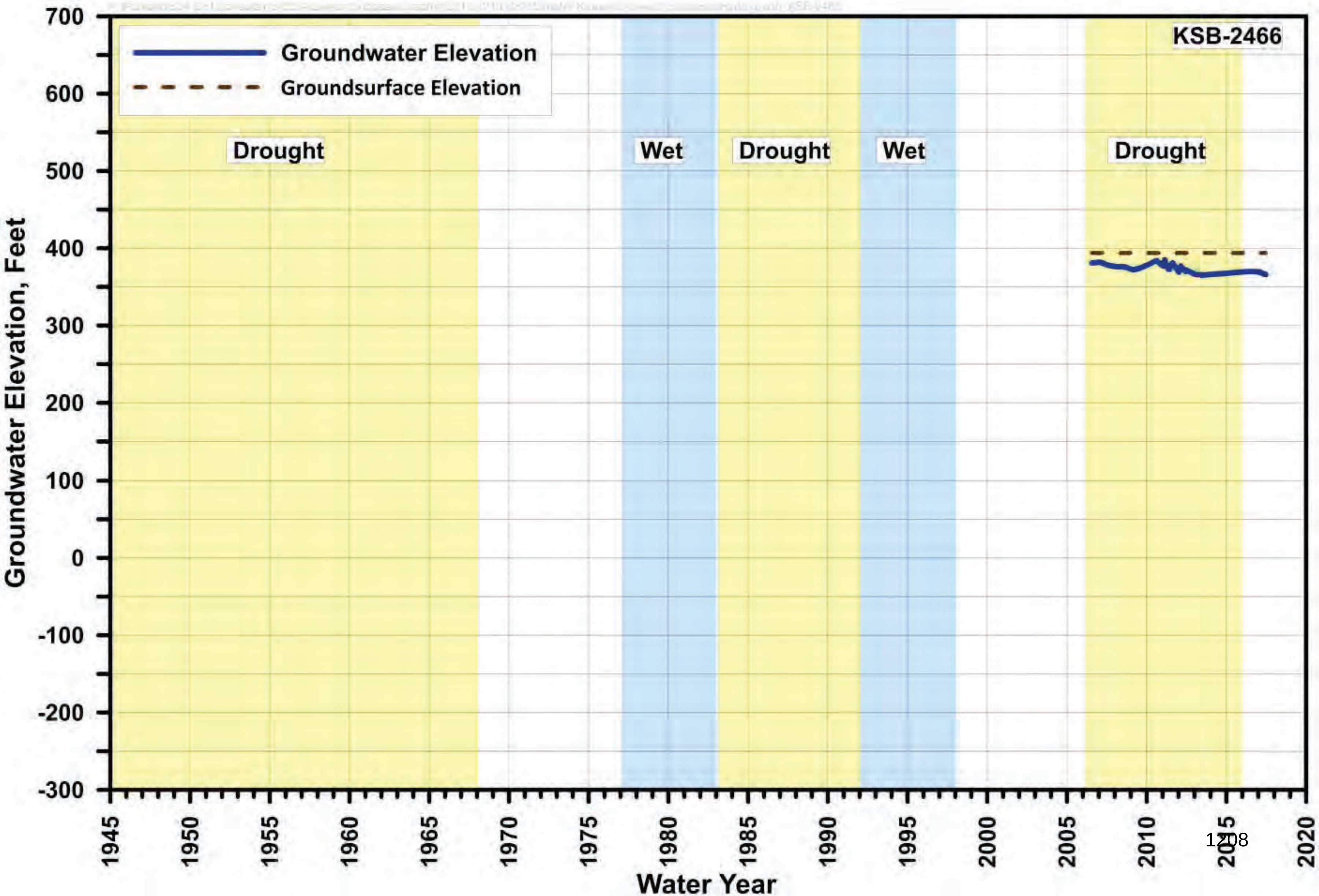

KSB-2345
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-2354
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

