

## 6 GSP MONITORING NETWORK

---

Numerous existing monitoring programs have been developed in the KRGSA Plan Area for a variety of monitoring objectives. This GSP takes advantage of the existing monitoring networks to provide a relatively long-term and continuous record of measurements from each monitoring station. In that manner, changes to the groundwater system can be evaluated within the context of historical information and provide a more informed dataset on which to make management decisions. Existing monitoring programs are summarized in **Section 2.5.1**; some monitoring efforts described previously are adopted into this GSP as dual-purpose programs to optimize data collection efforts. A brief summary of key programs relevant to the GSP monitoring network is provided herein for context.

Monitoring networks were established to address each of the sustainability indicators relevant to the KRGSA Plan Area. As described in **Section 5**, water levels serve as a reasonable proxy for each of the indicators being evaluated. Water level monitoring is supplemented with other methods where needed; for example, monitoring for potential undesirable results associated with land subsidence incorporates a coordinated Subbasin-wide monitoring program and includes monitoring of InSAR data developed by DWR for certain selected areas in the KRGSA Plan Area.

The preliminary GSP monitoring network for the KRGSA Plan Area is shown on **Figure 6-1**. This map contains 36 wells for focused GSP monitoring. At the time of this Review Draft KRGSA GSP, additional wells are being identified within the northern Plan Area to supplement wells shown on the map. Specifically, well records are being reviewed to add wells in the central and northeastern Urban MA. Some or all candidate wells may be included in the Final GSP submittal to DWR if records indicate sufficient data to meet program objectives, described below. In addition, some wells may be substituted for wells shown on **Figure 6-1**, if a nearby well provides improvements to the monitoring network.

This preliminary GSP monitoring network will be improved over time to comply with GSP regulations on data and standards (§352.4). Many wells in the program are production wells and will require shutting off pumps for an adequate time to measure representative monitoring levels. In addition, construction data are not available for some wells, although water level records for all wells indicate extractions from the Principal Aquifer. In addition, well completion reports indicate that most production wells in the Agricultural MA have similar construction (perforations about 220 feet to 500 feet). Nonetheless, efforts are underway to fill monitoring network deficiencies. Management actions have been developed for network improvements over the first five years of GSP implementation including:

- Improve Documentation of Wells and Information in the KRGSA Plan Area (see **Section 7.2.8**)
- Coordinate Water Quality Analysis through Existing Monitoring Programs (see **Section 7.2.9**).

Two additional management actions provide improvements in reporting to support the ongoing water budget analyses:

- Implement Well Metering Program in the Agricultural MA (see **Section 7.2.2**)
- Procedures for Reporting Groundwater Extractions (see **Section 7.2.3**)

## 6.1 MONITORING OBJECTIVES

The KRGSA GSP monitoring network is designed to support the KRGSA GSP Sustainability Goal. The primary objectives of the network are to detect indications of undesirable results as defined in **Section 5** and to monitor the effectiveness of Plan implementation as described in **Section 7**. As provided in GSP regulations, the monitoring network, when implemented, shall accomplish the following:

- (1) Demonstrate progress toward achieving MOs.
- (2) Monitor impacts to the beneficial uses or users of groundwater.
- (3) Monitor changes in groundwater conditions relative to MOs and MTs.
- (4) Quantify annual changes in water budget components. (§354.34)

These are also considered monitoring objectives of the KRGSA GSP monitoring network; additional objectives are listed below:

- Provide sufficient information to determine if MTs are being exceeded.
- Demonstrate progress toward interim milestones and MOs.
- Provide adequate spatial distribution and appropriate well construction to monitor groundwater conditions in the KRGSA Principal Aquifer.
- Record accurate water levels (within 0.1 feet) to evaluate sustainable management criteria.
- Document performance of GSP projects and management actions.
- Ensure that management actions do not cause undesirable results.

In addition to these attributes, wells must be accessible, functional, and practical, and have reasonable structural integrity for monitoring with typical water level monitoring equipment.

## 6.2 MONITORING NETWORK

The GSP monitoring network is presented on **Figure 6-1** and includes wells where water level monitoring will be conducted. These spatially-distributed wells represent 36 monitoring locations across the three KRGSA MAs including the Urban MA (12 wells), Agricultural MA (22 wells), and Banking MA (2 wells). The well locations were based on sustainability indicators (see **Figure 5-3**) that are explained throughout **Section 5** (in particular **5.4**, **5.7** and **5.8**) and include the following considerations:

- Municipal wells requiring maintenance of water levels for efficient well operations and water quality compliance.
- Agricultural areas requiring flexibility to draw down water levels during the irrigation season.
- Banking areas, which need operational flexibility to recover relatively large quantities of groundwater during drought to provide a critical water supply when other sources are limited.

- Areas of potential land subsidence, primarily located in the southern and eastern Agricultural MA, where historical and recent subsidence has been indicated.
- Transition areas between MAs and along the boundaries of the KRGSA to prevent unreasonable hydraulic gradients.

As explained in **Section 5**, undesirable results for each of the sustainability indicators are evaluated by MTs set at various water levels, generally based around adjustments to the historic low water level in 2015-2016. The sustainability indicator requiring the shallow-most MT will control the allowable water level at each well. This simplifies the monitoring program yet allows for evaluation of all sustainability indicators to occur. The MT, MO, and controlling sustainability indicator for the GSP monitoring network wells are summarized in **Table 6-1**. The MT for each well is provided on **Figure 6-2**.

