

Appendix Y

Standard Operating Procedure for Water Level Measurements and Reporting

STANDARD OPERATING PROCEDURE

Water Level Measurement and Reporting

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Drafted by:

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1. SCOPE AND APPLICATION

This Water Level (WL) Standard Operating Procedure (SOP) provides guidance for collecting water level measurements and reporting data that is consistent with the Subbasin's Groundwater Sustainability Plan (GSP). The Kern County Subbasin has 20 Groundwater Sustainability Agencies (GSAs) and one Water Management Area, which are collectively responsible for complying with the Sustainable Groundwater Management Act (SGMA). Collecting water level measurements that are representative of groundwater conditions is one of the GSAs obligations. To employ a consistent process between all GSAs, this SOP provides guidance for procedures following industry-wide best management practices. Additionally, pertinent information on Quality Assurance/Quality Control (QA/QC) procedures, and data reporting are covered in this document.

2. SUMMARY OF APPROACH

The objective of water level measurements is to collect accurate data that is representative of groundwater conditions across the Subbasin that will be compared against baseline conditions presented in the GSP and used to assess the effects of SGMA implementation. Chapter 15 of the 2024 GSP establishes monitoring networks for the four sustainability indicators applicable to the Kern County Subbasin: groundwater levels, water quality, reduction of groundwater in storage, and subsidence.

There are approximately 185 wells designated as groundwater level Representative Monitoring Wells (RMWs), which are also used for calculating reduction of groundwater in storage. The WQ monitoring network is a subset of the groundwater level RMWs. These wells were strategically selected to represent groundwater conditions across each Hydrogeologic Conceptual Model (HCM); some RMWs are designated to represent the relationship between sustainability indicators or SGMA related projects (refer to Chapter 13, Table 13-2).

3. DEFINITIONS

Depth to Water (DTW) – Vertical distance between the reference point and the water table.

Ground Surface Elevation (GSE) – Vertical distance between ground surface and mean sea level.

Ground Water Elevation (GWE) – Vertical distance water table and mean sea level. Distance is calculated by: $GWE = RPE - DTW$

Proxy Well – When a RMW is not available for measurements, a nearby well with a similar elevation profile and well construction can be used for water level measurements.

Reference Point (RP) –An established point where the water level measurements are collected for each RMW.

Reference Point Elevation (RPE) –Vertical distance between the reference point and mean sea level.

Representative Sample – A sample taken from a location at which specific conditions or parameters may be measured in a manner to characterize the quality or condition of the underlying groundwater.

Water Level Measurement /Groundwater Level Measurement – For the purpose of this SOP, a water level measurement/reading collected from a representative monitoring well for the purpose of SGMA compliance.

Water Level Measurement Device– For the purpose of this SOP, a water level measurement device is a collective term used to reference the electric well sounder, steel tape, plopper, and transducer, acoustic sounder, and airline water level measurement devices.

4. SAFETY

Wear appropriate field attire, such as long pants and work boots. Wearing heavy duty work gloves is recommended to avoid hand injury. A kneeling pad or knee pads are also recommended to avoid knee discomfort and injury while collecting water level measurements.

Prior to each workday, the forecasted temperature and humidity for the worksite should be reviewed to compare against the National Weather Service Heat Index to evaluate the risk level for heat illness. When the temperature equals or exceeds 95°F, or during a heat wave, high heat procedures should be used, which include additional preventive measures including pre-shift meetings to encourage employees to drink plenty of water, working in the buddy system or regular communication so observations can be made for heat related illness, and to remind employees of their right to take a cool-down rest when necessary. To prevent heat-related illness, proper hydration (drinking plenty of water), acclimatization (getting used to weather conditions), and schedules that alternate work with rest shall take place.

Well sites may be located in remote locations such as farmland where access could be limited, or road conditions may not be easily traversable. If water level measurements will be conducted in remote locations, inform other colleagues where the sampling will be in case of an emergency. It may also be prudent to bring a GPS unit in case the site is hard to locate and there is no cell phone reception. When arriving to the well site be aware of your site conditions and surroundings to avoid potential slip trip and fall hazards near the well.

5. EQUIPMENT AND SUPPLIES

The following is a checklist of supplies needed to collecting water level measurements.