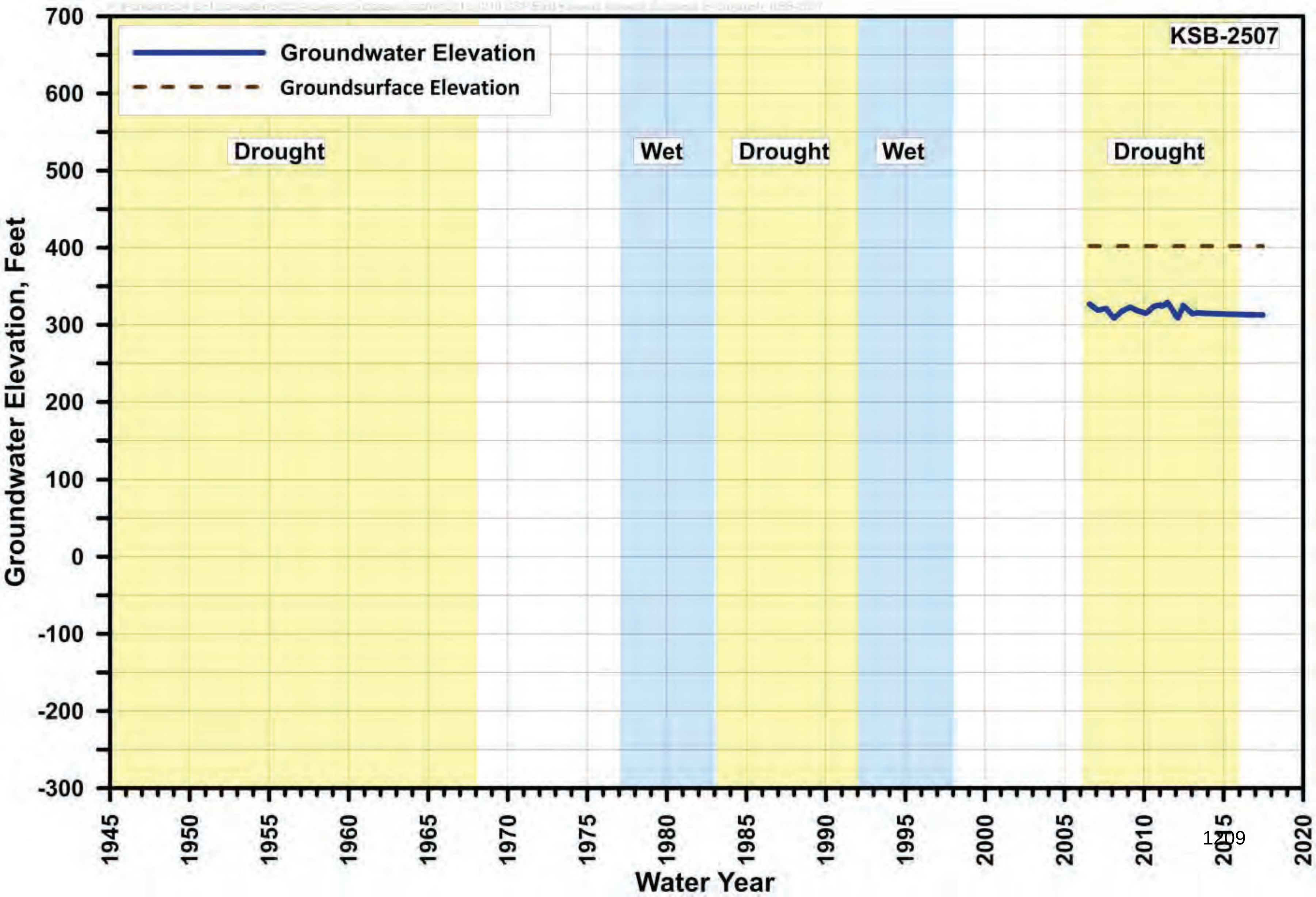

KSB-2369
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-2405
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