**Table 6-1: KRGSA GSP Monitoring Well Network with Sustainable Management Criteria**

GSP Monitoring Well State Well Number	Other Monitoring Program <sup>1</sup>	Historic High Water Level (ft, msl)	Historic Low Water Level (ft, msl)	Adjustment to Historic Low for MT (ft, msl)	Minimum Threshold (ft, msl)	Measurable Objective (ft, msl)	Controlling Sustainability Indicator
29S/26E-01K01	KCWA/ID4	212	66	-20	46	129	Water Levels
29S/26E-09H01	KCWA/ID4	193	87	-20	67	130	Water Levels
29S/26E-26K01	KCWA/ID4	296	141	0	141	219	Water Quality
29S/27E-08H53	KFMC/CASGEM	287	205	-20	185	236	Water Levels
29S/27E-35A02	KCWA/ID4	245	158	0	158	202	Water Levels and Quality
29S/28E-18K01	CASGEM	361	322	-20	302	332	Water Levels
29S/28E-19J02	KCWA/ID4	254	169	0	169	212	Water Levels and Quality
29S/28E-31J02	KFMC	210	145	0	145	178	Water Levels and Quality
30S/26E-03B01	KCWA/ID4	302	49	0	49	176	Water Levels and Quality
30S/26E-16B01/B02	City Piezometers	317	79	0	79	198	Water Levels and Quality
30S/26E-22P03	KDWD Monthly	279	111	-50	61	170	Water Levels
30S/26E-25A02	KFMC	236	128	0	128	182	Water Levels and Quality
30S/26E-35B01	KDWD Monthly	236	136	-50	86	161	Water Levels
30S/27E-05D01	KFMC/CASGEM	279	150	0	150	215	Water Levels and Quality
30S/28E-03D01	KFMC/CASGEM	194	119	0	119	157	Water Levels and Quality
30S/28E-11F01	KDWD Monthly	181	138	0	138	160	Water Levels and Quality
30S/28E-35L01	KDWD Monthly	234	100	-20	80	157	Subsidence
31S/26E-03J01	KFMC	235	80	-50	30	133	Water Levels
31S/26E-14B01	KCWA/DWR	205	110	-50	60	133	Water Levels
31S/26E-16P01	KDWD Monthly	202	59	-20	39	121	Subsidence
31S/26E-27D01	KCWA/DWR	198	65	-20	45	122	Subsidence
31S/26E-32B	KDWD Monthly	185	10	-20	-10	88	Subsidence
31S/27E-07B	CASGEM	197	120	-50	70	133.5	Water Levels
31S/27E-12Q	CASGEM	233	97	-50	47	140	Water Levels
31S/27E-19D01	KCWA/DWR	192	99	-50	49	121	Water Levels
31S/27E-25D01	KCWA/DWR	241	158	-20	138	190	Subsidence
31S/28E-05D02	Greenfield CWD	182	103	0	73	127.5	Water Levels and Quality
31S/28E-16A	KDWD Monthly	205	144	-20	124	164.5	Subsidence
31S/28E-20D	CASGEM	264	117	-20	97	180.5	Subsidence
31S/29E-07K	CASGEM	148	109	-20	89	118.5	Subsidence
31S/29E-28C	CASGEM	183	47	-20	27	105	Subsidence
31S/29E-30J01	KCWA/DWR	213	80	-20	60	137	Subsidence
32S/27E-03A	KDWD StToll	210	145	-20	125	130	Subsidence
32S/27E-07N	KDWD Monthly	170	58	-20	38	114	Subsidence
32S/28E-01P	KDWD Monthly	157	35	-20	15	86	Subsidence
L202 - City Inactive	City DDW	214	112	0	112	163	Water Levels and Quality

*KFMC - Kern Fan Monitoring Committee, CASGEM - California Statewide Groundwater Elevation Monitoring, City DDW - Division of Drinking Water water level and quality monitoring, KCWA/ID4 - Various KCWA and ID4 monitoring programs for evaluation of local groundwater conditions, KCWA/DWR - wells included in the Water Data Library and KCWA databases with representative well records, KDWD Monthly - depth to water measurements by KDWD for water level maintenance in its service area, KDWD StToll - water level monitoring for calculation of assessments.*

As discussed in **Sections 5.3** through **5.8**, the MO is a representative midpoint of the estimated operational range for each well (average of the historic water level high during the study period and the MT). Assuming the KRGSA is relatively close to a sustainable water budget (discussed in **Section 4.5.4**), this operational range is reasonable for future management. The MO for each monitoring well is provided on **Figure 6-3**. Also as explained in **Section 5**, the MT is adjusted downward in some areas for more flexible operation and to provide a buffer for another multi-year drought during the implementation period before all additional water supply projects are fully online.

As discussed in **Section 5-10** and illustrated by an example in **Figure 5-5**, hydrographs for the GSP monitoring wells have been used to determine the MT and MO. This analysis follows the approach to these criteria described in **Section 5.3** and the analyses of sustainability indicators (**Sections 5.4, 5.5, 5.7, and 5.8**). The hydrographs are provided in **Appendix J**.

As indicated on **Figure 6-1**, portions of the southern and northeastern Urban MA would benefit from additional monitoring sites. Cal Water, NORMWD, ENCSD, and other municipal well owners are currently reviewing records to identify potential inactive wells to enlist into the monitoring network. Additional well records are currently being reviewed for adding wells in the Urban MA prior to the submittal of the Final GSP to DWR in January 2020. The basis for the monitoring program, its ability to monitor each sustainability indicator, and additional monitoring networks are described below.

### **6.2.1 Site Selection and Representative Wells**

Because of the primary reliance on water level monitoring, the GSP network was established based first on availability of recent/current monitoring data. These data made it possible to determine the representativeness of the well and to conduct a qualitative evaluation of the water level data. Wells that were already being monitored as part of an ongoing monitoring program are prioritized based on the sustainability considerations discussed above and well records. **Table 6-1** and **Figure 6-2** identify the GSP monitoring wells by monitoring program on **Figure 6-2** as described below.

#### **6.2.1.1 Kern Fan Monitoring Committee (KFMC) Program Wells**

Wells included in the current Kern Fan Monitoring Committee (KFMC) program were identified as a first priority for inclusion in the KRGSA GSP monitoring network. Wells in this program selected for the GSP monitoring network are shown in **Table 6-1**.

