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KERN GROUNDWATER AUTHORITY
COORDINATION AGREEMENT COMPONENTS
WHITE PAPER SERIES

Item A
Groundwater Elevation Data

Introduction

There are seven components to Groundwater Sustainability Plan (GSP) coordination agreements. The coordination components are further described in the Department of Water Resources (DWR)'s GSP regulations, which were released in draft form in February, 2016. The seven components are:

a. **Groundwater elevation data.**
b. **Groundwater extraction data.**
c. **Surface water supply.**
d. **Total water use.**
e. **Change in groundwater storage.**
f. **Water budget.**
g. **Sustainable yield.**

The Kern Coordination Committee of the Kern Groundwater Authority (KGA) is preparing a series of white papers addressing each of the coordination elements identified above. This white paper addresses *Item a) Groundwater Elevation Data*. The information presented in this white paper provides a suggested methodology and protocols for the consistent collection of groundwater elevation data throughout the Kern sub-basin. The intent of this white paper is to advance the dialogue between participating members of the KGA on the development of a coordination agreement required under the Sustainable Groundwater Management Act (SGMA). The information presented herein is draft and subject to the input and revision from members of the Coordination Committee.

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Groundwater Elevation Data and Monitoring Protocols

The groundwater elevation and data monitoring protocols described below have been taken from existing protocols from Arvin Edison Water Storage District, Kern Tulare Water District and Kern Delta Water District. The draft protocols outlined below represent a starting point for discussion, refinement and adoption of protocols acceptable to the KGA.

Monitoring Spatial and Depth Extent

Each participating district of the KGA will be required to monitor groundwater levels at locations that ensure monitoring is adequate to prove/monitor the sustainability of the groundwater basin. The spatial distribution and density of wells is likely to vary for each District based on groundwater use and hydrogeologic conditions.

Each District will coordinate with the KGA to identify the final distribution and number of locations within the District's service area, based on minimum monitoring criteria and protocols developed by the KGA to guide consistent data collection and adequate coverage over the groundwater basin, and including a variety of screened intervals necessary to monitor the aquifers beneath the basin depending on the hydrogeology under each district..

Monitoring Schedule

All monitoring locations will be monitored bi-annually, once in the spring, and once in the fall. Spring levels represent a seasonal high prior to summer irrigation demands. Each District will measure water levels during the month of March. Fall levels represent a seasonal low after the summer irrigation demands. Each District will measure water levels during the month of October as well.

This data will be used for analysis of long-term water level trends. Groundwater pumping typically peaks during the summer growing season, and slows in the winter. Comparisons of groundwater levels in specific wells from spring of one year to spring of other years can indicate groundwater trends, such as lowering of the groundwater table during a drought period.

Description of Field Methods

Depth to groundwater will be measured and reported to the nearest 0.1 ft and may be measured in one of five ways: 1) electric well sounder, 2) plopper, 3) steel tape, and 4) transducer. An airline may also be used, but airline measurements are typically only accurate to within 1 foot. In addition, acoustic sounders may be used in conditions where groundwater depths make acoustic sounders the only practical device for taking measurements. Each of the above mentioned measurement methods is described briefly below.

- Electric sounder: Electric sounders typically include an electrode (probe) that is lowered within a well by a single line 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 have been used for many years by the USGS, DWR and the KCWA. They are typically used where a well's construction prevents measurement of water levels by electric sounders or ploppers. As is the case with 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 ¾" 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 now utilized in several monitoring wells used by the KCWA. 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 ispumped into the line until all water is displaced, and the resulting pressure is used to calculate water levels.

To assure that the same well is being measured each time, the District will create a Well Identification Sheet for each well site. The Well Identification Sheet will be used to track each well being monitored. An example Well Identification Sheet is included in Attachment A. Each Well Identification Sheet includes; well number, date of the District's survey, latitude and longitude, groundwater surface (GS) elevation, reference point (RP) elevation, location description and map, well type, well completion type, total depth if applicable, screened intervals if applicable, well completion report number if applicable, well use, description of RP, landowner information, and of RP location.

