Technical Memorandum

Groundwater Level Monitoring Data Gaps Analysis

County of San Luis Obispo, California

Prepared for

County of San Luis Obispo

Public Works Department

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Prepared by

GSI Water Solutions, Inc.

5855 Capistrano Avenue, Suite C
Atascadero, CA 93422
P: 805.460.4621
info@gsiws.com www.gsiws.com

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1 Introduction

The San Luis Obispo County Flood Control and Water Conservation District (District), through SLO County Public Works Water Resources Division, manages the County-wide groundwater monitoring program that measures groundwater levels in over 300 wells. The District collects this groundwater level data and maintains a level of confidentiality as preferred by each individual well owner. These wells are measured semi-annually in April and October of each year. This accumulated data has proven to be a valuable tool for assessing the groundwater resources throughout the County's various groundwater basins.

"Non-confidential" wells are used to meet the requirements of the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. In September 2014, the District published the CASGEM Monitoring Plan For High and Medium Priority Groundwater Basins (CASGEM Plan), which provides an overview and description of each High and Medium priority groundwater basin and subbasin within the District boundaries, a description of the groundwater elevation monitoring program, procedures for collecting and reporting groundwater level data, and an analysis of the spatial distribution of the monitored wells and data gap areas (San Luis Obispo County Flood Control and Water Conservation District, 2014) . The CASGEM Plan is a dynamic document that is to be evaluated and updated as the monitoring network is refined or enhanced to address specific program needs and data gaps.

Subsequent to publication of the CASGEM Plan, the State passed into law the Sustainable Groundwater Management Act (SGMA), which created a statewide framework for groundwater management. SGMA requires the formation of a Groundwater Sustainability Agency (GSA) in each High and Medium Priority groundwater basin. The GSA is responsible for developing, adopting, and implementing a Groundwater Sustainability Plan (GSP) that will achieve sustainable groundwater management within 20 years. Part of the GSP development process will involve the formation of a groundwater level monitoring network that provides the data necessary to develop an understanding of the basin setting (hydrogeologic conceptual model, groundwater conditions, undesirable results, and water budget), track compliance with minimum thresholds and measurable objectives, evaluate progress of management actions/projects, and assess whether the basin is being sustainably managed. Moving forward in High and Medium Priority, data gaps will be evaluated in terms of the specific data needs identified in the GSP.

The purpose of this project is to review and provide refinements to the CASGEM Plan data gap analysis in consideration of SGMA requirements. As noted above, data gaps will be evaluated in terms of the specific data needs identified in the GSPs, which have not been developed yet. Thus, it is not possible to identify all specific groundwater level data gaps in each High and Medium Priority groundwater basin at this time, nor should it be assumed that the District would be responsible for or desire to address all data gaps. Consequently, this document provides a summary of SGMA requirements for groundwater level monitoring networks and identifies key data gaps areas in each basin that the District can begin working towards addressing. Based on the data gap analysis, a recommend approach and schedule for filling data gaps over time is also presented.

A separate, but related effort was undertaken simultaneously to review and provide recommended well indices for selected basins that present aggregated well data that maintain confidentiality. The well indices will serve as a primary tool for communicating semi-annual groundwater conditions to the public and decision makers while GSPs are being developed. The well indices are presented under separate cover.

2 Project Objectives

The specific objectives of this project are to (1) review and provide refinements to the CASGEM Plan data gap analysis in light of SGMA requirements and (2) provide an approach and schedule for filling the data gaps in each of the six high and medium priority groundwater basins within the County:

- Cuyama Valley
- San Luis Obispo Valley
- Salinas Valley - Paso Robles Area Subbasin (Paso Robles)
- Salinas Valley – Atascadero Area Subbasin (Atascadero)
- Santa Maria River Valley
- Los Osos Valley

The project involved five primary tasks:

1. Evaluate SGMA GSP regulations and applicable Department of Water Resources (DWR) SGMA Best Management Practices (BMPs);
2. Develop criteria for evaluating data gaps;
3. Identify or estimate which water bearing zone(s) / aquifer(s) each ”Non-Confidential” well is screened in;
4. Identify data gaps based on the data gaps criteria and the lateral and vertical distribution of “Non-Confidential” wells; and
5. Develop a recommended approach and schedule for filling data gaps over time.

3 Data Gap Evaluation Criteria

The baseline data gap evaluation was presented in the 2014 CASGEM Plan. It is noted that the data gap evaluation presented in the CASGEM Plan was developed prior to SGMA and, therefore, should not be expected to be consistent with SGMA regulations and BMPs. The CASGEM Plan data gap evaluation was centered on the goal of providing at least one groundwater level monitoring location per 10 square miles within each water bearing zone/aquifer. For this evaluation, data gaps were evaluated relative to existing monitoring wells noted as both "Active" and "Non-Confidential" in the County database. Such wells could potentially fill the need of the data gap without drilling a new well.

The SGMA GSP Emergency Regulations and DWR's BMPs for Monitoring Networks and Identification of Data Gaps were reviewed to identify requirements relevant to the District's current evaluation of groundwater monitoring level data gaps.

In contrast with the CASGEM data gaps evaluation, SGMA does not define data gaps in terms of a monitoring well density metric; rather, data gaps are identified relative to the monitoring needed to develop an understanding of the basin setting (hydrogeologic conceptual model, groundwater conditions, change in storage, undesirable results, and water budget), track compliance with minimum thresholds and measurable objectives, evaluate progress of management actions/projects, and assess whether the basin is being sustainably managed. Thus, monitoring density is not prescribed in the SGMA GSP regulations or BMPs. This is because the application of a monitoring density metric by itself would not ensure the monitoring network addresses all of the data needs for SGMA compliance.

The following is an annotated list of the key data needs, requirements, and considerations for monitoring under SGMA GSPs. It should be understood that some items may not be applicable in every basin. Detailed listings of regulations and BMPs relevant to evaluating data gaps are presented in Appendix A. In general, the monitoring networks (well locations and depths) will be carefully selected to support development of Hydrogeologic Conceptual Models (HCMs), characterize internal hydraulic boundary conditions (groundwater flow barriers), support development of numerical models, and support water budget calculations in support of SGMA requirements.

1. Well Construction Information Mandatory - Wells lacking construction information can only be relied upon initially during GSP development and must be replaced over time.
2. Monitoring Well Characteristics - Preferred monitoring wells are dedicated (not pumped), have known construction details, are screened in a single, principal aquifer, and are not directly influenced by nearby pumping or injection.
3. Groundwater Flow Regime in Each Principal Aquifer - Monitoring well locations should be selected to characterize groundwater gradients and flow in each principal aquifer. Data must be sufficient for mapping groundwater depressions, recharge areas, and along margins of basins where groundwater flow is known to enter or leave a basin.
4. Sustainability Indicators - Monitoring well locations and depths should be carefully selected to provide the specific data necessary to support evaluation of the sustainability indicators.
    a. Chronic Lowering of Groundwater Levels - Monitoring wells should be located in areas where groundwater level declines have been observed historically or could

occur in the future. Generally, this means locating monitoring wells near areas of concentrated pumping, but also across the basin to characterize overall changes in groundwater levels.

b. Reduction of Groundwater Storage - Groundwater levels are the primary input for change in annual groundwater storage calculations. Monitoring wells should be located in areas where the greatest storage changes occur (unconfined areas, pumping centers, recharge areas, and discharge areas) with sufficient spatial density to adequately characterize groundwater storage changes.

c. Seawater Intrusion - Monitoring wells should be located in coastal areas in each principal aquifer that is hydraulically connected to seawater to assess and monitor hydraulic head in relation to the position of the seawater front.

d. Groundwater-Surface Water Interaction – Evaluation of Surface Water Depletion and Groundwater Dependent Ecosystems - Monitoring wells should be located adjacent to interconnected surface water features at the appropriate depths and locations necessary to characterize groundwater-surface water interaction.

e. Land Subsidence - Monitoring wells should be located in confined aquifers in areas with subsidence risk.

5. Measurable Objectives and Minimum Thresholds - Monitoring well locations should be located in areas where the GSA identifies measureable objectives and minimum thresholds.

6. Beneficial Uses - Monitoring wells should be located in areas where active wells or surface water diversions are susceptible to impacts related to declining groundwater levels.

7. Water Budget - Monitoring wells should be located in pumping centers, recharge areas, and discharge areas with sufficient spatial density to support quantification of the various water budget components in the basin.

8. Adjacent Basins - Monitoring wells should be located near boundaries between basins to provide data for quantifying groundwater exchange between the basins.

9. Management Actions/Projects – The monitoring network must provide data to map the effects of management actions/projects.

10. Density of Monitoring Sites – The density of groundwater level monitoring locations is dependent on multiple factors, including groundwater use, aquifer characteristics and groundwater flow, potential impacts to beneficial users of groundwater and surface water, and pre-existing understanding of aquifer responses. Areas that are subject to greater groundwater pumping, greater fluctuations in conditions, significant recharge areas, or specific projects may require more monitoring (temporal and/or spatial) than areas that experience less activity or are more static.

As is likely clear from a review of the foregoing list of considerations for monitoring under SGMA GSPs, many of the criteria for evaluating monitoring well locations and, hence, data gaps, will be determined during GSP development using the professional judgment of those developing the GSPs. It is important to recognize that the District's groundwater level monitoring program could be an integral part of the monitoring program for a GSP. However, the District's groundwater level monitoring program by itself does not necessarily need to meet all of the SGMA requirements.

In terms of the task at hand of evaluating the CASGEM program data gaps, our review of the SGMA regulations and monitoring network BMP has led to the conclusion that a detailed analysis of the data gaps in each basin is not possible at this time because the GSAs have not begun discussing monitoring needs. However, it is clear that moving away from a density-focused approach for evaluating data gaps and instead focusing on the key data needs in each basin is more appropriate in terms of supporting SGMA efforts in the basins. Of all the monitoring requirements and considerations, characterizing the groundwater flow regime in each principal aquifer is probably the most fundamental and largest data gap in the basins. Furthermore, our review of the CASGEM monitoring plan has revealed that there are significant gaps in the vertical distribution of data in most basins. It is recommended that the District focus its efforts on addressing this data gap. Moreover, providing regional data to characterize groundwater flow is consistent with the regional nature of the District's County-wide groundwater monitoring program.

4 Identification of Water Bearing Zones / Aquifers

4.1 Cuyama Valley Basin

Four water-bearing zones are recognized in the CASGEM monitoring plan for Cuyama Valley: Alluvial Channel, Younger Alluvium, Older Alluvium, and the Morales Formation. For the purposes of identifying the index areas and index wells and the identification of data gaps, the water-bearing zones were grouped into the following hydrostratigraphic units (GSI, 2018a):

- Alluvium (Shallow Zone)
- Morales Formation (Deep Zone)

The alluvial units were grouped based on our experience in other basins which indicates that there is typically considerable hydraulic communication between different age alluvial units. Although the GSP for this basin may ultimately identify a need to monitor the individual alluvial units, we believe it is appropriate to group the units for the purposes of this evaluation.