These wells are located over a broad area of the Urban MA, the Banking MA, and the western Agricultural MA and provide maximum benefits for GSP monitoring. First, the purpose of these wells is to monitor groundwater conditions on the Kern Fan both adjacent to and surrounding the multiple groundwater banking projects, a purpose also applicable to this GSP monitoring network. For example, one KFMC monitoring well (30S/27E-05D01) installed on the California State University Bakersfield campus, is important for monitoring local banking activities on the Kern River and the aquifer response in local municipal wells in the KRGSA Plan Area. Second, the program has been developed based on

agency agreements including a KFMC MOU executed in the mid-1990s; accordingly, these wells have been part of a coordinated and widely-used monitoring program for more than 20 years.

Importantly, these wells have been determined by the KFMC to be representative of groundwater conditions in the region and have been successful at tracking the aquifer response to groundwater recharge and recovery along the Kern River channel and in the Banking MA. Finally, water levels from this monitoring program are used by KCWA and others to develop water level contour maps, water quality information, and hydrographs that allow tracking of water level trends and fluctuations over time. This use demonstrates the ability of these wells to adequately represent groundwater conditions in the Urban MA and western Agricultural MA.

These KFMC wells provide the following attributes to the GSP monitoring network:

- Long established records of high-quality data.
- Data from numerous multi-depth monitoring wells for vertical gradients.
- Vetted by numerous agencies over time.
- High frequency of monitoring; some wells have monthly records.
- Publicly-available data for transparency and wide-spread use.
- Higher likelihood of obtaining access for GSP monitoring.

#### **6.2.1.2 KCWA/ID4 Wells**

In addition to the KFMC program, KCWA/ID4 conducts monitoring in numerous wells and piezometers throughout the ID4 service area to evaluate a variety of local groundwater conditions throughout the Urban MA. In particular, ID4 has drilled and monitored a well adjacent to the Calloway Pool (29S/28E-18K01 – also part of the KFMC) that provides a record of water levels adjacent to the Kern River near one of the primary diversion points on the river. This well, along with others, are also included in the DWR CASGEM program, described below. KCWA/ID4 ownership of key wells in this program facilitate long-term access for the KRGSA GSP monitoring network.

The program also includes compilation of data from additional wells in the Urban MA that are monitored by others. Municipal wells included in this program are being prioritized for inclusion in the GSP monitoring network because of the relatively long-term data record for these wells. Well owners and operators (including Cal Water, the City, NORMWD, and others) are working to develop well records and allow access for continued GSP monitoring. In general, wells in this program have the same attributes as the KFMC wells. Inclusion of some private wells will require additional communication to develop access agreements.

#### **6.2.1.3 Inactive Municipal Wells and Nearby Monitoring Wells**

As mentioned in the above paragraphs, the KRGSA is working with municipal well owners to identify the most representative monitoring locations for detecting potential undesirable results in the Urban MA. In particular, the City has identified both an inactive production well and multi-depth piezometers for inclusion in the program. These wells, listed as L202 and 30S/26E-16B01/B02, are strategically located in

the middle of the City wellfield in the Urban MA and adjacent to the municipal wells in the Banking MA, respectively. Greenfield CWD has also identified an inactive well in its wellfield to use for GSP monitoring. As documented in the MOU (**Appendix C**), Greenfield CWD is responsible for independent implementation of the GSP in its service area and will conduct its own water level monitoring program and provide data to the KRGSA GSP. However, this well has been reviewed for inclusion in the KRGSA GSP and all monitoring protocols included in this document are also applicable to the Greenfield CWD well (31S/28E-5D2 on **Figure 6-1** and in **Table 6-1**).

#### **6.2.1.4 CASGEM Program – KCWA/ID4 and KDWD**

Since its inception, two KRGSA member agencies, ID4 and KDWD, have participated in the State CASGEM program for monitoring of water levels in the KRGSA. Incorporation of these wells into the GSP monitoring program provides many of the same attributes as wells from other monitoring programs including existing approved protocols, relatively long water level records, ability to access the well for reporting purposes, and the use of publicly-available data. CASGEM wells included in the GSP monitoring networks are identified in **Table 6-1**.

#### **6.2.1.5 KDWD Monitoring Programs**

KDWD monitors local agricultural and district-owned wells for a variety of objectives including tracking depth to water for water level maintenance, calculation of assessments on SWP water supplies, CASGEM compliance, and provision of data for KCWA or DWR monitoring programs. Most of the wells currently included in the GSP monitoring network in KDWD are included in one of these programs with CASGEM and KCWA monitoring programs identified as priorities. Except for KDWD-owned wells, all of the wells in the monitoring network are privately-owned with limited construction data and less-complete water level records compared to other wells. Nonetheless, they provide spatial distribution and the ability to increase monitoring in areas of potential land subsidence. Improvements to the monitoring network are identified for these wells (see **Section 7.2.8**).

### **6.2.2 Monitoring Frequency**

At a minimum, water levels will be measured in all wells on a semi-annual basis in Spring and Fall to capture the seasonal high and low water levels. This program will allow for the generation of water table/potentiometric surface maps of the Principal Aquifer on an annual basis. In general, the semi-annual water level measurements are useful for determining water levels before and after the primary irrigation season to examine the drawdown from pumping and the ability of the aquifer to recover in the Spring. Due to the large number of wells requiring coordination in the Subbasin, the KGA has suggested coordinated time frames for water level measurements as follows:

- January 15<sup>th</sup> to March 30<sup>th</sup>
- September 15<sup>th</sup> to November 15<sup>th</sup>.

Although the semi-annual program may work well for the Agricultural MA, more frequent water level measurements will be needed for the Urban MA. Monthly monitoring for those wells is anticipated to

detect potential undesirable results sufficiently early to manage the wellfield accordingly. **Table 6-2** documents the current monitoring frequency for tracking the sustainable management criteria.