A sample Field Groundwater Level Measurement Form is attached in Attachment A. The form will be used to track well monitoring. The form includes the date, no-measurement code, questionable measurement code, reference point elevation, ground surface elevation, depth to water, water surface elevation, measured by, and comments fields. No measurement and questionable measurement codes are provided at the bottom of the form, and are similar to those used by DWR.

A sample Well Summary Table is attached in Attachment A. The table includes line entries for each well, and will be used to summarize each District's monitoring program. There are entries in the sheet for the well's identification, state well number, and other key information from the Well Identification Sheet.

Calibration of Field Equipment

District personnel will routinely clean, maintain, and test the accuracy of measurement devices in accordance with Best Professional Practices(BPPs) for Measurement Device Accuracy, Calibration and Maintenance, developed by the KGA. These BPPs will be similar to those established under Agricultural Water management Plans.

Data Collection and Quality Control

Groundwater depth measurements will be recorded in field notebooks or digital devices, data collected and information specified in the Field Groundwater Level Measurement Form. Technicians are required to enter the date, depth to groundwater to the nearest 0.1 ft, comments and initials. Comments may include the following: pump running, questionable measurement, pumping nearby, oil present, cascading water, etc. During each field visit, prior level readings will be compared to the new readings to provide a benchmark and approximate location of water levels.

After field personnel have completed their work, they shall enter the data recorded on their notebooks or iPads into an electronic spreadsheet or database. District staff will review groundwater level measurements for accuracy within five days of obtaining the measurements. Should a measurement appear suspicious, a confirmation reading shall be obtained. Field data collected by Districts will be consolidated on a single electronic spreadsheet or database, and provided to the KGA.

Data Entry

Upon completion of field methods, the data will be entered into an electronic spreadsheet, which is then shared with other staff, consultants and other agencies, as needed.

Well Location Surveys

About every 5 years, District staff will conduct a visual survey of the District and update their well location map, as well as drivers (electrical, diesel and natural gas) of all wells (active and inactive) in the District. The District will provide updated well location maps to the KGA to support basin-level reporting requirements. The District and KGA will collaboratively review changes to well locations to ensure adequate coverage of the groundwater basin.

Attachment A – Example Tables, Sheets, and Forms

Monitoring Well Information Sheet

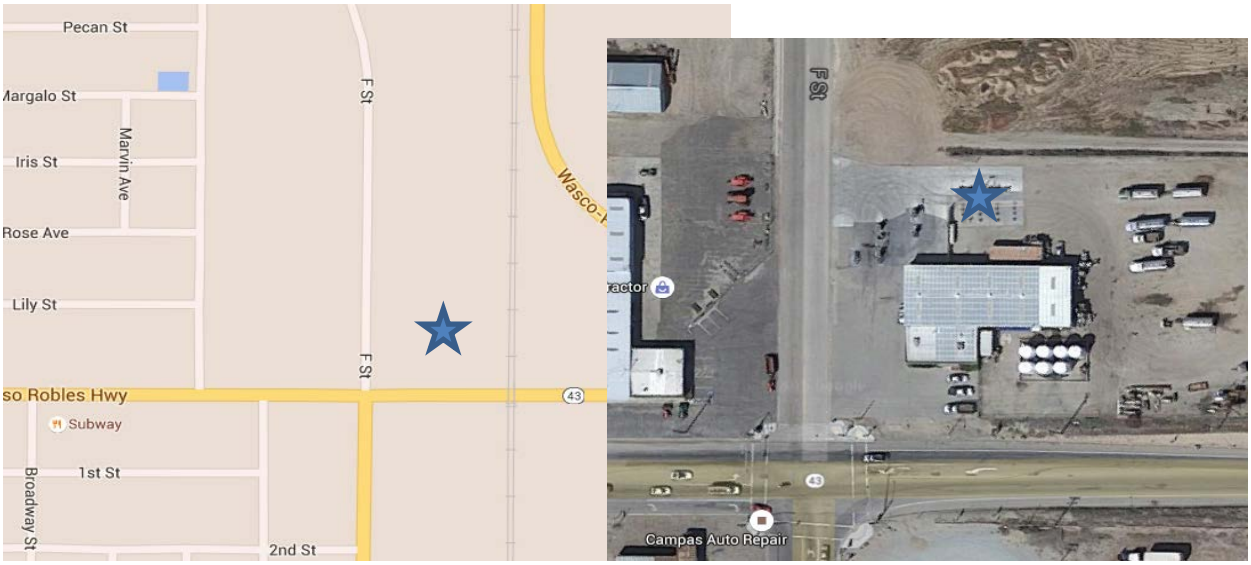
Local Well ID	Smith #1	**State Well Number**	11W25S15A01	**Important notes:** fence gate is not locked, but arrange chain to look locked.
Well Depth (ft)	400	**Casing Material**	Steel	
Screen Top	200	**Date Constructed**	2/15/1978	
Screen Bot	400	**Casing Diameter**	6"	
Latitude	38.97913	**Date Surveyed**	4/5/1995	
Longitude	-121.37269	**Well Type**	Industrial	
RP Elev	108.5	**Well Completion Report #**		
GS Elev	107.00			