Total number of "Active" "Non-Confidential" wells: 2, both CASGEM wells;

- Number in Shallow Zone: None
- Number in Deep Zone: 2

4.2 San Luis Obispo Valley Basin

Four water-bearing zones are recognized in the CASGEM monitoring plan for San Luis Obispo Valley Basin: Valley Alluvium, Terrace Deposits, Paso Robles Formation, and the Squire Member of the Pismo Formation. Based on the CASGEM Plan and a recent characterization of the San Luis Obispo Valley Basin (GSI, 2018b), water-bearing zones were categorized into four hydrostratigraphic units. For the purposes of identifying index areas and index wells and the identification of data gaps, these unites were (GSI, 2018a):

- Alluvium (Shallow Zone)
- Terrace Deposits (Shallow Zone)
- Paso Robles Formation (Shallow or Deep Zone depending on location)
- Squire (Member of the Pismo Formation) (Deep Zone)

The San Luis Obispo Valley Basin is divided into two prominent areas: the San Luis Valley to the northwest and the Edna Valley to the southeast. Within the San Luis Valley, groundwater is extracted from both the Alluvium and Paso Robles Formations, which are managed as a single shallow groundwater resource. Likewise, in the Edna Valley, groundwater is extracted from either the Alluvium (Shallow Zone) or the combined Paso Robles Formation and Squire Member of the Pismo formation (Deep Zone), which together are considered as a single water-bearing zone. Notably, while the terrace deposits can yield a minor quantity of water to wells, their contribution is minor; based on this it are not consider an important water resource (GSI , 2018b).

For the sake of this analysis, the Shallow Zone consists of the Alluvium, Terrace Deposits and, in places, the Paso Robles Formation. The Deep Zone consists of the Paso Robles Formation, in places, and the Squire Member of the Pismo Formation.

Total number of "Active" "Non-Confidential" wells: 1, a CASGEM well;

- Number in Shallow Zone: 1
- Number in Deep Zone: None

4.3 Salinas Valley Basin

Within the Salinas Valley Basin, two Subbasins are present within the County of San Luis Obispo: the Paso Robles Area Subbasin and the Atascadero Area Subbasin. These Subbasins were initially included in the Paso Robles Area Subbasin ("Paso Basin"), but have since been separated when the Atascadero Area Subbasin was designated a separate subbasin by the California Department of Water Resources (DWR) in 2017 during the Basin Boundary Modification process.

4.3.1 Paso Robles Area Subbasin

The CASGEM monitoring plan recognizes four water-bearing zones in the "Paso Robles Basin" based on the basin groundwater model layering (Zones 1 – 4). The zones generally represent recent alluvium (Zone 1) and the Paso Robles Formation (Zones 2 – 4). However, the Paso Robles GMP does not differentiate the wells vertically for the purposes of developing the "composite hydrographs." For the purposes of developing the index well groupings, the District directed GSI to align the index areas with the Paso Robles GMP "sub-areas" and the wells identified in the GMP "composite hydrographs" (GSI, 2018a). Similarly, the data gaps evaluation proceeded without differentiating vertical horizons between alluvium and the Paso Robles Formation and within the Paso Robles Formation. We believe it is more appropriate for the GSA to make such determinations, if needed. The total number of "Active" "Non-Confidential" wells: 19, 8 are CASGEM wells.

4.3.2 Atascadero Area Subbasin

As discussed for the Paso Areas Subbasin, the CASGEM monitoring plan combines the Paso and Atascadero Area Subbasins. With that, the same water-bearing zones are recognized within the Atascadero Area Subbasin. The Paso Robles GMP does not differentiate the wells vertically for the purposes of developing the "composite hydrographs." The index well grouping was aligned with the Atascadero index area within the Paso Robles GMP "sub-areas" and the wells identified in the GMP "composite hydrographs" (GSI, 2018a). Similarly, the data gaps evaluation proceeded without differentiating vertical horizons between alluvium and the Paso Robles Formation and within the Paso Robles Formation. We believe it is more appropriate for the GSA to make such determinations, if needed. The total number of "Active" "Non-Confidential" wells: 12, 6 are CASGEM wells.

4.4 Santa Maria River Valley Basin

The Santa Maria Basin water-bearing zones are composed of the following hydrostratigraphic units:

- Alluvium and Dune Sands (Shallow Zone)
- Paso Robles Formation (Middle Zone)
- Careaga Formation (Deep Zone)

Total number of “Active” “Non-Confidential” wells: 32, 2 are CASGEM wells;

- Number in Shallow Zone: 5 (1 CASGEM)
- Number in Middle Zone: 9
- Number in Deep Zone: 14 (1 CASGEM)
- Number N/A or Unidentified: 4

4.5 Los Osos Valley Basin

The CASGEM monitoring plan recognizes six aquifer zones in the Los Osos Valley Basin, which are referred to as Zones A – E. The CASGEM monitoring plan groups the six zones into three “aquifers” as follows: Perched Aquifer (Zones A and B), Upper Aquifer (Zone C), and the Lower Aquifer (Zones D and E) and the Alluvial Aquifer. The CASGEM Aquifer designations were retained for this project. It is noted that the Perched Aquifer is not managed, thus, it was not evaluated for data gaps.

For the purposes of identifying index areas in Los Oso Valley and index wells and evaluating data gaps, water-bearing zones were categorized into the following hydrostratigraphic units (GSI, 2018a):

- Alluvium (Shallow Zone)
- Paso Robles Formation (Deep Zone)

Total number of “Active” “Non-Confidential” wells: 6, 4 are CASGEM wells;

- Number in Shallow Zone: 1 (CASGEM)
- Number in Deep Zone: 5 (3 are CASGEM)

5 Approach for Addressing Data Gaps

The following approach was employed by GSI Water Solutions to identify data gap areas in each of the six high and medium priority groundwater basins within the County, assign priority to the identified data gap areas, and to estimate the costs for adding new monitoring wells to the County monitoring program:

- Identify areas in each water bearing zone, not represented by "Active" "Non-Confidential" wells that would benefit from additional water level measurements as described in Section 3, data gap selection criteria.
- Select data gap areas to improve the understanding of the groundwater basin flow regime, storage calculations, and interflow between groundwater basins.
- Select data gap areas to address likely sustainability indicators such as potential chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, groundwater-surface water interaction, and land subsidence as a result of the beneficial use of the groundwater.
- Rank the priority of the data gaps by giving more weight to data gaps in areas of potential seawater intrusion and chronic lowering of groundwater levels and potential land subsidence in beneficial use areas, followed by areas of groundwater/surface water interactions and areas of potential inter-basin flow, then by data gaps in areas that would improve the general understanding of the groundwater flow regime.
- Data gaps areas were checked against existing "Active" "Confidential" wells in the County database that could potentially fill the need of the data gap without drilling a new well, as shown on the relevant figures. It is presumed that the County would attempt to negotiate with these well owners to change the well status to "Non-Confidential." "Confidential" wells were considered if they were located within or near an identified data gap area and had known well completion details and/or a period of record groundwater elevations that appear to be representative of the target zone. For the purposes of this report, a "Confidential" well that is considered likely to fill the needs of a data gap is defined as a 'data gap well'. In cases where the well completion status is unknown but the groundwater elevations suggest completion within the target water bearing zone based on comparison to nearby wells, the wells are selected for further investigation[10] to confirm suitability as a data gap well, as noted in Tables 6-9. In all cases, the owner of each existing potential data gap well would need to be contacted to see if they are willing to allow their well to become an official monitoring well.
- Data gap areas that do not coincide with existing "Confidential" wells with appropriate specifications are candidates for a new monitoring well to fill the data gap. Approximate required depths of completion were evaluated for each potential new monitoring well and a preliminary cost estimate was developed for drilling and installation of the potential additional wells.

[10] Video logging and acoustic logging could be performed to determine the key well construction information.

6 Data Gap Evaluation Results

A data gap evaluation was performed for each of the six high and medium priority groundwater basins within the County using the approach outlined in Section 5. The following sections present the results of the data gap evaluation for each basin. The figures associated with this section show the identified data gap areas, with priority classes indicated by color. Typically, data gaps present in different aquifers / water-bearing zones have been co-located with the idea that any future monitoring wells would be completed in each aquifer/zone (i.e. nested or clustered monitoring wells).

"Active" "Confidential" wells that are candidates for addressing data gaps are indicated on the figures and detailed in Tables 6 - 9. It is expected that the County would first attempt to negotiate with these well owners to change the well status to "Non-Confidential". Any data gaps not filled through this process would require monitoring wells if they are to be addressed. An approximate required completion depths and costs[11] have been estimated for new monitoring wells and are presented in Tables 10 - 19.

GSI recognizes that addressing all data gaps identified in each basin it is not likely feasible and may not be necessary. As such, the following factors should be considered moving forward when deciding which data gaps should be addressed and in what order.

- GSP data gaps evaluation;
- Professional judgment;
- Changing groundwater conditions; and
- Access for drilling and easements,

It is recognized that the data gap priorities suggested in this technical memorandum may change in the future based on these criteria.

6.1 Cuyama Valley Basin

A data gap evaluation was performed for both the Shallow Zone and the Deep Zone in the Cuyama Valley Basin using the criteria presented above in Section 3 and approach described in Section 5. The two water-bearing zones, as defined above in Section 4.1 are the Shallow Zone (alluvium) and the Deep Zone (Morales Formation). A total of 14 data gap areas were identified, eight in the Shallow Zone and six in the Deep Zone as shown in Table 1 and on Figure 1 and Figure 2. Placement of additional wells in each of these data gap areas would aid in the understanding of the groundwater flow regime (gradient and

[11] Assumptions for cost estimation purposes: Mud rotary drilling is assumed. Assumed well construction is 5-inch inside diameter (ID) poly-vinyl chloride (PVC) well casing completed in the target zone of each data gap. 5-inch diameter was assumed to facilitate adequate well development and provide access for 4-inch pumps in wells with deep water levels for purging when sampling for water quality. Shallow wells could be smaller diameter, particularly if not completed in a mud rotary borehole. Costs assume all wells are drilled under a single contract. Additional mobilization costs would be incurred if project is divided into phases and unit costs would increase for a smaller number of wells per contract. Costs include prevailing wage. Costs for mud and development water transportation and disposal, if needed, are not included. Cost estimate assumptions are used to provide a common cost estimate platform for the purposes of this evaluation only and should not be interpreted as well design recommendations. Monitoring wells should be designed based on site conditions by the professional in responsible charge.

direction), would result in more accurate estimates of the basin water budget and changes in groundwater storage, and would increase the ability to track basin measureable objectives and minimum thresholds and map the effects of management actions and/or projects.

- Shallow Zone data gap areas 1 through 6 and Deep Zone data gap areas 1 through 4 are located in the areas of potential chronic lowering of groundwater levels and potential land subsidence associated with agricultural water use in the Southeast part of the Cuyama Valley Basin that is located within SLO County (USGS, 2015).
- Shallow Zone data gap areas 1, 2, 7 and 8 are positioned in areas where groundwater-surface water interactions may be evaluated.