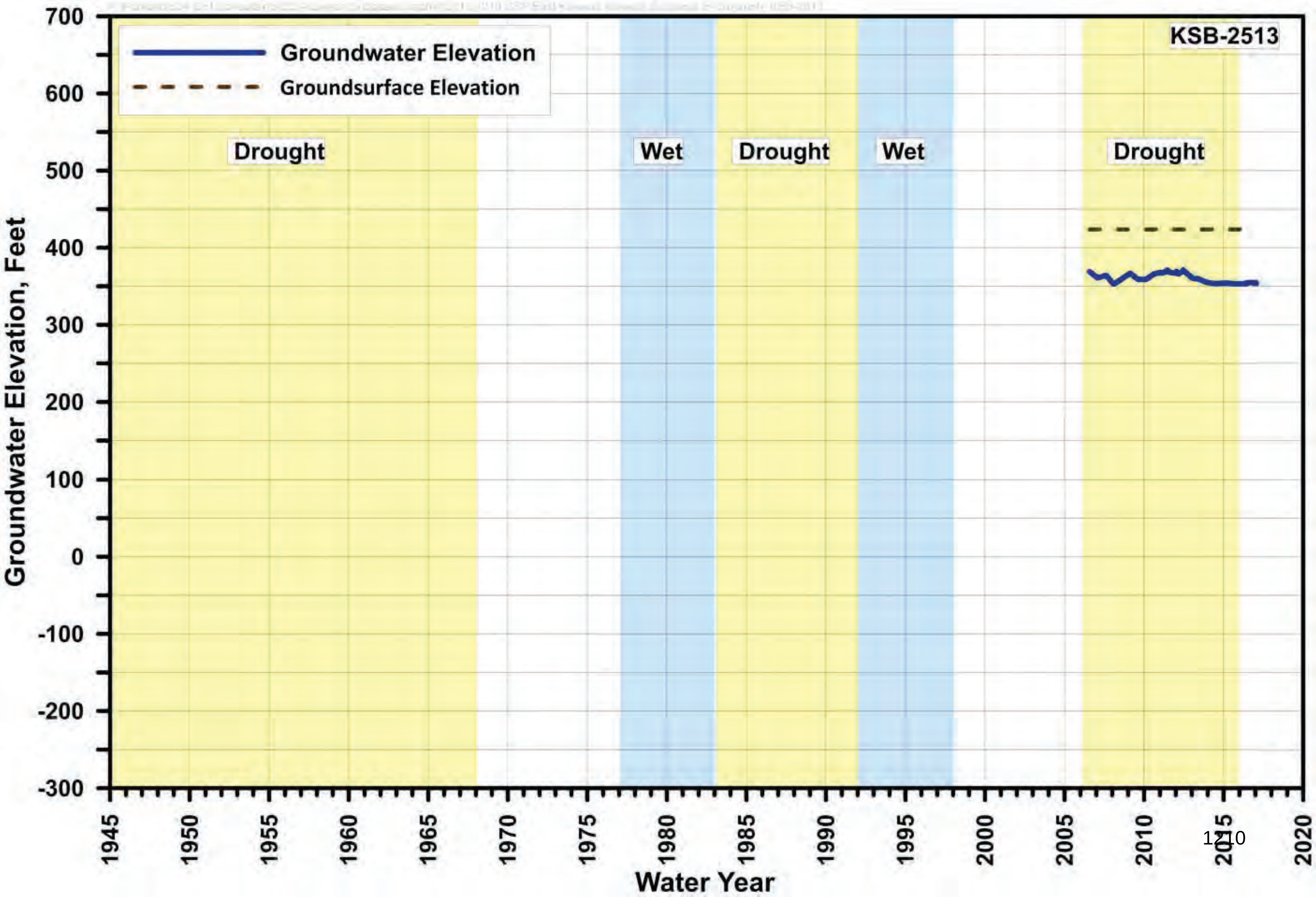

KSB-2411
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

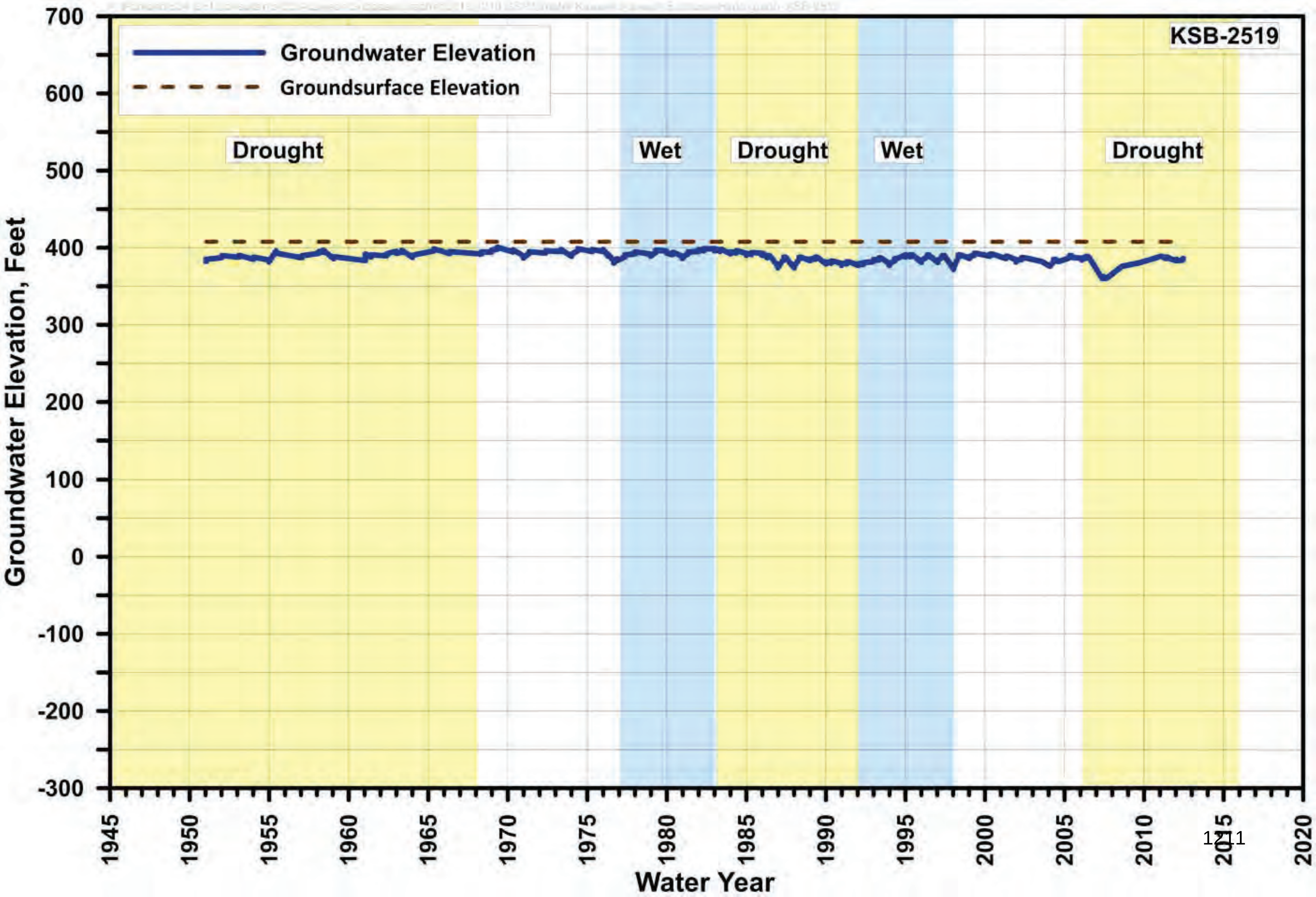


KSB-2466