**Table 6-2: Monitoring Frequency**

<b>GSP Monitoring Well State Well Number</b>	<b>Controlling Sustainability Indicator</b>	<b>Monitoring Frequency</b>
29S/26E-01K01	Water Levels	Semi-Annually
29S/26E-09H01	Water Levels	Semi-Annually
29S/26E-26K01	Water Quality	Monthly
29S/27E-08H53	Water Levels	Semi-Annually
29S/27E-35A02	Water Levels and Quality	Monthly
29S/28E-18K01	Water Levels	Semi-Annually
29S/28E-19J02	Water Levels and Quality	Monthly
29S/28E-31J02	Water Levels and Quality	Monthly
30S/26E-03B01	Water Levels and Quality	Monthly
30S/26E-16B01/B02	Water Levels and Quality	Monthly
30S/26E-22P03	Water Levels	Semi-Annually
30S/26E-25A02	Water Levels and Quality	Monthly
30S/26E-35B01	Water Levels	Semi-Annually
30S/27E-05D01	Water Levels and Quality	Monthly
30S/28E-03D01	Water Levels and Quality	Monthly
30S/28E-11F01	Water Levels and Quality	Monthly
30S/28E-35L01	Subsidence	Semi-Annually
31S/26E-03J01	Water Levels	Semi-Annually
31S/26E-14B01	Water Levels	Semi-Annually
31S/26E-16P01	Subsidence	Semi-Annually
31S/26E-27D01	Subsidence	Semi-Annually
31S/26E-32B	Subsidence	Semi-Annually
31S/27E-07B	Water Levels	Semi-Annually
31S/27E-12Q	Water Levels	Semi-Annually
31S/27E-19D01	Water Levels	Semi-Annually
31S/27E-25D01	Subsidence	Semi-Annually
31S/28E-05D2	Water Levels and Quality	Monthly to Quarterly
31S/28E-16A	Subsidence	Semi-Annually
31S/28E-20D	Subsidence	Semi-Annually
31S/29E-07K	Subsidence	Semi-Annually
31S/29E-28C	Subsidence	Semi-Annually
31S/29E-30J01	Subsidence	Semi-Annually
32S/27E-03A	Subsidence	Semi-Annually
32S/27E-07N	Subsidence	Semi-Annually
32S/28E-01P	Subsidence	Semi-Annually
L202 - City Inactive	Water Levels and Quality	Monthly

In addition, regulations require a long-term access agreement that allows access on a year-round basis to allow for increased monitoring frequency as needed.

### 6.2.3 Well Construction Data

Well construction data are shown for the GSP monitoring network wells, as available. Well records are still being gathered for some missing data. In addition, other wells are being considered for inclusion in the program or as a substitute for wells that have missing information. A management action to fill missing data for the monitoring well network is included in **Section 7.2**.

**Table 6-3: GSP Monitoring Network Construction Data**

GSP Monitoring Well State Well Number	Ground Surface Elevation (ft, msl)	Well Depth (ft, bgs)	Top of Perforated Interval (ft, bgs)	Bottom of Perforated Interval (ft, bgs)	Well Use
29S/26E-01K01					
29S/26E-09H01					
29S/26E-26K01					
29S/27E-08H53	404.5				
29S/27E-35A02					
29S/28E-18K01	421.9		80	540	
29S/28E-19J02					
29S/28E-31J02					
30S/26E-03B01					
30S/26E-16B01/B02	346		B1- 140-250	B2- 300-390	
30S/26E-22P03	338.5		610	794	
30S/26E-25A02	348		590	690	
30S/26E-35B01	336	708	102	198	
30S/27E-05D01	374.7		85	504	
30S/28E-03D01		804			
30S/28E-11F01					
30S/28E-35L01					
31S/26E-03J01	327.14				
31S/26E-14B01					
31S/26E-16P01					
31S/26E-27D01					
31S/26E-32B					
31S/27E-07B		630			
31S/27E-12Q		710			
31S/27E-19D01					
31S/27E-25D01					
31S/28E-05D2		420	180	420	Inactive
31S/28E-16A	336.61				
31S/28E-20D	322.38	200	100	200	Irrigation
31S/29E-07K	407.79	798	330	780	Irrigation
31S/29E-28C	406.43	530	280	530	Irrigation
31S/29E-30J01					
32S/27E-03A	299.53				
32S/27E-07N	292.52				
32S/28E-01P	343.62				
L202 - City Well	393	710	375	675	Inactive



#### 6.2.4 Groundwater Level Monitoring

In the KRGSA, groundwater levels are currently monitored by municipal well owners including Cal Water (for the City of Bakersfield), KCWA/ID4, Greenfield CWD, ENCSD, KDWD, and others. These agencies employ a variety of methods and equipment for water level monitoring including electric sounders, acoustic sounders, and transducers. Cal Water and KCWA/ID4 generally follow procedures developed by USGS (Cunningham and Schalk, 2011). These procedures are reproduced in **Appendix I**.

The KRGSA has coordinated with other GSAs for establishment of Subbasin-wide data collection protocols for water levels. The GSA-developed data collection protocols for water levels are reproduced below, with one modification, and will be adopted into this GSP.

- Monitoring program will use a Subbasin-wide standardized data form (example form provided in KGA GSP document)
- Groundwater level data shall be collected from each principal aquifer in the basin
- Collection of data between the approved time frames only
  - January 15<sup>th</sup> to March 30<sup>th</sup>
  - September 15<sup>th</sup> to November 15<sup>th</sup>
- A weighted water level meter, or other approved measuring device, will be used to measure the depth to groundwater
- Depth to groundwater must be measured relative to an established Reference Point on the well casing. If no mark or reference point is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing
- The elevation of the Reference Point of the well must be surveyed to the North American Vertical Datum of 1988. The elevation must be accurate to within 0.1 foot.
- Each well's Reference Point will be cataloged to ensure identical procedures are followed for subsequent measurements.
- The data collector should remove the appropriate cap, lid or plug that covers the monitoring access point listening for pressure release. If a release is observed, the measurement should follow a period of time to allow the water level to equilibrate.
- Depth to groundwater must be measured to an accuracy of 0.1 foot below the Reference Point.
- The water level meter shall be decontaminated after measuring each well.
- The data collector shall calculate the groundwater elevation as:
  - $GWE = RPE - DTW$
  - GWE = Groundwater Elevation
  - RPE = Reference Point Elevation
  - DTW = Depth to Water
- A unique identifier that includes a general written description of the site location, date established, access instructions and point of contact, type of information to be collected, latitude, longitude and elevation.
- Monitoring location should also track all modifications to the site in a modification log

The data collector must ensure that all measurements are consistent units of feet, tenths of feet or hundredths of feet. Measurements and Reference Point Elevations should not be recorded in feet and inches.