1. Water level meter such as electric well sounder, steel tape, plopper, transducer, acoustic sounder, or airline
 - a.) Manufacturer's manual instructions, if available
2. Engineers tape with 0.1-foot increments
3. Water to rinse water level meter
4. Disposable absorbent wipes, towel and or rag to clean the water level meter
 - a.) Note: Disposable absorbent wipes are dry, chemical-free wipes. Do not use disinfectant or scented wipes.
5. Groundwater Level Measurement Form
6. Blue or black ballpoint pen
7. Extra batteries for digital camera and water level meter
8. Proper attire for collecting water level measurements
9. Heavy duty work gloves, if necessary
10. GPS unit, if necessary
11. Kneeling/knee pad, if necessary
12. Phone camera/digital camera to take pictures of measurement location, recommended
13. Disposable gloves, optional

6. WATER LEVEL MEASUREMENT SCHEDULE

Water level measurements are collected a minimum of **twice per year** to align with the Subbasin's seasonal monitoring protocols. The Kern Subbasin Data Management System (DMS) is the best reference for a current list of Groundwater Level Representative Monitoring Wells (RMWs). Seasonal measurements must be collected during the following time frames:

- Spring (seasonal high) - January 15 to March 30
- Fall (seasonal low) – August 15 to November 15

Spring levels represent a seasonal high prior to summer irrigation demands while fall levels represent a seasonal low after summer irrigation demands. Groundwater pumping typically peaks during the summer growing season and slows in the winter. Water level measurement data will be used for analysis of long-term water level trends.

Due to operational differences between agricultural, municipal wells, and monitoring wells and conflicts between protocols to sample representative water level measurements and water quality samples (see Water Quality Sampling SOP), the following is the recommended coordination to collect representative water level measurements that align with the water quality sampling protocols:

- Water level measurements should be collected within two weeks of water quality samples.
 - For seasonally (Agricultural) operated wells,
 - Fall water level measurements should be collected when the well has remained offline for at least 24 hours after collection of water quality samples.
 - Spring water level measurements should be collected prior to the well running for the season.
 - For year-round (Municipal) operated wells,
 - Fall and Spring water level measurements should be collected when the well has been resting for sufficient time return to static water level (at least 24 hours, if possible). Note: It is recommended to coordinate with landowners to determine well operation status and schedule well level measurement reading. If well level reading is inconsistent with historical readings, reference Section 8 for troubleshooting options.

- Note: Agencies may collect water level readings while a well is pumping for informational purposes. Pumping water level reading should not be used for SGMA compliance reporting.

If measurements cannot be made from the monitoring well during the outlined timeframes, a measurement can be taken from a nearby well that has a similar water elevation profile to serve as a proxy. When using a proxy on the Kern County Subbasin Data Management System (DMS), a no measurement code will be selected, and a description of the proxy well should be provided as follows: “used proxy well, XX, located XX distance from well. DTW= XX; RPE XX; GWE= XX.”

If no alternate well is available, water levels can be estimated from Spring and Fall water level trends. This measurement should be flagged appropriately within the DMS and reported to the Department of Water Resources (DWR). If a water level measurement cannot be collected from a monitoring well for two consecutive years, a plan to replace or repair the well must be in place prior to the next monitoring period or submittal of the annual report, whichever occurs first.

7. PROCEDURE

7.1 Pre-field Preparation

Conduct pre-field preparation at least a day before planning on collecting water level measurements to ensure equipment and supplies are available and functioning.

1. Review and gather supplies from checklist of supplies discussed in Section 5.
2. Inspect water level meter device, calibrate according to manufacturer's instruction (if applicable) and ensure equipment is functioning correctly.
3. Review water level SOP sampling instructions and USGS's groundwater technical procedures ([Cunningham and Schalk, 2011](#)) if there are questions on specific water level meter devices and measurement procedures.
4. If available, review well information such as well construction, historical water level measurements and well operations to be familiar with well conditions. Populate a Groundwater Level Measurement Form with the following well information for reference in the field:
 - a.) Well identifier.
 - b.) GPS Coordinates.
 - c.) Reference point (RP) distance from the ground surface.
 - d.) Reference point elevation (RPE).
 - e.) Ground surface elevation (GSE).
 - f.) Previous fall and spring depths to water (DTW) measurements.
5. Clean water level meter with water and wipe dry with disposable absorbent wipe or clean towel/rag if meter appears to be dirty to avoid potential contamination of the wells during water level measurements.

7.2 Collecting Water Level Measurements

Water level measurements shall be reported to the nearest 0.1 feet (ft) when possible and may be measured by an electric well sounder, steel tape, plopper, and transducer. An acoustic sounder and airline may also be used, but measurements are typically not as accurate as the above methods. Each of the measurement methods is described in detail in Cunningham and Schalk (2011) and briefly summarized below.

- Electric sounder: Electric sounders typically include an electrode (probe) that is lowered within a well by a single or dual lines of conductive wire. When the tip of

the probe contacts water, an electric circuit is completed which registers on a current meter built into the sounder box.