The data gap areas in the Cuyama Valley Basin were generally ranked for priority by giving more weight to data gaps in areas of chronic lowering of groundwater levels and potential land subsidence in beneficial use areas, followed by areas of potential groundwater/surface water interactions, then by data gaps in areas that would improve the general understanding of the groundwater flow regime. Prioritization results for the Shallow and Deep Zones are shown in Table 1 and on Figure 1 and Figure 2.

A total of 14 data gap areas were identified in the Cuyama Valley Basin. Because none of these 14 data gap areas coincide with existing “Active” “Confidential” wells with appropriate specifications, it is assumed that installation of new monitoring wells will be required to fill the data gaps in the Cuyama Valley Basin. An approximate required depth of completion has been estimated for each proposed new monitoring well as shown in Table 10. The estimated costs associated with drilling and installation of these monitoring wells is broken down by priority level and presented in Table 11.

6.2 San Luis Obispo Valley Basin

A data gap evaluation was performed for both the Shallow Zone and the Deep Zone in the San Luis Obispo Valley Basin using the criteria presented above in Section 3 and approach described in Section 5. The two water-bearing zones, as defined above in Section 4.2, are the Shallow Zone (alluvium and terrace deposits and sometimes Paso Robles Formation) and the Deep Zone (Paso Robles or Squire Member of the Pismo Formation). A total of 47 data gap areas were identified: 23 in the Shallow Zone and 24 Deep Zone as shown in Table *2* and on Figure *3* and Figure *4*. Placement of additional wells in each of these data gap areas would aid in the understanding of the groundwater flow regime (gradient and direction), would result in more accurate estimates of the basin water budget and changes in groundwater storage, and would increase the ability to track basin measureable objectives and minimum thresholds and map the effects of management actions and/or projects.

- Data gap area 1 in the Deep Zone is associated with potential subsidence (Yeh and Associates, 2017; GSI, 2018b).
- Shallow Zone data gap areas 1 through 7 and Deep Zone data gap areas 2 through 6 are located in the areas of potential chronic lowering of groundwater levels associated with beneficial uses in agricultural areas.
- Shallow Zone data gap areas 1, 4, 9 - 13, and 15 - 19 are positioned in areas of potential groundwater-surface water interaction.

- Shallow Zone data gap areas 8 and 20 and Deep Zone data gap areas 7 and 16 are positioned to track potential inter-basin flow.

The data gap areas in the San Luis Obispo Valley Basin were generally ranked for priority by giving more weight to data gaps in areas of potential subsidence and/or potential chronic lowering of groundwater levels in beneficial use areas, followed by areas of potential groundwater/surface water interactions and areas of potential inter-basin flow, then by data gaps in areas that would improve the general understanding of the groundwater flow regime. Prioritization results for the Shallow and Deep Zones are shown in Table 2 and on Figure 3 and Figure 4.

A total of 47 data gap areas were identified in the San Luis Obispo Valley Basin as shown in Table 2 and on Figure 3 and . Five existing potential data gap wells were identified from the “Active” “Confidential” wells dataset in the San Luis Obispo Valley Basin as shown in Table 6 and on Figure 3 and Figure 4. Four of the potential data gap wells correspond to data gap areas 1, 14, 17, and 22 in the Shallow Zone and one of the potential data gap wells correspond to data gap area 24 in the Deep Zone. The well completion details are not known for two of the potential Shallow Zone data gap wells and one of the potential Deep Zone wells. These three wells all have a long period of record of groundwater elevation data and appear to fairly represent water levels in their respective water bearing zones. However, further investigation of each well is required to determine ultimate suitability as a data gap well. It is assumed that installation of new monitoring wells will be required to fill the remaining 42 data gaps in the San Luis Obispo Valley Basin. An approximate required depth of completion has been estimated for each proposed new monitoring well as shown in Table 12. The estimated costs associated with drilling and installation of these monitoring wells is broken down by priority level and presented in Table 13.

6.3 Salinas Valley Basin

6.3.1 Paso Robles Area Subbasin

A data gap evaluation for the Paso Robles Area Subbasin was performed using the criteria presented above in Section 3 and approach described in Section 5. For the purposes of this evaluation, the four water bearing zones identified above in Section 4.3.1are considered to be a single undifferentiated zone. A total of 13 data gap areas were identified for the Paso Robles Area Subbasin as shown in Table 3 and on Figure 5. Placement of additional wells in each of these data gap areas would aid in the understanding of the groundwater flow regime (gradient and direction), would result in more accurate estimates of the basin water budget and changes in groundwater storage, and would increase the ability to track the basin measureable objectives and minimum thresholds and map the effects of management actions and/or projects.

- Data gap areas 1 through 10 are located in the areas of potential chronic lowering of groundwater levels associated with beneficial uses by the City of Paso Robles and the agricultural areas to the east on Highway 46 towards the town of Shandon.
- Data gap areas 1 through 7 are positioned around the agricultural area approximately 3 miles to the northeast of Paso Robles that has experienced minor land subsidence (Valentine, D. W. et al., 1997).

- Data gap areas 1 - 3, 5, 8, 9, and 11 - 13 are positioned in areas where potential groundwater-surface water interactions may be evaluated.

The data gap areas in the Paso Robles Basin were generally ranked for priority by giving more weight to data gaps in areas of historical chronic lowering of groundwater levels and potential land subsidence in beneficial use areas, followed by areas of potential chronic lowering of groundwater levels and groundwater/surface water interactions. Prioritization results are shown in Table 3 and on Figure 5.

A total of 13 data gap areas were identified in the Paso Robles Basin as shown in Table 3 and on Figure 5. Eight existing potential data gap wells were identified from the “Active” “Confidential” wells dataset in the Paso Robles Basin as shown in Table 7 and on Figure 5. The eight potential data gap wells correspond to the data gap areas 1, 3, 5, 7, 9, and 11 - 13. The well completion details are known for all but the wells corresponding to data gaps 5, 12 and 13. These three wells all have a long period of record of groundwater elevation data and appear to fairly represent water levels in the single undifferentiated water bearing zone. However, further investigation of each well is required to determine ultimate suitability as a data gap well. It is assumed that installation of new monitoring wells will be required to fill the remaining five data gaps in the Paso Robles Basin. An approximate required depth of completion has been estimated for each proposed new monitoring well as shown in Table 14. The estimated costs associated with drilling and installation of these monitoring wells is broken down by priority level and presented in Table 15.

6.3.2 Atascadero Area Subbasin

The data gap evaluation for the Atascadero Area Subbasin was performed using the criteria presented above in Section 3 and approach described in Section 5. For the purposes of this evaluation, the four water bearing zones identified above in Section 4.3.2 are considered to be a single undifferentiated zone. As shown on Figure 5, no data gap areas were identified for the Atascadero Area Subbasin. All of the data gaps shown on Figure 5 are located within the Paso Robles Area Subbasin and discussed above.

6.4 Santa Maria River Valley Basin

A data gap evaluation was performed for both the Shallow/Middle Zone (combined) and the Deep Zone in the Santa Maria Basin using the criteria presented above in Section 3 and approach described in Section 5. The three water-bearing zones, as defined above in Section 4.4, are the Shallow Zone (alluvium), the Middle Zone (Paso Robles Formation), and the Deep Zone (Careaga Formation). Eleven data gap areas were identified for both the Shallow/Middle Zone and the Deep Zone as shown in Table 4 and on Figure 6 and Figure 7. Placement of additional wells in each of these data gap areas would aid in the understanding of the groundwater flow regime (gradient and direction), would result in more accurate estimates of the basin water budget and changes in groundwater storage, and would increase the ability to track the basin measureable objectives and minimum thresholds (particularly seawater intrusion) and map the effects of management actions and/or projects.

Shallow/Middle Zone data gap areas 1 and 2 and the Deep Zone data gap area 1 are positioned to aid in tracking potential seawater intrusion. Shallow/Middle Zone data gap areas 3 through 5 and Deep Zone data gap areas 2 through 6 are located in the areas of potential chronic lowering of groundwater levels associated with beneficial uses by the cities of Arroyo Grande and Nipomo and golf courses and agricultural areas in the area to the east of Highway 1. Shallow/Middle Zone data gap areas 3, 6, 7, 9, and 11 are positioned in areas where potential groundwater-surface water interactions may be evaluated.

The data gap areas in the Santa Maria Basin were generally ranked for priority by giving more weight to data gaps in areas of potential seawater intrusion and areas of potential chronic lowering of groundwater levels in beneficial use areas, followed by areas of groundwater/surface water interactions, then by data gaps in areas that would improve the general understanding of the groundwater flow regime. Prioritization results for the Shallow/Middle and Deep Zones are shown in Table 4 and on Figure 6 and Figure 7.

A total of 22 data gap areas were identified in the Santa Maria Basin. Eleven existing potential data gap wells were identified from the “Active” “Confidential” wells dataset in the Santa Maria Basin as shown in Table 8 and on Figure 6 and Figure 7. Six of the potential data gap wells correspond to data gap areas 3, 5, 6, 8, 9 and 11 in the Shallow/Middle Zone and five of the potential data gap wells correspond to data gap areas 1, 2, 5, 9 and 11 in the Deep Zone. The well completion details are known for all 11 wells and they each have long periods of record of groundwater elevation data. It is assumed that installation of new monitoring wells will be required to fill the remaining 11 data gaps in the Santa Maria Basin. An approximate required depth of completion has been estimated for each proposed new monitoring well as shown in Table 16. The estimated costs associated with drilling and installation of these monitoring wells is broken down by priority level and presented in Table 17.

6.5 Los Osos Valley Basin

A data gap evaluation was performed for both the Shallow Zone and the Deep Zone in the Los Osos Valley Basin using the criteria presented above in Section 3 and approach described in Section 5. The two water-bearing zones, as defined above in Section 4.5, are the Shallow Zone (alluvium) and the Deep Zone (Paso Robles Formation). Five data gap areas were identified for both the Shallow Zone and the Deep Zone as shown in Table 5 and on Figure 8 and Figure 9. Placement of additional wells in each of these data gap areas would aid in the understanding of the groundwater flow regime (gradient and direction), would result in more accurate estimates of the basin water budget and changes in groundwater storage, and would increase the ability to track the basin measureable objectives and minimum thresholds (particularly seawater intrusion) and map the effects of management actions and/or projects.

Data gap areas 1 and 3 in both the Shallow Zone and the Deep Zone are positioned to aid in tracking potential seawater intrusion. Data gap area 2 in both the Shallow Zone and the Deep Zone are located in the area of potential chronic lowering of groundwater levels associated with beneficial uses by the city of Los Osos. Shallow Zone data gap areas 2, 4 and 5 are positioned in areas where groundwater-surface water interactions may be evaluated. Data gap area 4 in both the Shallow Zone and the Deep Zone are positioned to track potential inter-basin flow.

The data gap areas in the Los Osos Valley Basin were generally ranked for priority by giving more weight to data gaps in areas of potential seawater intrusion and areas of potential chronic lowering of groundwater levels in beneficial use areas, followed by areas of potential groundwater/surface water interactions and areas of potential inter-basin flow, then by data gaps in areas that would improve the general understanding of the groundwater flow regime. Prioritization results for the Shallow and Deep Zones are shown in Table 5 and on Figure 8 and Figure 9.