The KRGSA will continue to work with the KGA and other GSAs in the Subbasin to finalize data collection protocols for a coordinated monitoring network. Monitoring protocols shall be reviewed at least every five years as part of the Five-Year Plan Update evaluation.

### **6.2.5 Groundwater Quality Monitoring**

The KRGSA contains more than 200 wells that are sampled periodically for compliance with drinking water quality regulations. Although these data are concentrated in the Urban MA, this is the area where undesirable results with respect to degraded water quality have occurred. The KRGSA GSP incorporates water quality sampling from others to take advantage of ongoing, regulated groundwater quality monitoring programs.

These regulatory programs are conducted with QA/QC measures and are monitored in wells determined to be representative wells for the purposes of water quality objectives associated with the program. As such, these programs represent the best data available for analyzing water quality conditions across the KRGSA Plan Area. As described previously, water levels are being used as a proxy for all relevant sustainability indicators, and no new water quality monitoring by KRGSA is proposed at this time. Rather, the following programs provide access to high-quality data for ongoing assessments of changes in groundwater quality.

#### ***6.2.5.1 Municipal Well Title 22 Compliance Monitoring***

In compliance with SWRCB drinking water programs, municipal wells and small water systems are routinely monitored for a wide variety of water quality constituents in accordance with permits for provision of drinking water. For example, in 2018 about 120 wells were part of the groundwater quality sampling program in the large municipal wellfield of the Urban MA. The City of Bakersfield KRGSA Plan Manager is also the City Water Resources Manager with access to all sampling and analyses associated with the municipal well water quality programs.

Groundwater quality data are also available in the Agricultural MA as part of these drinking water programs. Small water systems and community water systems routinely sample groundwater quality in compliance with the SWRCB drinking water programs. Most of these data sets can be accessed from the online water quality data portal GeoTracker, maintained by the SWRCB.

#### ***6.2.5.2 Irrigated Lands Regulatory Program (ILRP)***

Groundwater quality is also being sampled in compliance with the State Water Board's Long-Term Irrigated Land's Regulatory Program" (ILRP). This program provides for waste discharge requirements from irrigated lands through surface waters and groundwater monitoring. Owners or operators of irrigated lands may comply with the program either as individuals or through coalition groups. In the

KRGSA area, the Kern River Watershed Coalition Authority was formed to combine resources in order to monitor, review, analyze, and reduce the cost of compliance in the Kern River sub-watershed.

The latest monitoring plan is detailed in the KRWCA's Groundwater Trend Monitoring Work Plan – Phase II Monitoring Network Addendum 2.0. There are four secondary wells (not yet being monitored) and five supplementary wells (monitored by local public water system and reported to KRWCA) located in the KRGSA. These will be analyzed annually for nitrate concentrations; TDS will be analyzed on a 5-year interval. Wells in the KRGSA area will begin monitoring in the 2019 sampling event. In addition, the ILRP provides best-management practices (BMPs) for control of nitrate and TDS including BMPs for fertilizer application to control and manage nitrogen.

As this program is implemented across the KRGSA, sampling results will be downloaded from GeoTracker and incorporated into the ongoing tracking of groundwater conditions.

#### **6.2.5.3 Water Quality Monitoring at Regulated Sites**

As described in Section 3.3.4.6, numerous sites associated with regulated environmental investigations and clean-up programs have been identified in the KRGSA Plan Area (see **Table 3-4**). Some of these sites are associated with groundwater monitoring that may provide useful information for the GSP implementation. In particular, sites located near municipal wellfields would allow for potential impacts to water supply to be tracked and evaluated. Data from these programs are available on GeoTracker and will be downloaded and reviewed for possible inclusion in the ongoing water quality analysis.

#### **6.2.5.4 SWP Water Quality Monitoring**

ID4 conducts Title 22 and constituents of concern analyses of source water, treated water and groundwater wells as part of the monitoring program for the Henry C. Garnett Water Purification Plant. When groundwater provides the influent water supply, samples are analyzed weekly for arsenic, conductivity, and nitrate. Monthly monitoring includes 1,2-dibomomethand (EDB), DBCP, VOCs and gross alpha. Source water data have been summarized in the ID4 Report of Water Conditions (ID4, 2017).

#### **6.2.5.5 Kern River Water Quality Monitoring**

The City of Bakersfield monitors Kern River water quality at various locations along the Carrier and River Canals. Data are compiled and included in the annual Hydrographic Reports developed for the Kern River.

### **6.2.6 Inelastic Land Subsidence Monitoring**

Although no undesirable results with respect to land subsidence have been identified in the KRGSA, a multi-faceted approach for land subsidence monitoring has been developed for the GSP monitoring network. Water level monitoring described above will provide the initial evaluation for the potential for undesirable results and focus on the southern and eastern KRGSA Plan Area. Because minimum thresholds associated with water levels and water quality maintain water levels at or above historic low

levels, the potential for land subsidence for almost all of the KRGSA Urban MA is mitigated. The KRGSA Banking MA is also mitigated due to minimum thresholds associated with degraded water quality.