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

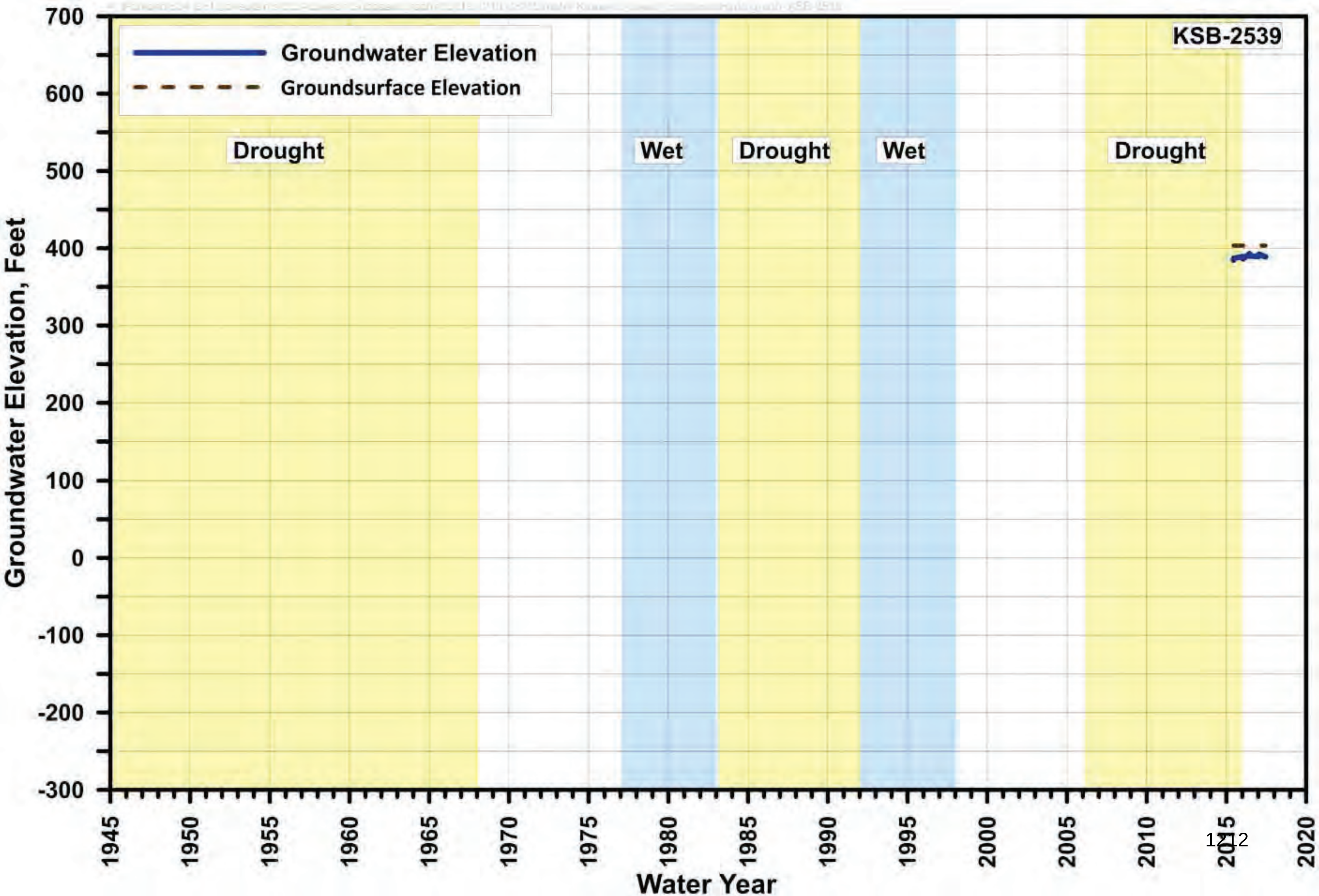


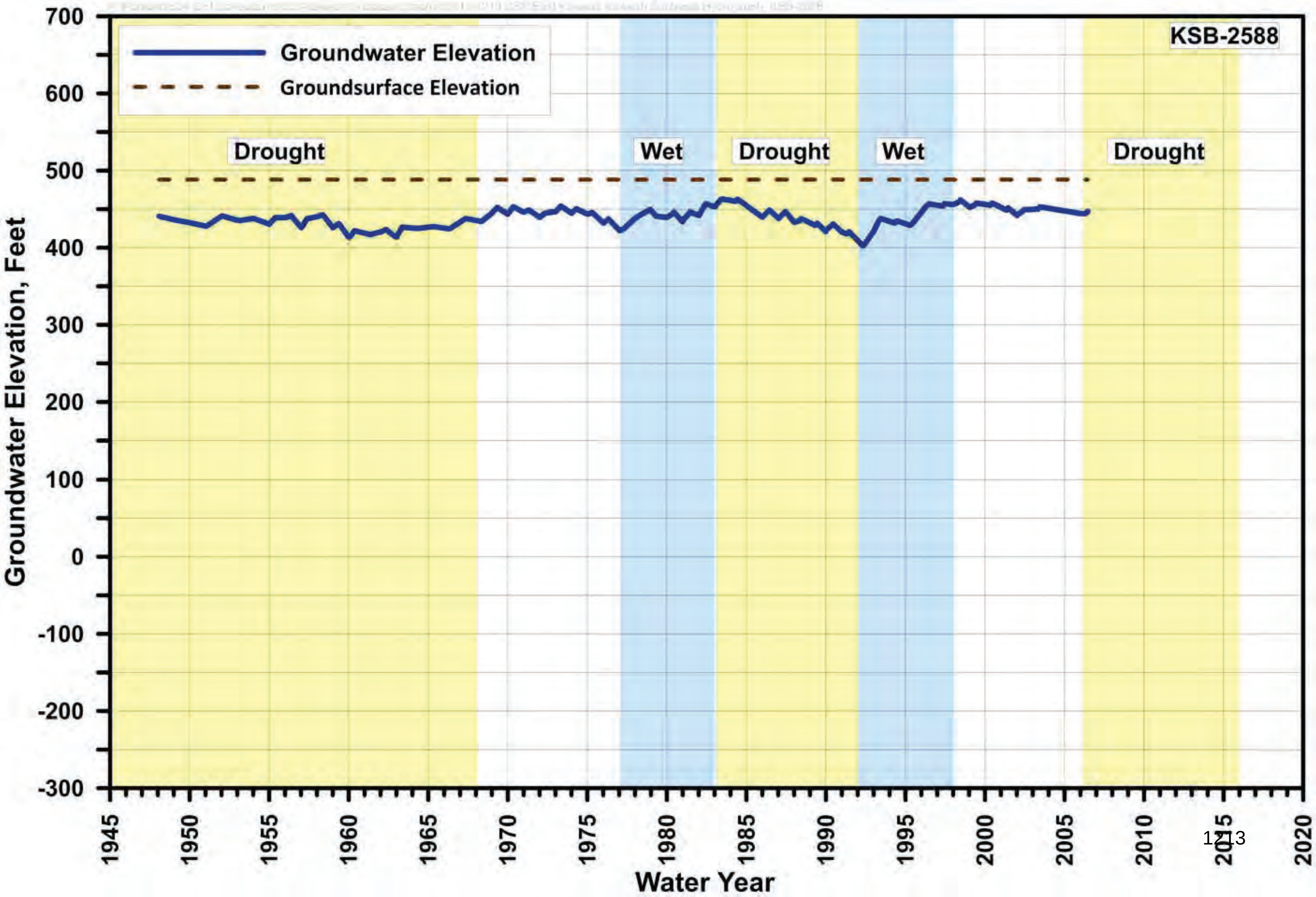
KSB-2507
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