Well Owner Information	**Name**	Joe Smith	**Email**	joe@smith.com
	Phone	555-555-5555	**Addrss**	5555 Fifth Street, Wasco, CA 55555

Location Description:

In the Town of Wasco. Two block north of Highway 43 on east side of F Street.

Map:



Site Photos:

Groundwater Level Measurement Form

Groundwater Area _____

Measuring Agency _____

Local Well ID _____

State Well Number _____

Date	NM Code	QM Code	RP Elev	GS Elev	Depth to Water (feet below RP)	Water Surface Elevation	Measured By	Comments

NM = No Measurement Code

0 Unable to reach well
1 Pumping
2 Pump house locked
3 Tape hung up
4 Can't get tape in casing
5 Unable to locate well
6 Well has been destroyed
7 Special/Other
8 Casing leaking or wet
9 Temporarily inaccessible
D Dry well
F Flowing artesian well
G Nearby flowing
H Nearby recently flowing

QM = Questionable Measurement Code

1 Pumping
2 Nearby pump operating
3 Casing leaking or wet
4 Pumped recently
5 Air or pressure gauge measurement
6 Other
7 Recharge or surface water effects near well
8 Oil or foreign substance in casing
9 Acoustical sounder
E Recently flowing
F Flowing

Well Construction Information Table

Local Well ID	State Well Number	Date Constructed	Formation Monitored	Total Depth (feet bgs)	Casing Diameter (inches)	Depth of Well Casing (feet bgs)	Top of Screen	Bottom of Screen	Casing Material	Ground Surface Elevation (feet above msl)	Reference Point Elevation (feet above msl)
Chapter GSP XX											
Old Well #2		4/20/1970		209	12	144	Open hole	NA	Steel	106	107
Cemetery		unknown		unknown	10	unknown	unknown		Steel	135.00	135.28
Swainson		unknown		unknown	10	unknown	unknown		Steel	139.50	140.65
MW-1		10/26/2004		40	2	40	29	39	Plastic	109.00	109.71
MW-2		10/26/2004		45	2	46.0	25	45	Plastic	113.10	113.69
MW-3		10/25/2004		35	2	350	200	300	steel	103.0	103.41
MW-16		10/24/2002		46	2	455.0	250	335	Unk	125.00	127.66
Thompson		11/23/1977		100	6	100	unknown	unknown	Steel	141	142
Carlson/Strawn		6/3/1974		114	6	985	600	900	Unk	156.2	157
Spencer		8/28/1978		107	10	200	Open hole	NA	Steel	130.5	134
Smith 6		7/22/1976		120	6	120	100	120	Plastic	187	187
Gove		10/26/1978		160	6	160	80	160	Plastic	188.4	188