A total of ten data gap areas were identified in the Los Osos Valley Basin. Three existing potential data gap wells were identified from the “Active” “Confidential” wells dataset in the Los Osos Valley Basin as shown in Table 9 and on Figure 8 and Figure 9. The potential data gap wells correspond to data gap area 1 in both the Shallow Zone and the Deep Zone and data gap area 2 in the Shallow Zone. The well completion details are known for all 3 wells and they each have long periods of record of groundwater elevation data. It is assumed that installation of new monitoring wells will be required to fill the remaining seven data gaps in the Los Osos Valley Basin. An approximate required depth of completion has been estimated for each proposed new monitoring well as shown in Table 18. The estimated costs associated with drilling and installation of these monitoring wells is broken down by priority level and presented in Table 19.

7 Recommended Approach, Schedule, and Budget for Addressing Data Gaps

A recommended approach for addressing data gaps was developed that attempts to address the District's desire to be proactive while also recognizing that data gaps will be more fully reviewed by GSAs during GSP development and that grant funding will likely be available from the State to address data gaps once the GSPs have been developed. GSI assumes that the District will participate in the identification and characterization of data gaps with the GSAs, help the GSAs assess and improve the monitoring networks, and coordinate with the GSAs to fill data gaps over time to avoid unnecessary redundancy with monitoring programs.

Given that the GSPs will be developed over the next three to five years and that significant grant monies are expected to be released for GSP implementation (including addressing data gaps), GSI believes the most fiscally prudent approach for the near term would be to focus on actions that have minimal capital outlay and that put the District (and partner GSAs) in the best position to compete for[12] and leverage grant monies for addressing data gaps when they become available. These actions include:

1. Evaluating "Active" "Confidential" wells in identified data gap areas and negotiating with the well owners to change the status to "Non-Confidential" so that the data can be used publically;
2. Complete a well siting study to identify viable drilling sites where monitoring wells could be drilled in data gap areas; and
3. Negotiate right-of-way options for drilling sites based on the well siting study results.

The following schedule is recommended:

- 0 – 6 months:
    - Participate in GSP development activities and coordinate with GSA concerning data gaps.
    - Issue RFP for well siting study and select consultant.
    - Contact owners of "Active" "Confidential" wells and identify those who are willing to convert status to "Non-Confidential".
    - Update data gaps.
    - Complete contracting and issue notice to proceed for well siting study.
- 6 – 18 months:
    - Participate in GSP development activities and coordinate with GSA concerning data gaps.

[12] In our experience, the most competitive applications for implementation grants are those that contain turn-key projects. For addressing data gaps, this means having right-of-way already secured, etc.

    - Complete well siting study (with ongoing re-prioritization based on GSP development)
    - Begin right-of-way discussions based on preliminary well siting study results (with ongoing re-prioritization based on GSP development)
- 18 – 36 months:
    - Participate in GSP development activities and coordinate with GSA concerning data gaps.
    - Negotiate right-of-way options for monitoring wells (with ongoing re-prioritization based on GSP development)
    - Monitor DWR grant process and apply for applicable grants
- 36+ months:
    - Monitor DWR grant process and apply for applicable grants
    - Solicit proposals/bids, contract, and construct monitoring wells in logical batches according to funding availability in each basin and data gap priorities.

- The following rough cost estimates are provided for preliminary planning purposes: Negotiating with the well owners to change the status to "Non-Confidential": None - District labor only
- Well Siting Study for Five Basins: $300,000
- Right-of-Way Negotiation: $10,000 - $20,000 per site (contact landowner, obtain preliminary title report, and negotiate easement deed terms)
- Easement: Compensation to be negotiated on case-by-case basis
- Monitoring Wells:
    - Drilling Costs: Approximately $161 per foot ($3.7M for all data gaps - see assumptions in Footnote No. 11)
    - Consultant Costs for Program management, field oversight by hydrogeologist, and monitoring well installation reports: Approximately $83 per foot ($1.9M for all data gaps)

8 References

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Tables

Table 1: Cuyama Valley Basin Data Gap Analysis

Aquifer Groundwater Flow Regime	Data Gap Area No.	Groundwater Gradient Map	Other GSP Considerations that Might Also Be Addressed							Priority
			Chronic Lowering of Groundwater Levels	Reduction of GW Storage	Seawater Intrusion	Groundwater/ Suraface Water Interaction	Land Subsidence	Beneficial Uses	Inter-Basin Flow	
Shallow	1	X	X	X	n/a	X	X	X		1
	2	X	X	X	n/a	X	X	X		1
	3	X	X	X	n/a		X	X		1
	4	X	X	X	n/a		X	X		1
	5	X	X	X	n/a		X	X		1
	6	X	X	X	n/a		X	X		1
	7	X		X	n/a	X				2
	8	X		X	n/a	X				2
Deep	1	X	X	X	n/a		X	X		1
	2	X	X	X	n/a		X	X		1
	3	X	X	X	n/a		X	X		1
	4	X	X	X	n/a		X	X		1
	5	X		X	n/a					2
	6	X		X	n/a					2

Table 2: San Luis Obispo Valley Basin Data Gap Analysis

Aquifer Groundwater Flow Regime	Data Gap Area No.	Groundwater Gradient Map	Other GSP Considerations that Might Also Be Addressed							Priority
			Chronic Lowering of Groundwater Levels	Reduction of GW Storage	Seawater Intrusion	Groundwater/ Suraface Water Interaction	Land Subsidence	Beneficial Uses	Inter-Basin Flow	
Shallow	1	X	X	X	n/a	X		X		1
	2	X	X	X	n/a			X		1
	3	X	X	X	n/a			X		1
	4	X	X	X	n/a	X		X		1
	5	X	X	X	n/a			X		1
	6	X	X	X	n/a			X		2
	7	X	X	X	n/a			X		2
	8	X		X	n/a			X	X	2
	9	X		X	n/a	X				2
	10	X		X	n/a	X				2
	11	X		X	n/a	X				2
	12	X		X	n/a	X				2
	13	X		X	n/a	X				2
	14	X		X	n/a					2
	15	X		X	n/a	X				2
	16	X		X	n/a	X				2
	17	X		X	n/a	X				2
	18	X		X	n/a	X				2
	19	X		X	n/a	X		X		2
	20	X		X	n/a				X	2
	21	X		X	n/a					3
	22	X		X	n/a					3
	23	X		X	n/a					3
Deep	1	X		X	n/a		X			1
	2	X	X	X	n/a			X		1
	3	X	X	X	n/a			X		1
	4	X	X	X	n/a			X		1
	5	X	X	X	n/a			X		1

Table 2: San Luis Obispo Valley Basin Data Gap Analysis

Aquifer Groundwater Flow Regime	Data Gap Area No.	Groundwater Gradient Map	Other GSP Considerations that Might Also Be Addressed							Priority
			Chronic Lowering of Groundwater Levels	Reduction of GW Storage	Seawater Intrusion	Groundwater/ Suraface Water Interaction	Land Subsidence	Beneficial Uses	Inter-Basin Flow	
Deep	6	X	X	X	n/a			X		1
	7	X		X	n/a				X	2
	8	X		X	n/a					2
	9	X		X	n/a					2
	10	X		X	n/a					2
	11	X		X	n/a					2
	12	X		X	n/a					2
	13	X		X	n/a					2
	14	X		X	n/a					2
	15	X		X	n/a					2
	16	X		X	n/a				X	2
	17	X		X	n/a					3
	18	X		X	n/a					3
	19	X		X	n/a					3
	20	X		X	n/a					3
	21	X		X	n/a					3
	22	X		X	n/a					3
	23	X		X	n/a					3
	24	X		X	n/a					3

Table 3: Salinas Valley – Paso Robles Area Subbasin Data Gaps Analysis

Data Gap Area No.	Groundwater Gradient Map	Other GSP Considerations that Might Also Be Addressed							Priority
		Chronic Lowering of Groundwater Levels	Reduction of GW Storage	Seawater Intrusion	Groundwater/ Suraface Water Interaction	Land Subsidence	Beneficial Uses	Inter-Basin Flow	
1	X	X	X	n/a	X	X	X		1
2	X	X	X	n/a	X	X	X		1
3	X	X	X	n/a	X	X	X		1
4	X	X	X	n/a		X	X		1
5	X	X	X	n/a	X	X	X		1
6	X	X	X	n/a		X	X		1
7	X	X	X	n/a		X	X		1
8	X	X	X	n/a	X		X		2
9	X	X	X	n/a	X		X		2
10	X	X	X	n/a			X		2
11	X		X	n/a	X				3
12	X		X	n/a	X				3
13	X		X	n/a	X				3

Table 4: Santa Maria Basin Data Gap Analysis

Aquifer Groundwater Flow Regime	Data Gap Area No.	Groundwater Gradient Map	Other GSP Considerations that Might Also Be Addressed							Priority
			Chronic Lowering of Groundwater Levels	Reduction of GW Storage	Seawater Intrusion	Groundwater/ Suraface Water Interaction	Land Subsidence	Beneficial Uses	Inter-Basin Flow	
Shallow/Middle	1	X		X	X					1
	2	X		X	X					1
	3	X	X	X		X				1
	4	X	X	X						1
	5	X	X	X						1
	6	X		X		X				2
	7	X		X		X				2
	8	X		X						2
	9	X		X		X				2
	10	X		X						2
	11	X		X		X				2
Deep	1	X		X	X					1
	2	X	X	X				X		1
	3	X	X	X				X		1
	4	X	X	X				X		1
	5	X	X	X				X		1
	6	X	X	X				X		1
	7	X		X				X		1
	8	X		X				X		2
	9	X		X				X		2
	10	X		X				X		3
	11	X		X				X		3

Table 5: Los Osos Valley Basin Data Gap Analysis

Aquifer Groundwater Flow Regime	Data Gap Area No.	Groundwater Gradient Map	Other GSP Considerations that Might Also Be Addressed							Priority
			Chronic Lowering of Groundwater Levels	Reduction of GW Storage	Seawater Intrusion	Groundwater/ Suraface Water Interaction	Land Subsidence	Beneficial Uses	Inter-Basin Flow	
Shallow	1	X		X	X					1
	2	X	X	X		X		X		1
	3	X		X	X					2
	4	X		X		X			X	2
	5	X		X		X				3
Deep	1	X		X	X					1
	2	X	X	X				X		1
	3	X		X	X					2
	4	X		X					X	2
	5	X		X						3

Table 6: San Luis Obispo Valley Basin Existing "Active" "Confidential" Potential Data Gap Wells

Aquifer Groundwater Flow Regime	Data Gap Area No.	Period of Record	Perforated Zone or Total Depth (feet bgs)	Well Owner	Priority Level
Shallow	1	May-12 to Oct-16	50-170	Purveyor / MWC	1
	14	Apr-65 to Oct-16	190 deep	Private	2
	17	Nov-58 to Oct-16	unknown	Private	2
	22	Nov-58 to Oct-16	unknown	Private	3
Deep	24	Apr-93 to Oct-16	unknown	Private	3