For the Agricultural MA, historical subsidence has been identified in previous investigations as explained in **Section 3.3.5**. With the potential for undesirable results higher in the southern and eastern Agricultural MA, minimum thresholds have been set to within 20 feet of historic low water levels. These protective levels are supplemented with selected monitoring using the InSAR data being published by DWR on a web portal. Finally, the land subsidence monitoring program will include participation in the Subbasin-wide monitoring program.

#### **6.2.6.1 Water Level Monitoring for Land Subsidence**

Minimum thresholds included on **Figure 6-2** will be evaluated at each of the GSP monitoring network wells controlled by land subsidence on a semi-annual basis (see **Table 6-2**). These data will be supplemented with other subsidence monitoring activities as summarized below.

#### **6.2.6.2 GPS Station Monitoring for Land Subsidence**

Three GPS control stations, which collect high-precision geodetic data useful for land subsidence monitoring, are in the KRGSA Plan Area as shown by the green dots on **Figure 6-4**. Two of the monitoring points (ARM1 and ARM2), located south of Bakersfield, are part of the California Spatial Reference Center (CSRC) (SOPAC/CSRC, 2019b). The third monitoring site (BFLD), located north of Bakersfield and north the Kern River, is part of the California Real Time Network (CRTN). The CSRC and CRTN operate under the Scripps Orbit and Permanent Array Center (SOPAC). Data are collected at a rate of one sample per second by Southern California Integrated GPS Network (SCIGN) for ARM1 and ARM 2 and by UC Berkeley/Caltrans (CVSRN) for BFLD (SOPAC/CSRC, 2019a). ARM1 and ARM2 are part of the California Spatial Reference System (CSRS) established July 2, 2017 as the official geodetic datum in California (CSRC, 2019; SOPAC/CSRC, 2019b). BFLD is one of 48 continuous Global Navigation Satellite Systems (GNSS) stations operated by SOPAC (SOPAC/CSRC, 2019b). Data from the stations will be downloaded quarterly and analyzed for the Annual Report.

#### **6.2.6.3 InSar Monitoring for Land Subsidence**

To supplement the GPS data described above, the KRGSA will also monitor subsidence through the DWR SGMA web portal, which will publish ongoing InSAR data from NASA/JPL for GSA use. Recent InSAR data available from May 2015 through December 2016 (recent drought) is shown on **Figure 6-4**. (These data are the same data presented on **Figure 3-38** with an adjusted color ramp to highlight only local KRGSA data rather than the regional data).

It is our understanding that DWR will post data on a one-mile grid for easy viewing and download. Data can be accessed through the website for each mile-section selected for review. For the preliminary program, the KRGSA has selected 12 square mile sections for quarterly downloading and comparison to the water level and GPS data. The 12 one-mile sections for monitoring are indicated by an X on **Figure 6-4**.

#### **6.2.6.4 Coordinated Subsidence Monitoring in the Subbasin**

The KGA is leading an effort to develop a coordinated land subsidence monitoring program that will prioritize areas of interest involving critical infrastructure in the Kern County Subbasin. At these locations, the effectiveness and feasibility of installing additional GPS monitoring sites will be evaluated. The program will also include the collection and review of data from local GPS monitoring stations.

The KRGSA intends to participate in this coordinated regional monitoring effort. Additional details of the proposed coordinated subsidence monitoring program will be developed beginning in Year One of the implementation period of the Subbasin GSPs.

### **6.3 ANNUAL REPORTING AND FIVE-YEAR EVALUATION**

Annual reporting will be coordinated at the Subbasin level but will provide separate analyses on compliance and implementation with the KRGSA GSP. Results for GSP monitoring will be summarized in each annual report with an emphasis on compliance with minimum thresholds for each sustainability indicator. Progress toward maintaining measurable objectives will also be presented. Spring and Fall measurements will be taken to capture the estimated high and the low water level of each water year. For the Kern County Subbasin, these measurements are typically collected in March and October to bracket the irrigation season. The timing of Spring and Fall water level measurements will be coordinated on a Subbasin-wide basis and will likely allow for a short window of time to allow for some flexibility in data collection while ensuring that measured groundwater elevations provide a consistent snapshot of groundwater conditions. Water level measurements will be used to develop Subbasin-wide water level contour maps for Spring and Fall time periods.