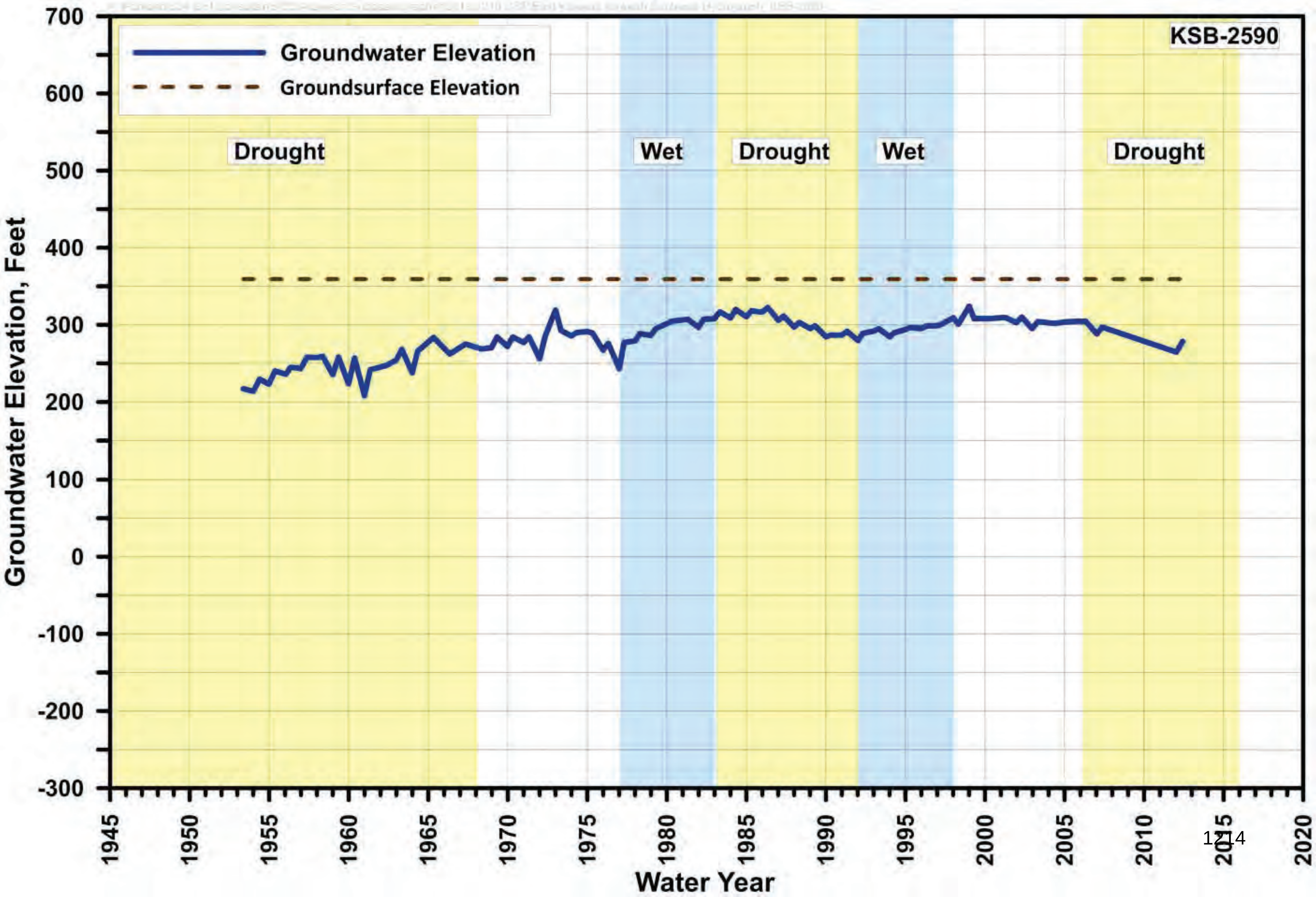

KSB-2513
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



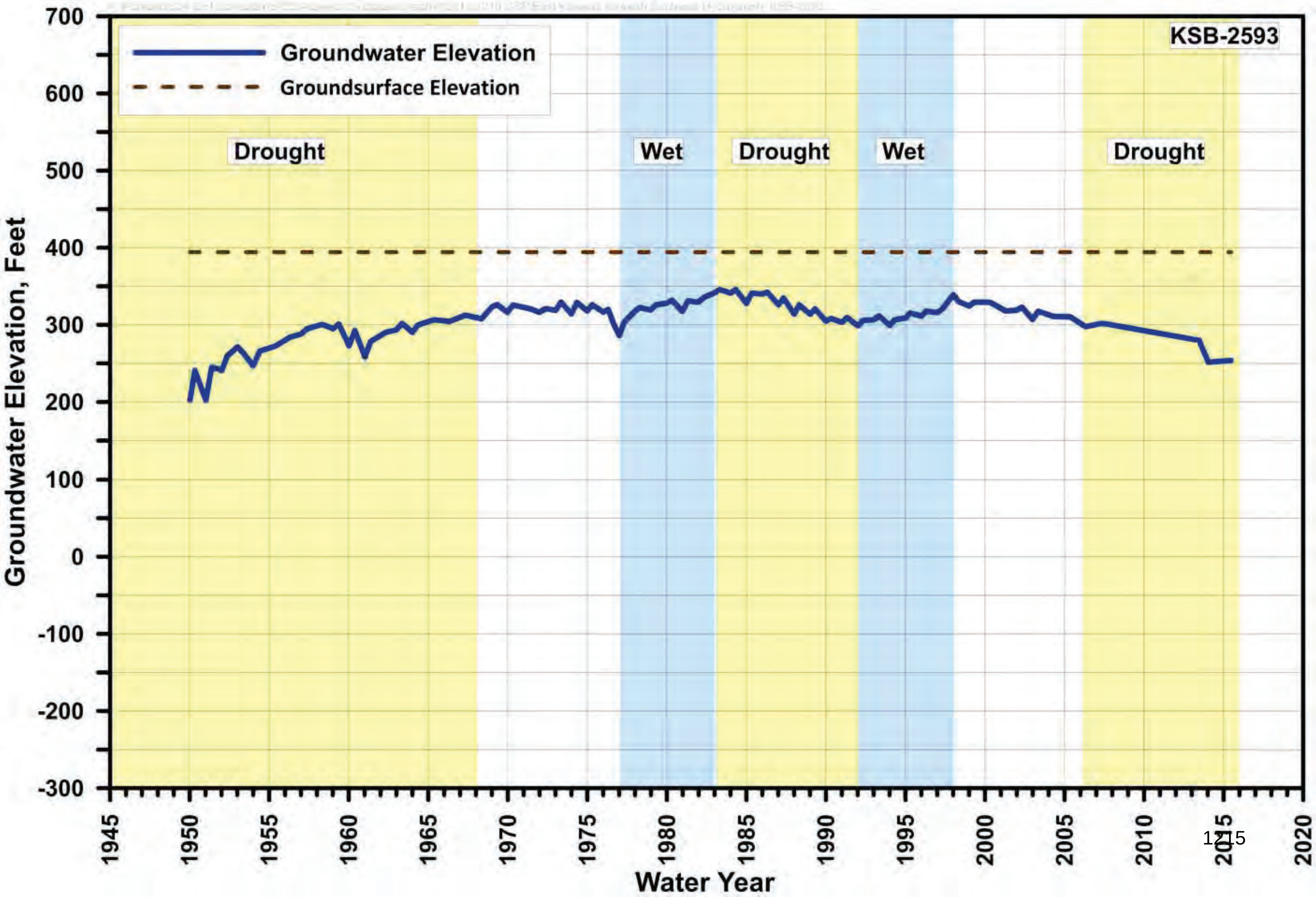
KSB-2519
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