Table 7: Salinas Valley Paso Robles and Atascadero Area Subbasins Existing "Active" "Confidential" Potential Data Gap Wells

Data Gap Area No.	Period of Record	Perforated Zone or Total Depth (feet bgs)	Well Owner	Priority Level
1	Oct-12 to Nov-16	415-555	Private	1
3	May-97 to Oct-16	464-1060	Purveyor / MWC	1
5	Nov-74 to Oct-16	unknown	Private	1
7	May-97 to Oct-16	290-370, 410-430, 470-590	Purveyor / MWC	1
9	Oct-12 to Oct-15	152-172, 222-232, 282-292	Public - State Entity	2
11	Dec-60 to Oct-16	225 deep	Private	3
12	Oct-92 to Nov-16	unknown	Private	3
13	Apr-75 to Nov-16	unknown	Private	3

Table 8: Santa Maria Basin Existing "Active" "Confidential" Potential Data Gap Wells

Aquifer Groundwater Flow Regime	Data Gap Area No.	Period of Record	Perforated Zone or Total Depth (feet bgs)	Well Owner	Priority Level
Shallow	3	Jan-70 to Oct-16	105-125	Private	1
	5	Apr-73 to Oct-16	274 deep	Private	1
	6	Apr-65 to Oct-16	40-82	Private	2
	8	Oct-98 to Oct-16	232-312	Private	2
	9	Aug-81 to Oct-16	43-63	Private	2
	11	Nov-58 to Oct-16	80 deep	Private	2
Deep	1	Dec-75 to Oct-16	450-460	Public - State Entity	1
	2	Nov-82 to Oct-16	290-575	Purveyor / MWC	1
	5	May-75 to Oct-16	300-380	Private	1
	9	Apr-73 to Oct-16	315-372	Private	2
	11	Oct-75 to Oct-16	350 deep	Private	3

Table 9: Los Osos Valley Basin Existing "Active" "Confidential" Potential Data Gap Wells

Aquifer Groundwater Flow Regime	Data Gap Area No.	Period of Record	Perforated Zone (feet bgs)	Well Owner	Priority Level
Shallow	1	Oct-72 to Oct-16	56 - 84	Purveyor / MWC	1
	2	Feb-85 to Oct-16	50 - 70	Private	1
Deep	1	May-86 to Oct-16	230 - 270	Purveyor / MWC	1

Table 10: Cuyama Valley Basin Data Gap Areas - Proposed New Wells

Aquifer Groundwater Flow Regime	Data Gap Area No.	Target Zone (feet bgs) (Approx.)	Priority Level
Shallow	1	50 to 100	1
	2	50 to 100	1
	3	50 to 100	1
	4	50 to 100	1
	5	50 to 100	1
	6	50 to 100	1
	7	30 to 50	2
	8	30 to 50	2
Deep	1	500	1
	2	500	1
	3	500	1
	4	500	1
	5	100 to 200	2
	6	100 to 200	2

Table 11: Cuyama Valley Basin Estimated Drilling Costs by Priority Level

Priority Level	Number of Wells	Estimated Footage	Estimated Drilling Cost
1	10	2,600	$ 417,000
2	4	500	$ 81,000
3	--	0	--
Total	14	3,100	$ 498,000

Table 12: San Luis Obispo Valley Basin Data Gap Areas - Proposed New Wells

Aquifer Groundwater Flow Regime	Data Gap Area No.	Target Zone (feet bgs) (Approx.)	Priority Level
Shallow	2	50 to 150	1
	3	50 to 150	1
	4	50 to 150	1
	5	50 to 150	1
	6	50 to 150	1
	7	50 to 100	2
	8	50 to 100	2
	9	50 to 150	2
	10	50 to 150	2
	11	50 to 150	2
	12	50 to 150	2
	13	50 to 150	2
	15	50 to 150	2
	16	50 to 150	2
	18	50 to 150	2
	19	50 to 100	2
	20	50 to 150	2
	21	50 to 150	3
	23	50 to 150	3
Deep	1	200 to 500	1
	2	200 to 500	1
	3	200 to 500	1
	4	200 to 500	1
	5	200 to 500	1
	6	200 to 500	1
	7	200 to 500	2
	8	200 to 500	2
	9	200 to 500	2
	10	200 to 500	2
	11	200 to 500	2
	12	200 to 500	2
	13	200 to 500	2
	14	200 to 500	2
	15	200 to 500	2
	16	150 to 300	2
	17	200 to 500	3
	18	200 to 500	3
	19	200 to 500	3
	20	200 to 500	3
	21	200 to 500	3
	22	150 to 300	3
	23	150 to 300	3

Table 13: San Luis Obispo Valley Basin Estimated Drilling Costs by Priority Level

Priority Level	Number of Wells	Estimated Footage	Estimated Drilling Cost
1	11	3,250	$ 522,000
2	22	6,800	$ 1,099,000
3	9	3,550	$ 567,000
Total	42	13,600	$ 2,188,000

Table 14: Salinas Valley Paso Robles Area Subbasin Data Gap Areas - Proposed New Wells

Data Gap Area No.	Target Zone (feet bgs) (Approx.)	Priority Level
2	400	1
4	400	1
6	400	1
8	450	2
10	450	2

Table 15: Paso Robles Basin Estimated Drilling Costs by Priority Level

Priority Level	Number of Wells	Estimated Footage	Estimated Drilling Cost
1	3	1,200	$ 192,000
2	2	900	$ 145,000
3	--	0	$ -
Total	5	2,100	$ 337,000

Table 16: Santa Maria Basin Data Gap Areas - Proposed New Wells

Aquifer Groundwater Flow Regime	Data Gap Area No.	Target Zone (feet bgs) (Approx.)	Priority Level
Shallow	1	150	1
	2	150	1
	4	150	1
	7	50 to 150	2
	10	50 to 150	2
Deep	3	400	1
	4	400	1
	6	300	1
	7	300	1
	8	300	2
	10	300	3

Table 17: Santa Maria Basin Estimated Drilling Costs by Priority Level

Priority Level	Number of Wells	Estimated Footage	Estimated Drilling Cost
1	3	1,850	$ 297,000
2	2	600	$ 97,000
3	1	300	$ 48,000
Total	6	2,750	$ 442,000

Table 18: Los Osos Valley Basin Data Gap Areas - Proposed New Wells

Aquifer Groundwater Flow Regime	Data Gap Area No.	Target Zone (feet bgs) (Approx.)	Priority Level
Shallow	3	50 to 80	2
	4	50 to 80	2
	5	50 to 80	3
Deep	2	300	1
	3	300	2
	4	300	2
	5	300	3

Table 19: Los Osos Valley Basin Estimated Drilling Costs by Priority Level

Priority Level	Number of Wells	Estimated Footage	Estimated Drilling Cost
1	1	300	$ 48,000
2	4	760	$ 123,000
3	2	380	$ 61,000
Total	7	1,440	$ 232,000