- Once the water level has been located by the probe, an engineer's tape is used to determine the depth to groundwater. Groundwater levels are confirmed when two consecutive measurements are within 0.1 ft of one another.
- Steel tape: Steel tapes are typically used where a well's construction prevents measurement of water levels by electric sounders or ploppers. Similar to the electric sounders, the depth to water is confirmed by two consecutive measurements where the depth to water is within 0.1 ft.
- Plopper: A plopper is a capped $\frac{3}{4}$ -inch threaded reduced bushing attached to an engineer's tape graduated to hundredths of a foot. The air pocket trapped in the capped bushing produces a distinctive plopping noise when the bushing strikes the standing water within the well casing. Under ideal conditions, water levels can be measured to an accuracy of 0.1 foot.
- Transducer: Transducers are installed at fixed well depth and measure and record pressures in the water column. Pressure readings are used to calculate static water level depths. Transducers are calibrated and the data is downloaded according to manufacturers' specifications.
- Acoustic sounder: Acoustic well sounders measure depth to water by bouncing sound waves off the water surface. Measurements taken by acoustic sounders have a measurement error of from 3% to 5% and, due to this inaccuracy, are not recommended for use in this monitoring program. However, in instances where depth to water exceeds 500 ft, acoustic sounders may be the only practical device for measuring depths to groundwater. Groundwater level readings collected by acoustic sounder will be labeled as "questionable" when reported.
- Airline: An airline measurement uses a compressed air source, a small diameter tube, and pressure gauge to determine distance from a reference point to the water surface. Air is pumped into the line until all water is displaced, and the resulting pressure is used to calculate water levels.

When collecting a water level measurement use the following as guidance:

1. When arriving at the well site, if possible, confirm that the well has been resting for the appropriate time outlined in Section 6 to collect a representative static water level measurement.
2. Verify pre-populated well information on Groundwater Level Measurement Form.

- a.) Well identifier.
 - b.) GPS Coordinates.
 - c.) Reference point (RP) distance from the ground surface.
 - d.) Reference point elevation (RPE).
 - e.) Ground surface elevation (GSE).
3. Ensure the field equipment (water level meter) is calibrated, clean and functioning properly.
 - a.) Note: Field equipment should be checked prior to leaving for the field to minimize setup needed.
 4. It is recommended to wear heavy-duty gloves when collecting water level measurements.
 5. Remove the appropriate cap, lid, or plug covering the monitoring access point and listen for any pressure release. If a release is detected, the measurement should be taken after allowing some time for the water level to stabilize.
 6. Measure DTW in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. DTW should be measured to the nearest 0.1 foot relative to the RP.
 - a.) Confirm that the water level measurement by collecting two consecutive measurements within 0.1 ft of one another.
 - b.) If measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize by collecting multiple measurement. The groundwater level is considered stable when no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the reading should be appropriately qualified as a questionable measurement.
 7. Record the date, time (24-hour format), DTW, measured by and comments regarding any factors that may influence the depth to water readings on the Groundwater Level Measurement Form:
 - a.) It is recommended to refer to existing well and sounding port photos, if available, or take photos of the well and sounding port used to collect the water level measurement to assure that the same well and port are being used each time. This is especially important when it comes to collecting from multi-completion wells.

8. Verify all field information (date, time (24-hour format), DTW, measured by and comments) on Groundwater Level Measurement Form is populated before departing. Ensure all measurements are in consistent units of ft, tenths of ft, and hundredths of ft.
 - a.) Note: Avoid recording measurements in ft and inches
 - b.) Note: It is recommended to calculate and record GWE prior to leaving the well site to verify field readings are reasonable.
9. See Section 10 for reporting.

8. TROUBLESHOOTING

8.1 Unusual Water Level Readings

When collecting water level measurements in the field, there may be times where an unusual measurement will occur. To ensure that the measurement is correct, record the initial measurement and then take at least two more confirmation measurements. It is also best to document these on the Groundwater Level Measurement Form. If the water level measurements are unusual compared to historic groundwater levels, confirm that the correct well is being measured by checking the GPS coordinate and previously documented field measurement photos. The water level device should also be calibrated per the manufacturer's instructions.

9. QUALITY ASSURANCE AND CONTROL

Quality assurance and control measures for collecting, recording, and reviewing water level measurements are in place to ensure data is representative and may be used for compliance purposes. During each field visit, prior Spring and Fall DTW measurements will be compared to the new measurements to provide a benchmark and approximate location of water levels. The well name, GPS coordinates, date, time, DTW to the nearest 0.1 ft, operator initials, observations and pertinent information as comments are required entries on the groundwater level measurement form. Additionally, a Water Level Questionable Measurement (QM) (Table 1) and Water Level No Measurement (NM) code (Table 2) will be assigned on the groundwater level measurement form, if applicable.