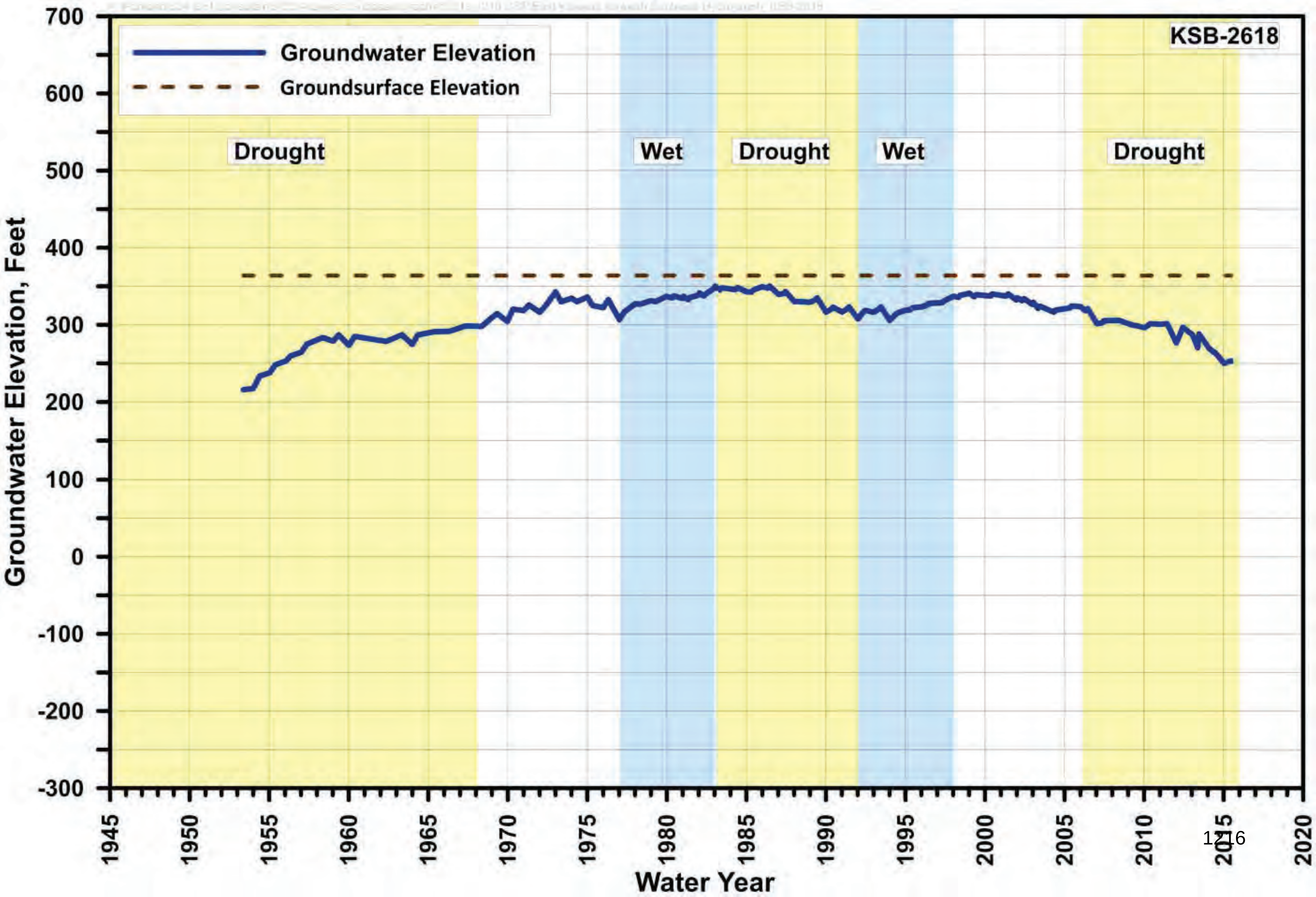

KSB-2539
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
Water Year
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