Figures

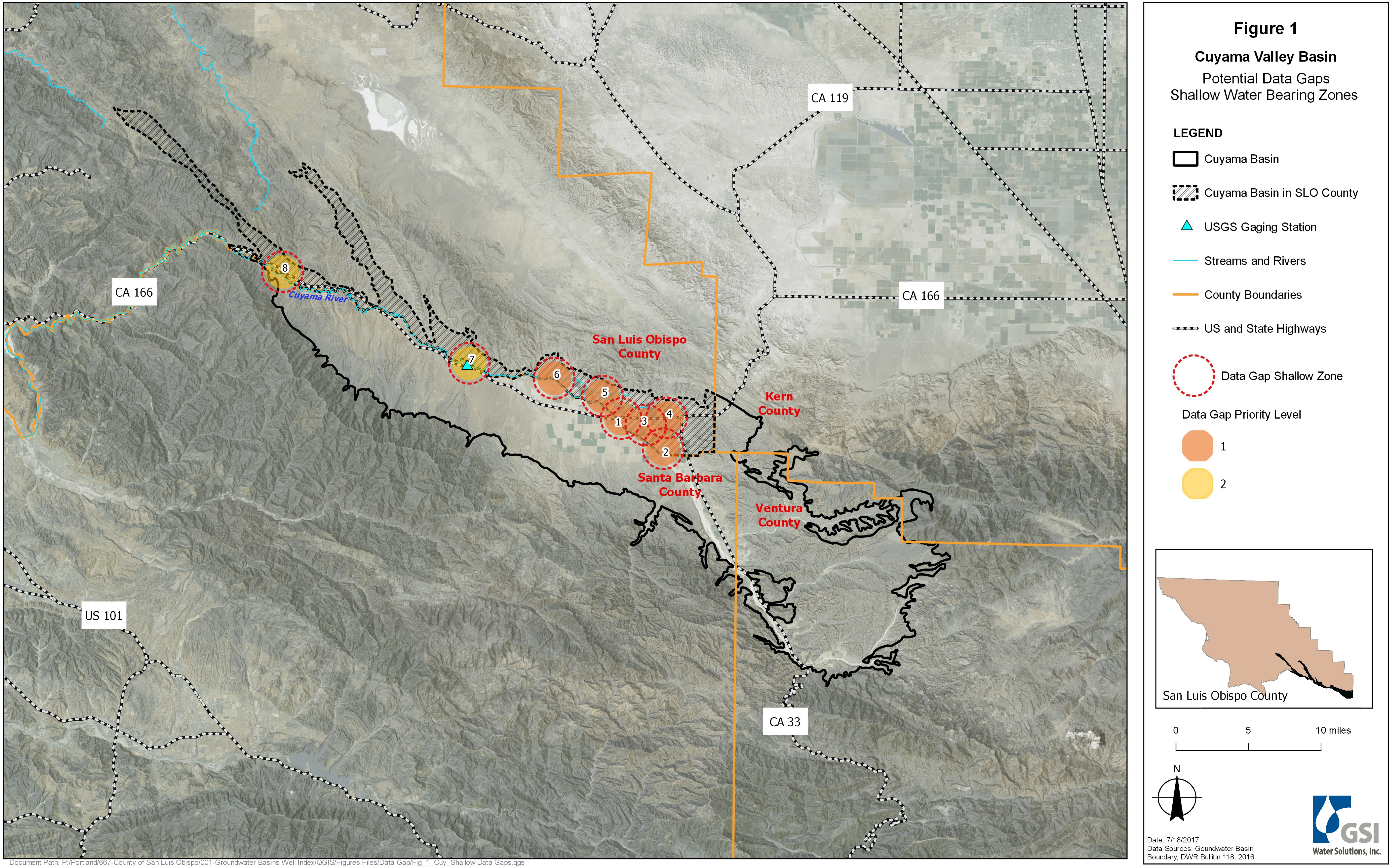

Figure 1

Cuyama Valley Basin

Potential Data Gaps
Shallow Water Bearing Zones

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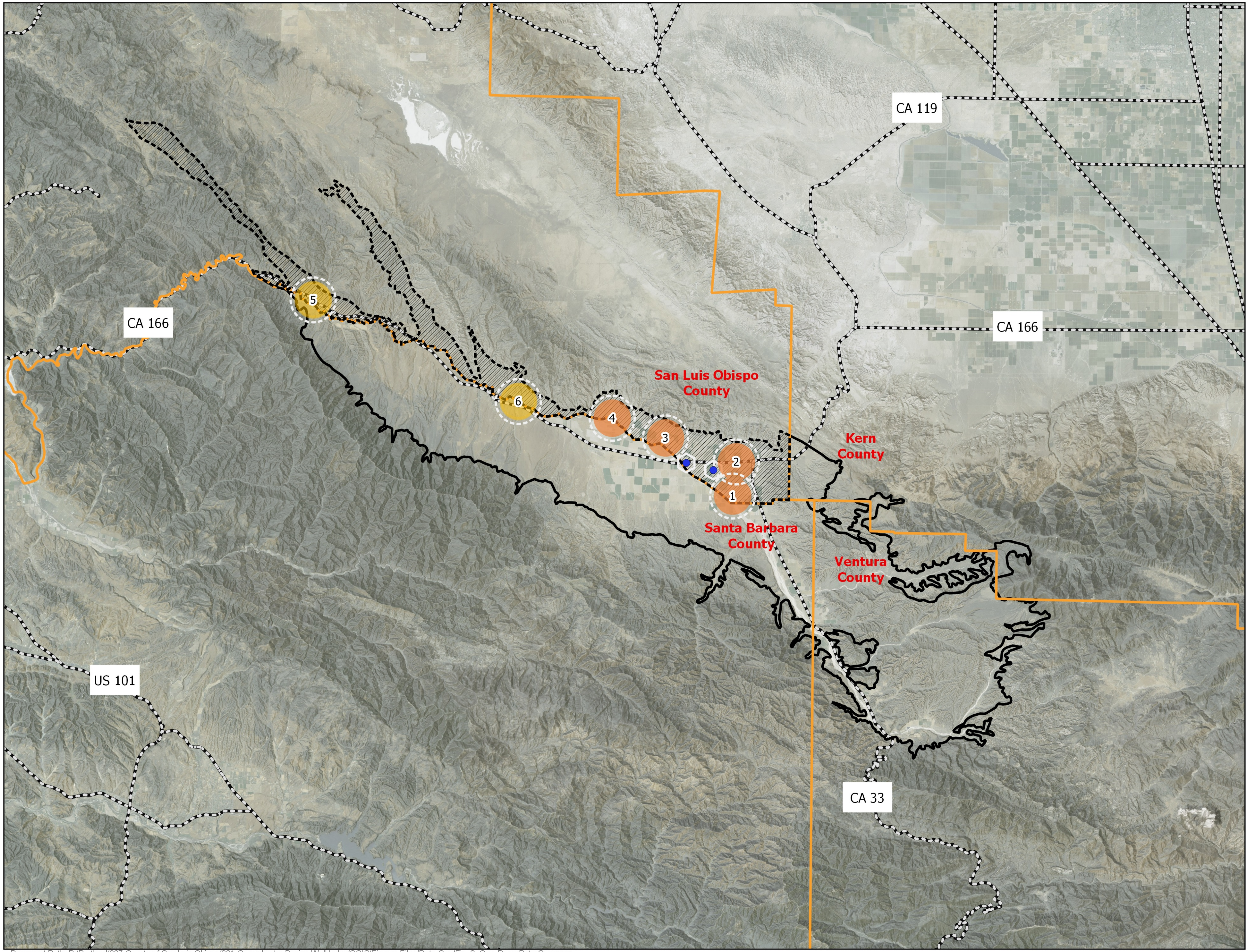


Figure 2

Cuyama Valley Basin

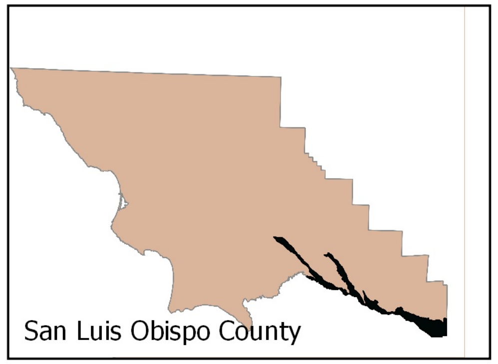
Potential Data Gaps
Deep Water Bearing Zones

LEGEND

- Cuyama Basin
- Cuyame Basin in SLO County
- "Active" "Non-Confidential" Well
- CASGEM Monitoring Well
- County Boundaries
- US and State Highways
- Data Gap Deep Zone

Data Gap Priority Level

- 1
- 2



0 5 10 miles

N

Date: 7/18/2017
Data Sources: Goundwater Basin Boundary, DWR Bulltin 118, 2016

GSI Water Solutions, Inc.

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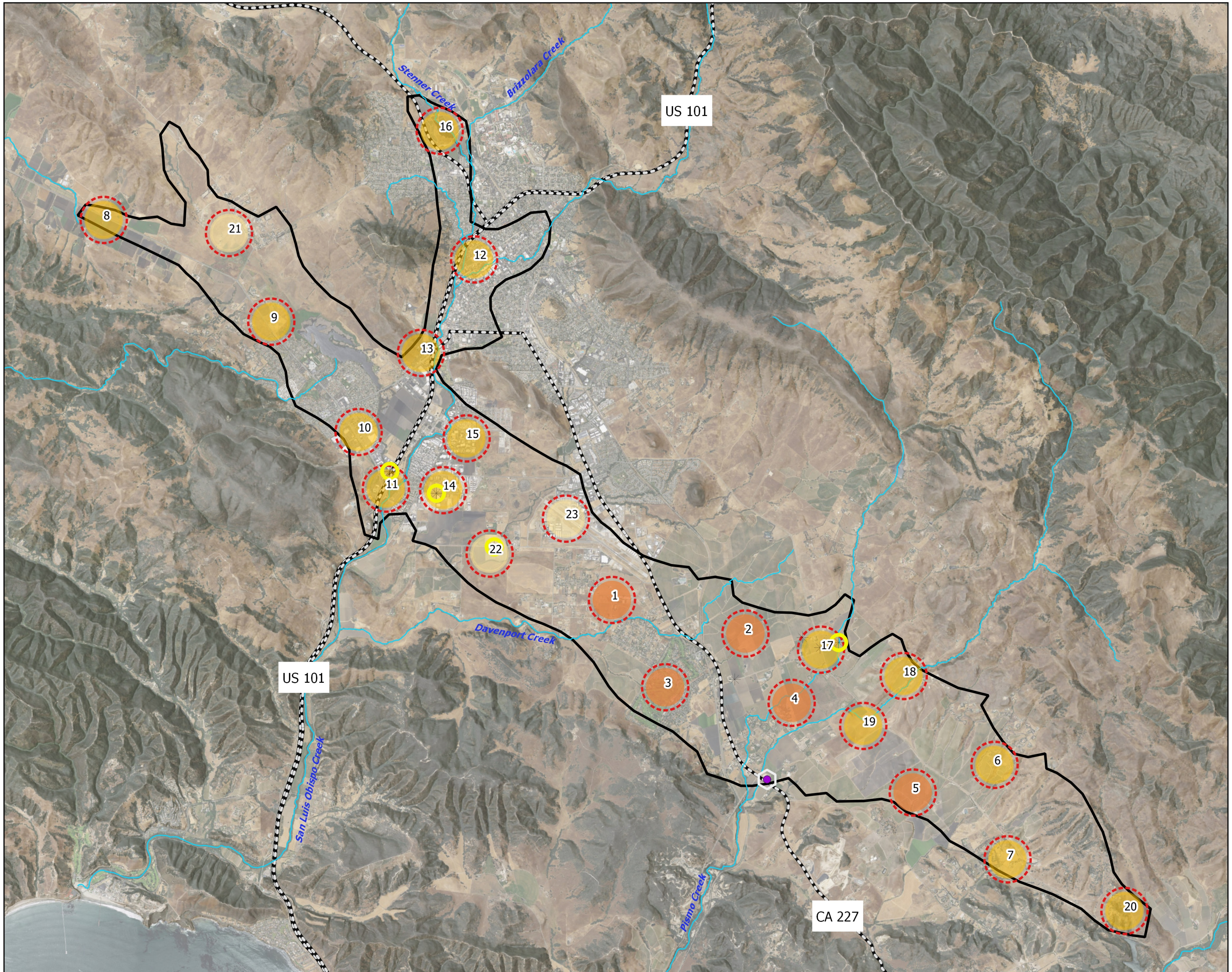


Figure 3

San Luis Obispo Valley Basin

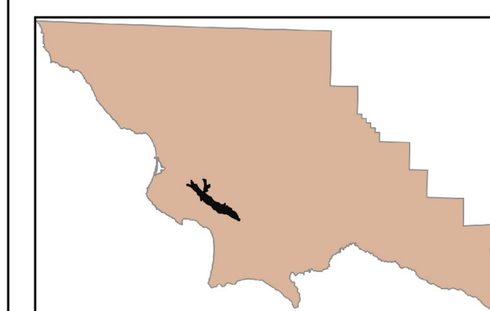
Potential Data Gaps
Shallow Water Bearing Zones

LEGEND

- San Luis Obispo Valley Basin
- "Active" "Non-Confidential" Well
- "Active" "Confidential" Well
- CASGEM Monitoring Well
- Creeks
- US and State Highways
- Data Gap Shallow Zone

Data Gap Priority Level

- 1
- 2
- 3
- Potential Data Gap Well



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Date: 7/18/2017
Data Sources: Groundwater Basin Boundary, DWR Bulltin 118, 2016

GSI Water Solutions, Inc.