Table 1 Water Level No Measurement (NM) Error Codes

Value	Description	Code Key	Definition
0	Measurement Discontinued	1	
1	Pumping	2	The well is actively pumping while measurements were collected.
2	Pumping house locked	3	Pumping house is locked with no other way to access to take measurement.
3	Tape hung up	4	Unable to collect measurement due to technical issue with tape.
4	Can't get tape in casing	5	Unable to collect measurement due to technical issue with tape.
5	Unable to locate well	6	Cannot find well with given information. Include expected well location and state unable to locate.
6	Well has been destroyed	7	The well is no longer in use and has been destroyed. State date of destruction.
7	Special/Other	8	Use when no other codes are available. If used, need to include reason to Agency Admin or QA/WQC.
8	Casing leaking or wet	9	
9	Temporarily inaccessible	10	Cannot access well site. Document reason why well is inaccessible.
D	Dry well	11	The well is dry; therefore, there is no water level to take measurement from.
F	Flowing artesian well	12	Water is overflowing from the casing vent; therefore, water level is at ground surface.

Table 2. Water Level Questionable Measurement (QM) Error Codes

Value	Description	Code Key	Definition
0	Caved or deepened	1	Well has had its casings integrity compromised, and/or had its casings pulled and borehole drilled deeper. Include a comment for future reference in the notes section.
1	Pumping	2	The well is actively pumping while measurements were collected.
2	Nearby pump operating	3	Another well is close enough to hear the motor running.
3	Casing leaking or wet	4	If there is pooling water in or around the well head monument at the surface, usually while well is pumping you will see this.
4	Pumped recently	5	Water level is rising in the well and two consistent measurements cannot be collected.
5	Air or pressure gauge measurement	6	When the method of measurement is an air pressure gauge or barometric transducer instead of electric or steel tape. This method is notoriously inaccurate and can be used to explain fluctuation in reported values.
6	Other	7	Use when no other codes are available. If used, need to include reason to Agency Admin or QA/QC Reviewer.
7	Recharge or surface water effects near well	8	Use if there is a designated recharge basin nearby, or if there are field flood irrigation practices. Commonly applied at walnut or peach orchards.
8	Oil or foreign substance in casing	9	Use if there is significant amount of oil, remnant from the motor lubricant dripping downhole, sitting on top of the water level. It is most noticeable if the sounding tape has several inches or more of residue.
9	Acoustical sounder	10	Sounder that utilizes sound to measure distance to water.
E	Recently flowing	12	Well had been flowing artesionally (water is flowing out of the well casing) in previous measurement attempts, but no longer.
F	Flowing	13	Aquifer is under pressure and water is flowing out of the well casing.
G	Nearby flowing	14	Nearby well is flowing artesionally, if well is pressure capped and is screened in same aquifer as the nearby flowing well, then can infer that this well is flowing as well.
H	Nearby recently flowing	15	Water is flowing out of the casing from a well close enough to see from the well you are measuring. Only occurs in pressurized aquifer.

Water levels measurement data are recorded in notebooks, iPads, or mobile application into an electronic spreadsheet or database which will be used to import water level data into the DMS. The groundwater level measurements should be reviewed for accuracy within five days of obtaining the measurements. Instruction to review the Imported data are included in Section 3.3 of the DMS User Manual. Should a measurement appear inconsistent with historical readings, a confirmation reading shall be obtained.

10. REPORTING

10.1 Data Entry

10.1.1 Data Management System (DMS)

WL RMW water level data will be entered into Kern County Subbasin Data Management System (DMS). Data may be entered manually or imported via an import template. Refer to the DMS Quick Guide for Entering Water Level Data. Groundwater level measurements should be imported and reviewed for accuracy within five days of obtaining the measurements (Refer to DMS User Manual Section 3.3).

10.1.2 Compliance Evaluation

While entering data, review data for SMC compliance. QA/QC procedure in the DMS presents sample results on a water level elevation graph with historical results as well as the Measurable Objective (MO) and Minimum Threshold (MT). WL RMW's Measurable Objective (MO) and Minimum Threshold (MT). Any MT exceedance may trigger additional action. The Subbasin's MT Exceedance policy should be referenced in the event of an exceedance. It should also be noted that the DMS will distribute email notification to Kern's GSA Manager's and Point-of-Contact once the sample result(s) are approved.

10.2 Data Accessibility

Water level data collected for SGMA compliance is publicly available data. Users may view water quality data via the guest portal of DMS. Data will also be made publicly available through the SGMA Portal.

10.3 Annual Reporting to Department of Water Resources (DWR)

WL RMW data is provided to DWR as part of annual reporting. Annual Reports will also contain a written narrative and hydrographs addressing water level compliance in the Subbasin.

11. REFERENCES

Cunningham, W. L., & Schalk, C. W. 2011, Groundwater technical procedures of the US Geological Survey (No. 1-A1). US Geological Survey.
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