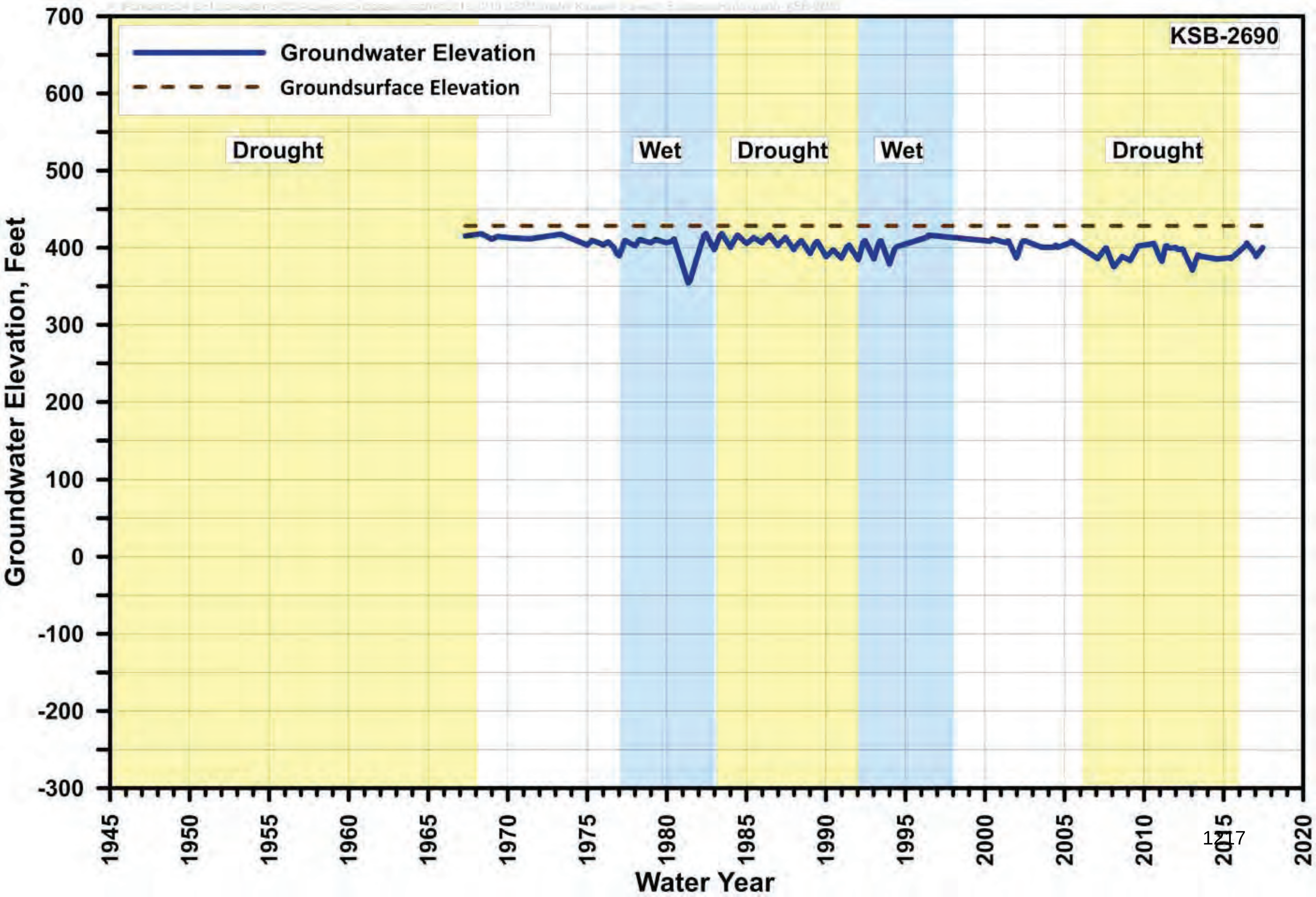

KSB-2588
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



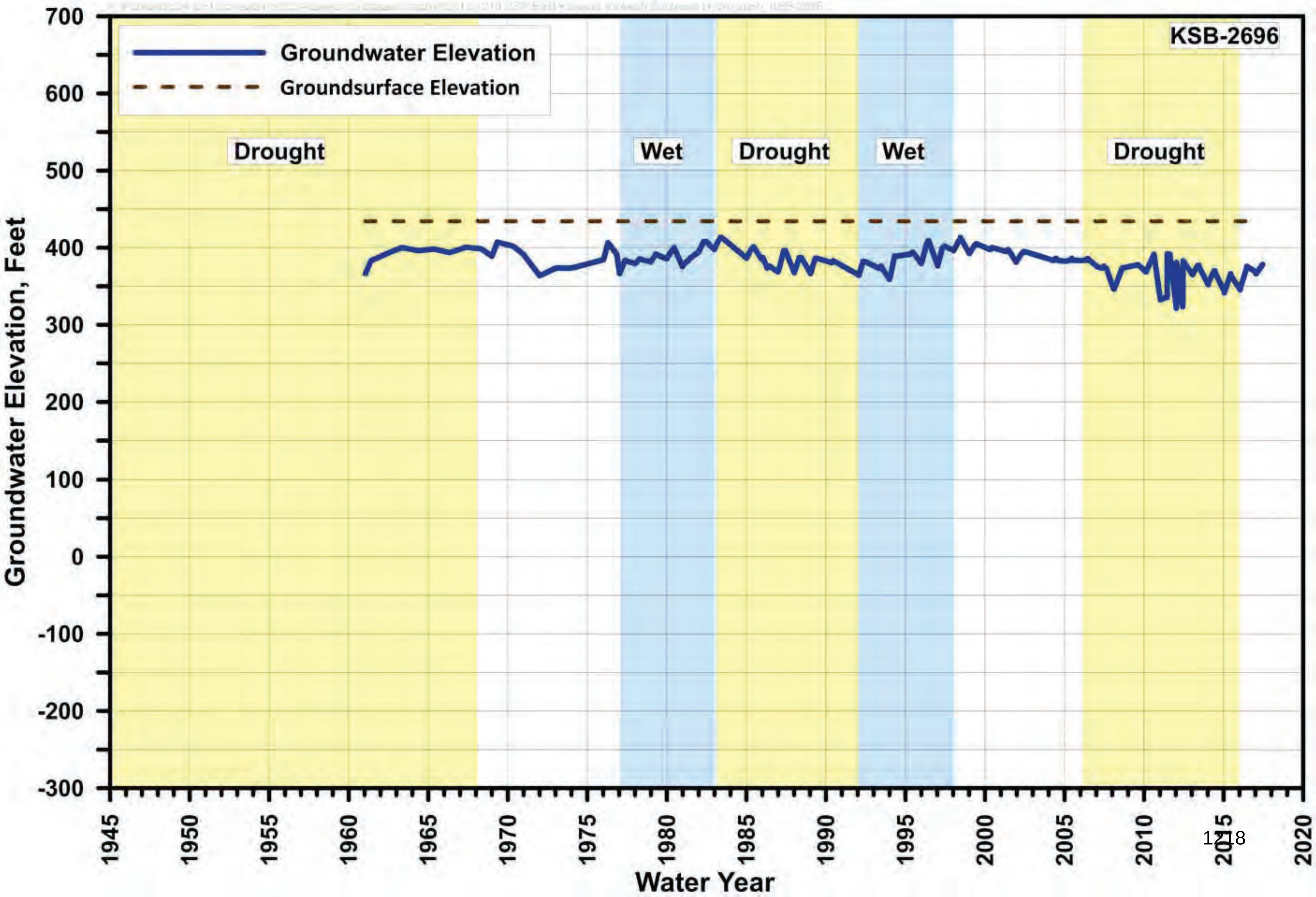
KSB-2590
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