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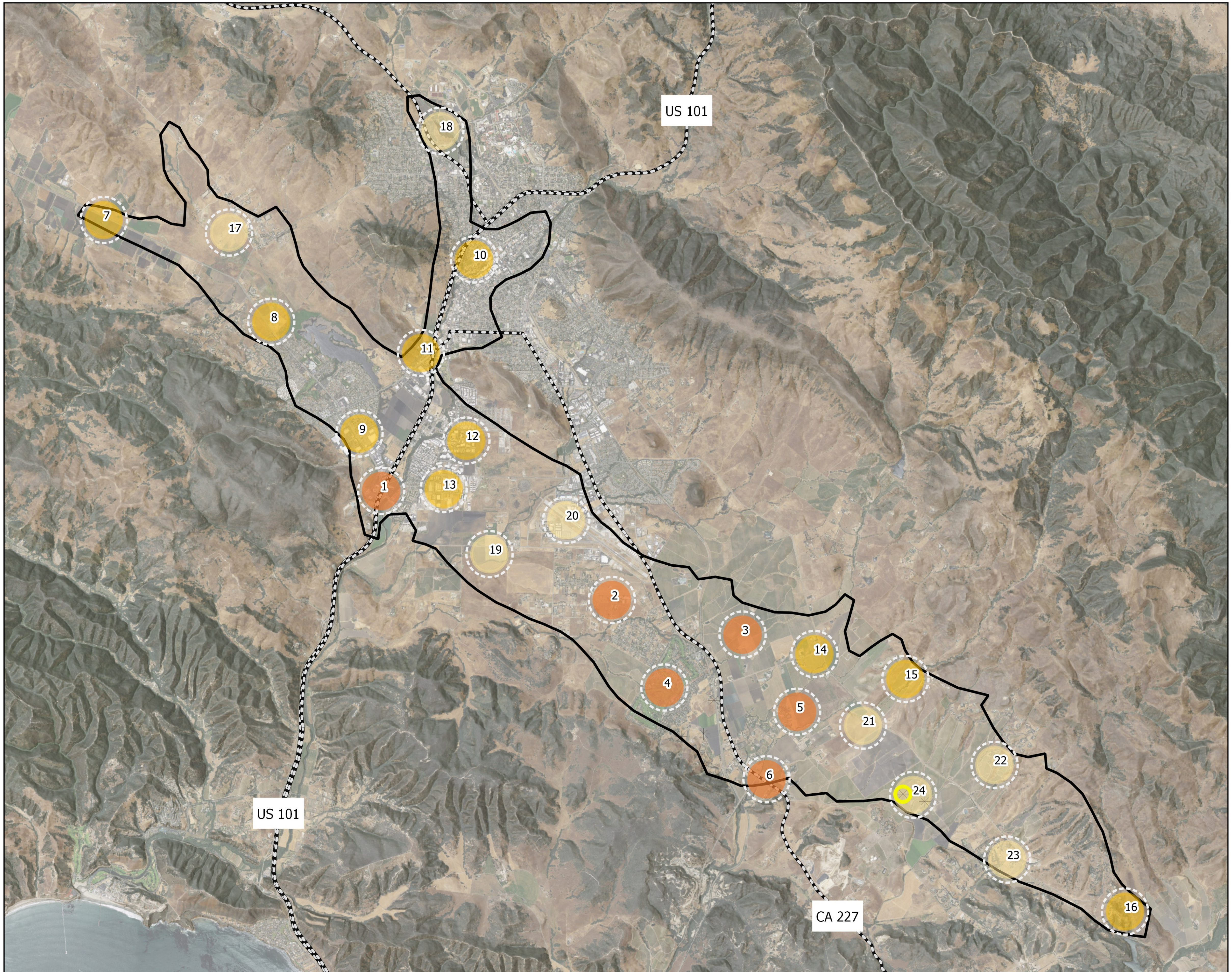


Figure 4

San Luis Obispo Valley Basin

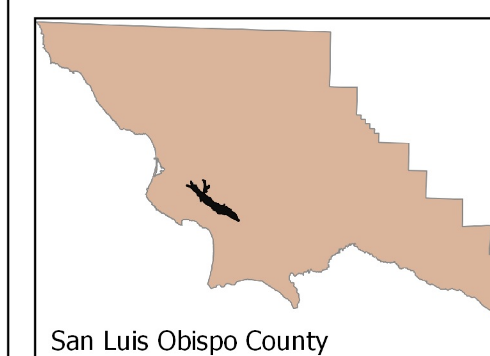
Potential Data Gaps
Deep Water Bearing Zones

LEGEND

- San Luis Obispo Valley Basin
- "Active" "Confidential" Well
- US and State Highways
- Data Gap Deep Zone

Data Gap Priority Level

- 1
- 2
- 3
- Potential Data Gap Well



0 1 2 miles

N

Date: 7/11/2017
Data Sources: Goundwater Basin Boundary, DWR Bulltin 118, 2016

GSI Water Solutions, Inc.

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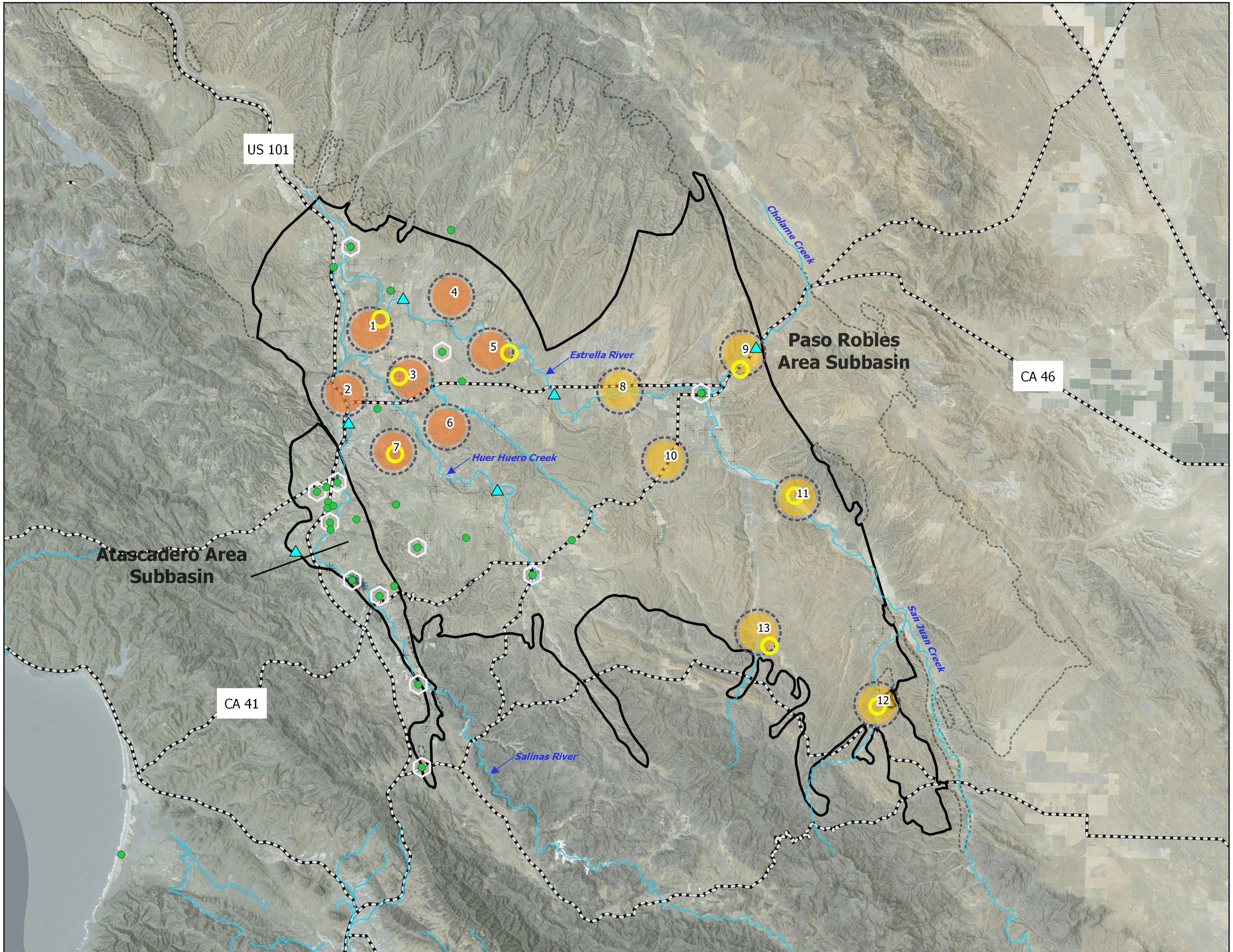


Figure 5

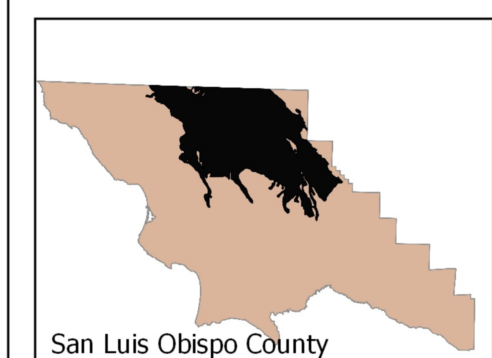
Salinas Valley Basin Paso Robles Area and Atascadero Area Subbasins

LEGEND

- Area Subbasins
- DWR Bulletin 118 Basin Boundary
- "Active" "Non-Confidential" Well
- "Active" "Confidential" Well
- CASGEM Monitoring Well
- USGS Gaging Station
- Streams and Rivers
- US and State Highways
- Data Gap

Data Gap Priority Level

- 1
- 2
- Potential Data Gap Well



0 5 10 miles

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Date: 1/12/2018
Data Sources: Goundwater Basin Boundary, DWR Bulltin 118, 2016

GSI Water Solutions, Inc.

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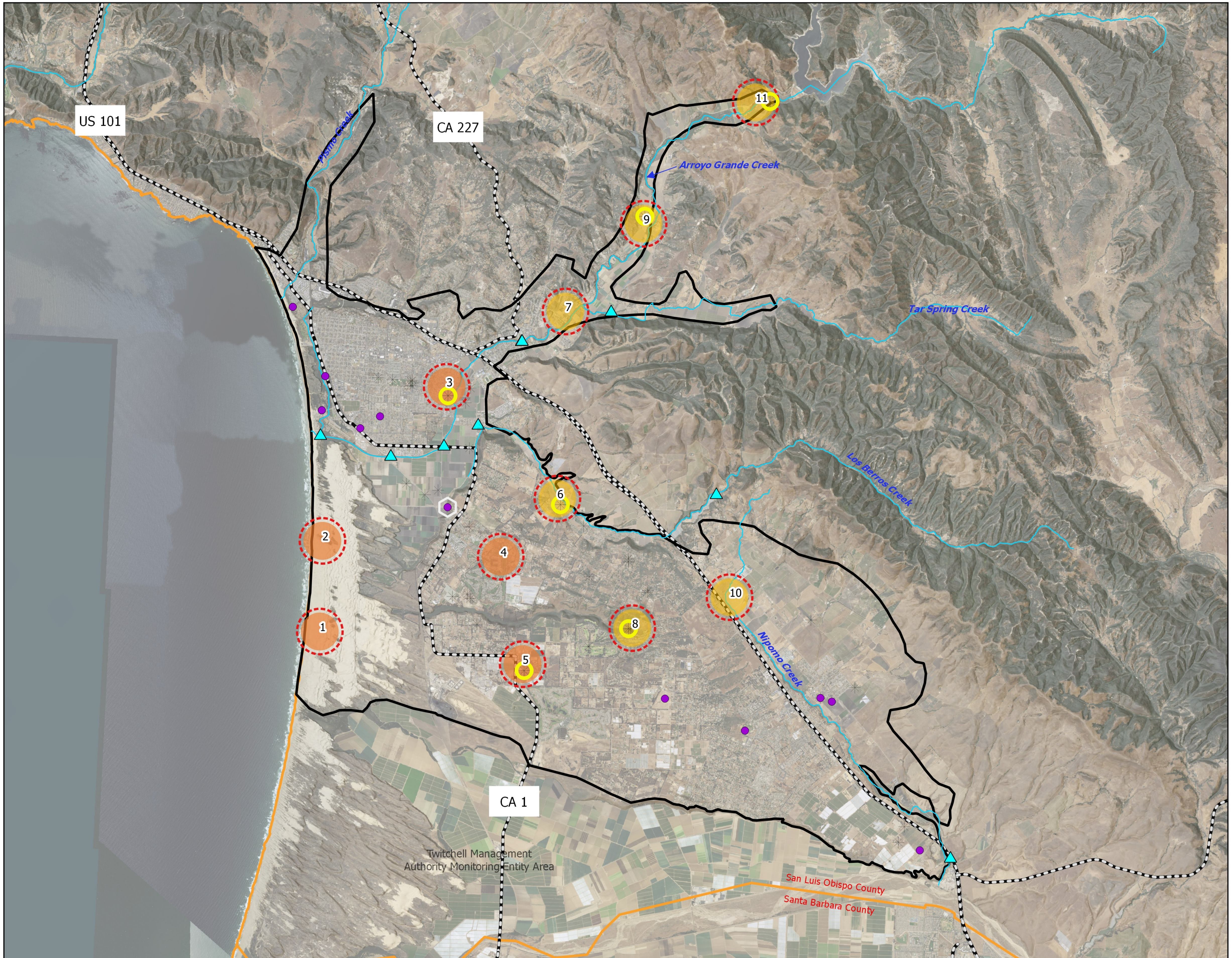