### **6.4 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM**

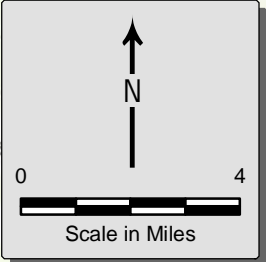
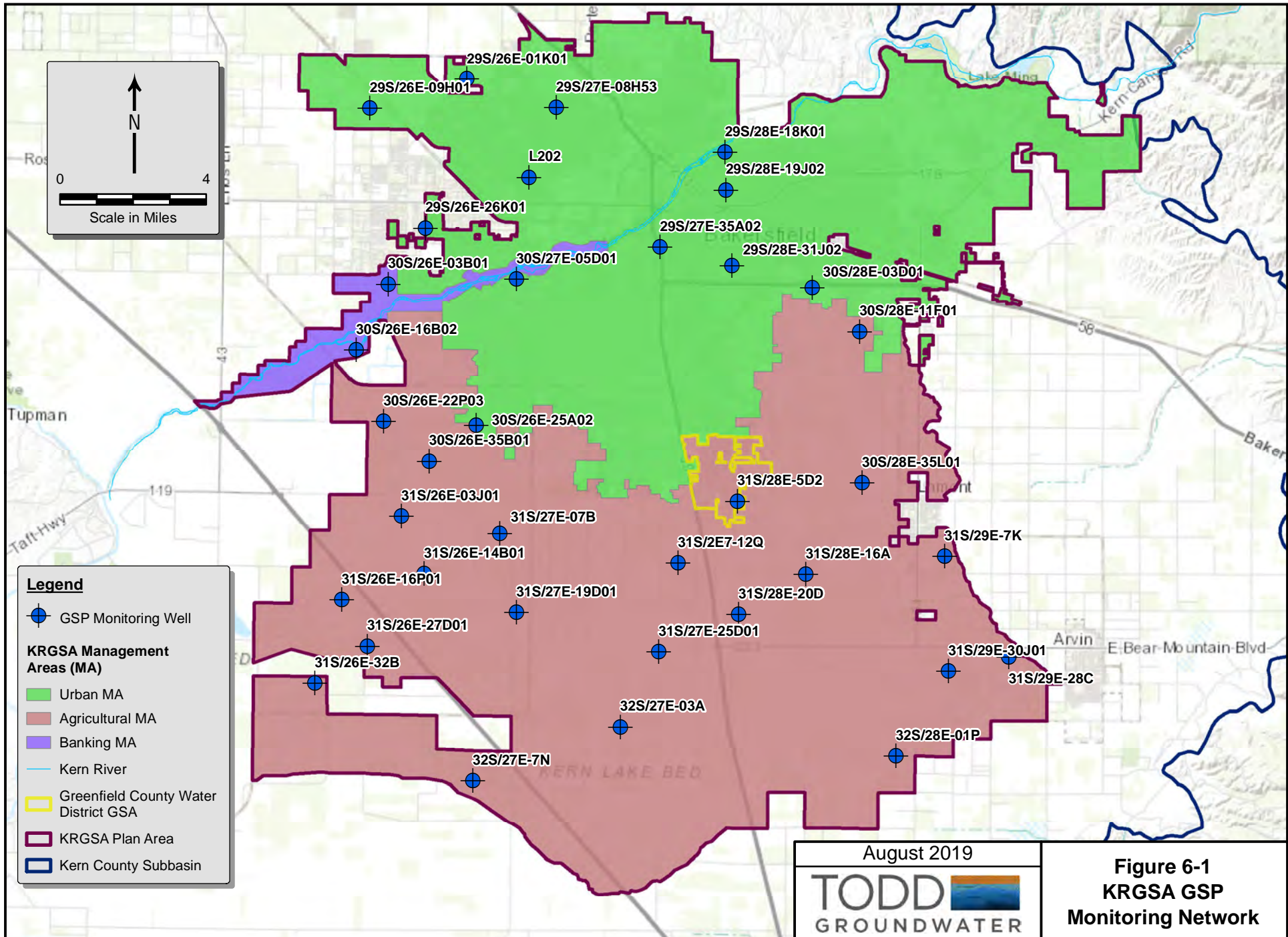
Protocols for quality assurance/quality control will be conducted at various levels for the KRGSA GPS monitoring program. Typically, these include written procedures for equipment use, transport, and calibration; full recordation of well details; and accurate water level measurements, verified and checked by field and office personnel.

Field equipment must be properly maintained and calibrated for accurate water level measurements. Any calibration documentation will include the equipment type, make/model, and serial number. Written procedures will be used for each type of equipment used in the water level monitoring program.

KCWA has developed specific protocols for calibration of well sounders used to monitor water levels. Those calibration protocols are adopted for this GSP monitoring network for KCWA-monitored wells. Additional details for QA/QC of the water level monitoring program are provided in **Appendix I**.

## **6.5 DATA MANAGEMENT SYSTEM**

Water levels will be input and maintained in a KRGSA Data Management System (DMS) for ease and use and reference by KRGSA Plan Managers. The Subbasin is exploring options for a Subbasin-wide DMS to allow access and use by all Subbasin GSAs. Accordingly, the separate DMS for the KRGSA data will likely consist of basic electronic formats in common software programs such as Microsoft Excel or Access that provide compatibility and ease of uploading into the Subbasin-wide DMS.



**Legend**

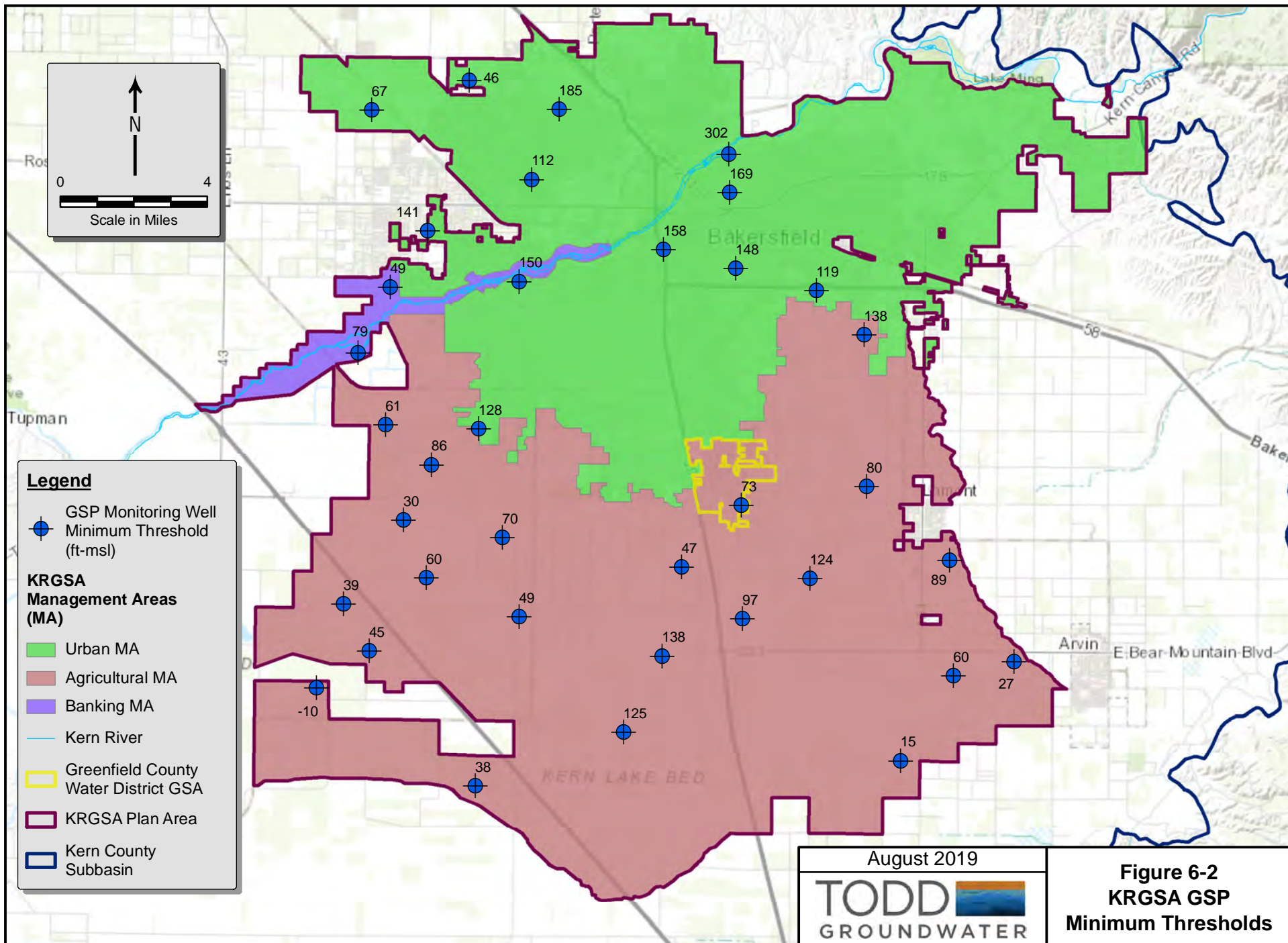
- GSP Monitoring Well
- KRGSA Management Areas (MA)**
  - Urban MA
  - Agricultural MA
  - Banking MA
- Kern River
- Greenfield County Water District GSA
- KRGSA Plan Area
- Kern County Subbasin