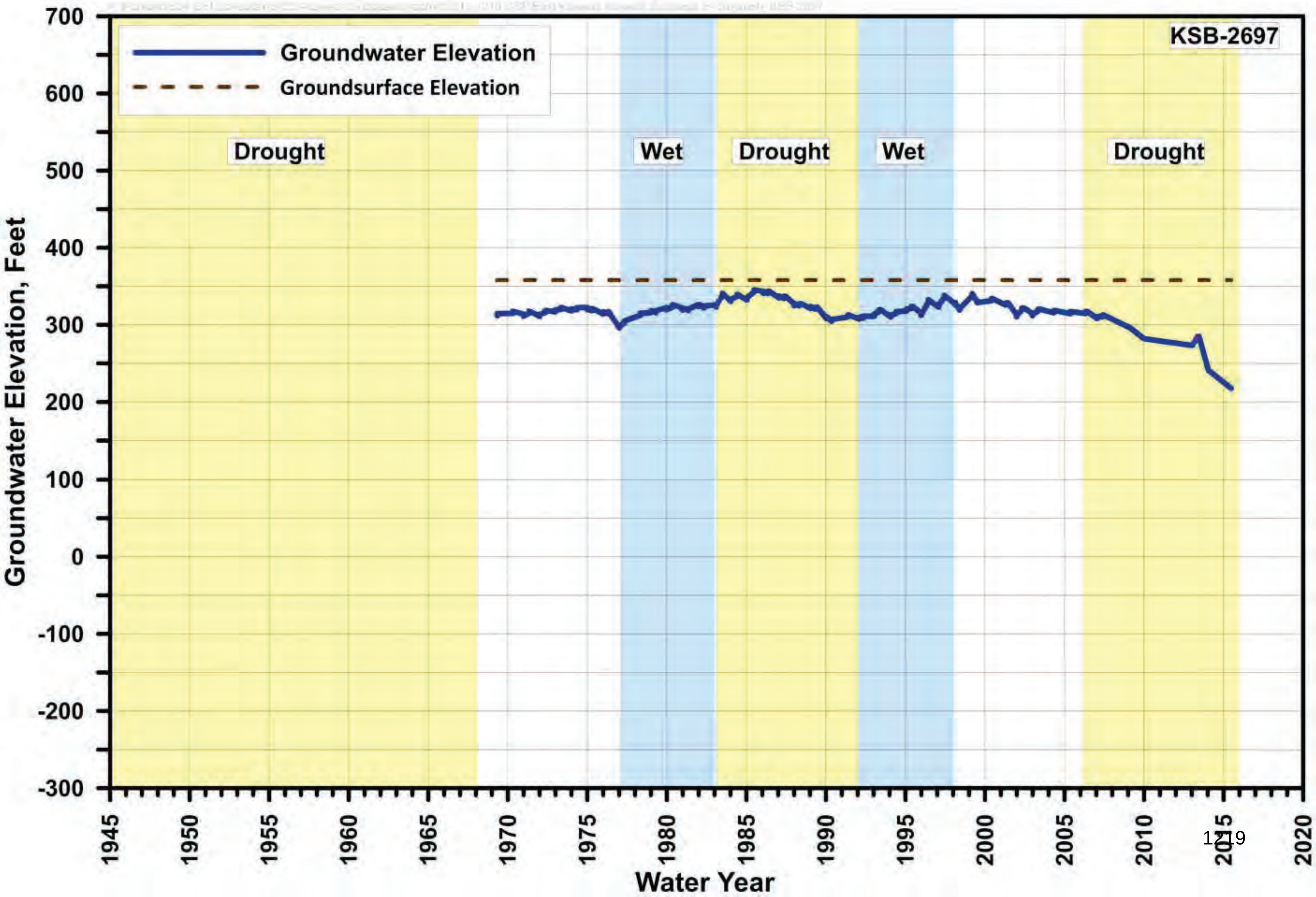

KSB-2593
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year

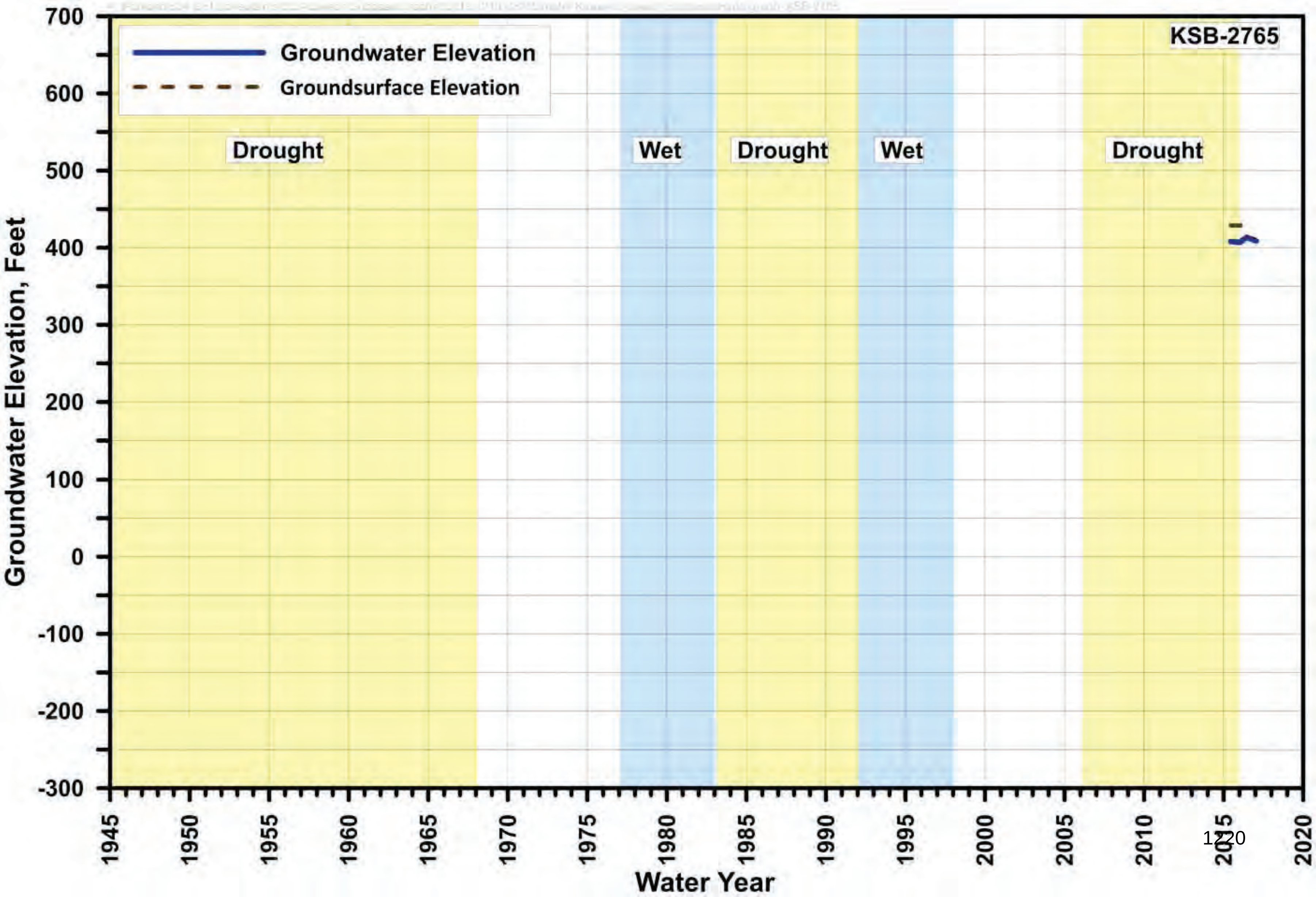

KSB-2618
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



KSB-2690
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-2696
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year


KSB-2697
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year



KSB-2765
Groundwater Elevation
Groundsurface Elevation
Drought
Wet
Drought
Wet
Drought
Groundwater Elevation, Feet
700
600
500
400
300
200
100
0
-100
-200
-300
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Water Year