August 2019

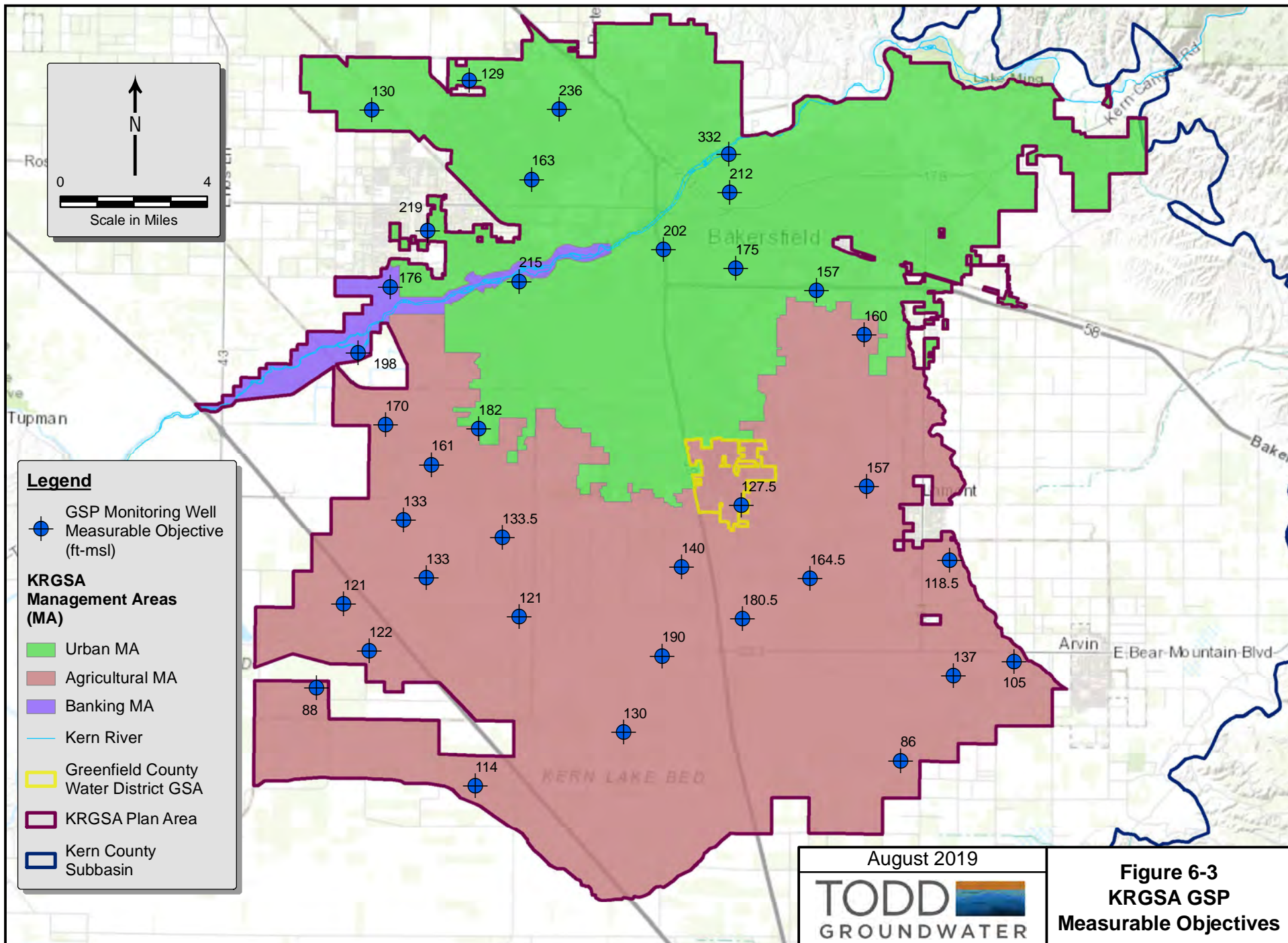
**TODD** **GROUNDWATER**

**Figure 6-1**  
**KRGSA GSP**  
**Monitoring Network**









August 2019  
**TODD**   
 GROUNDWATER

**Figure 6-3**  
**KRGSA GSP**  
**Measurable Objectives**