Figure 6

Santa Maria Basin

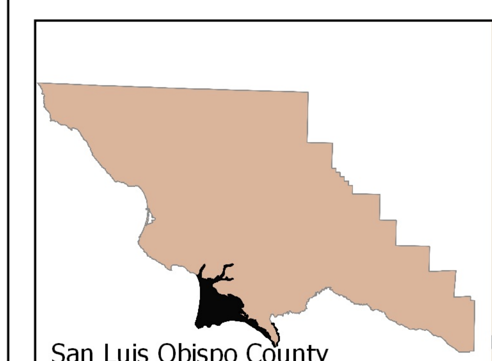
Potential Data Gaps Shallow/Middle Water Bearing Zones

LEGEND

- Santa Maria Basin
- "Active" "Non-Confidential" Well
- "Active" "Confidential" Well
- CASGEM Monitoring Well
- USGS or Other Gaging Station
- Creeks
- US and State Highways
- County Boundary
- Data Gap Shallow Zone

Data Gap Priority Level

- 1
- 2
- Potential Data Gap Well



0 1 2 3 miles

N

Date: 7/18/2017
Data Sources: Goundwater Basin Boundary, DWR Bullitin 118, 2016

GSI Water Solutions, Inc.

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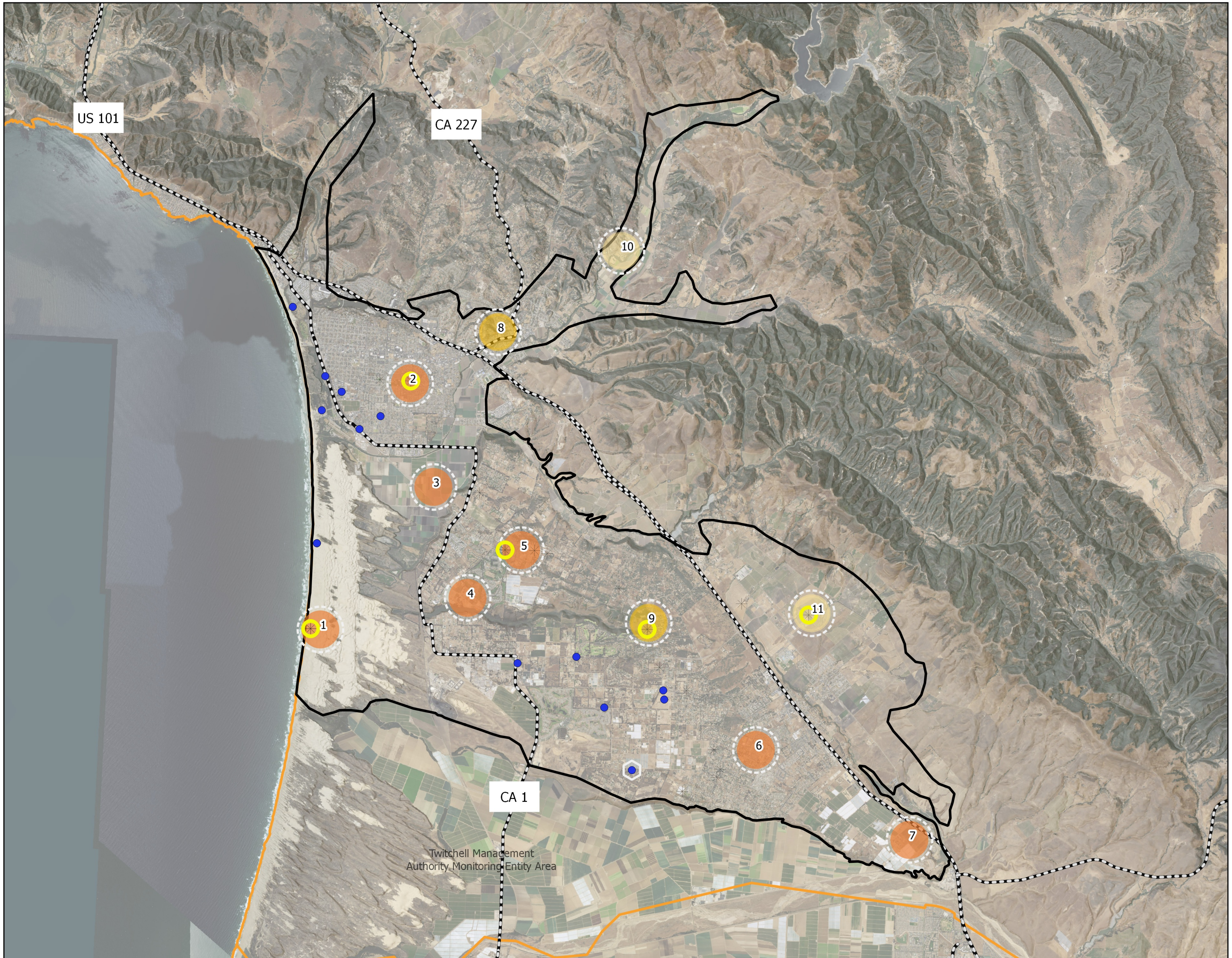


Figure 7

Santa Maria Basin

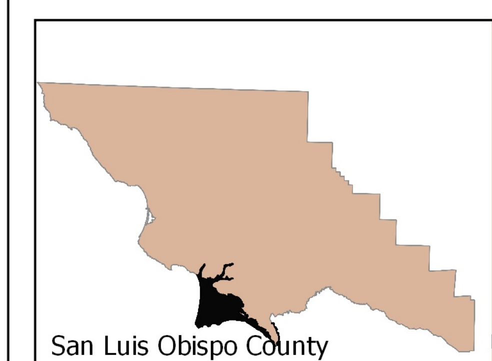
Potential Data Gaps
Deep Water Bearing Zones

LEGEND

- Santa Maria Basin
- "Active" "Non-Confidential" Well
- "Active" "Confidential" Well
- CASGEM Monitoring Well
- US and State Highways
- County Boundary
- Data Gap Deep Zone

Data Gap Priority Level

- 1
- 2
- 3
- Potential Data Gap Well



0 1 2 3 miles

N

Date: 7/18/2017
Data Sources: Goundwater Basin Boundary, DWR Bullitin 118, 2016

GSI Water Solutions, Inc.

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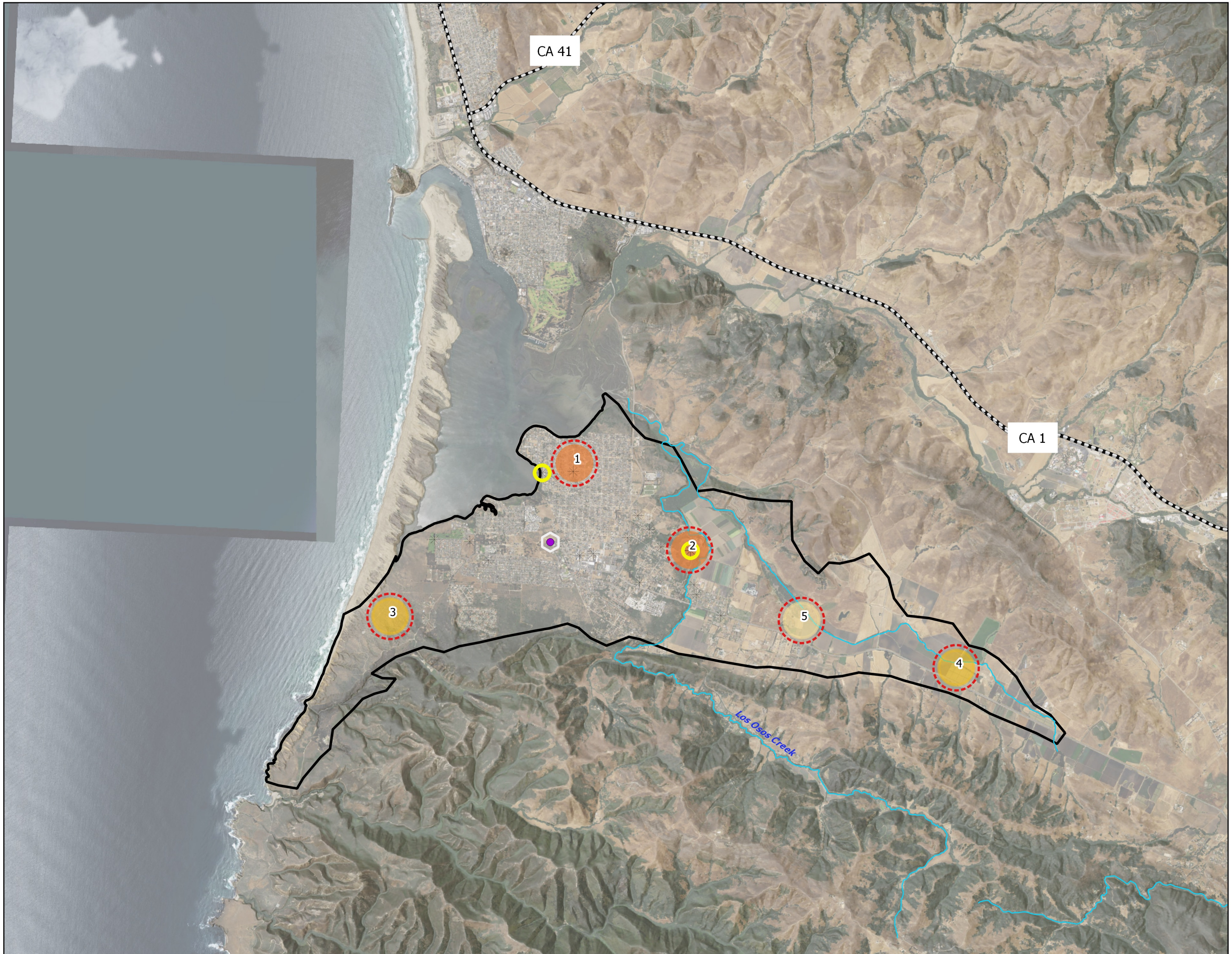


Figure 8

Los Osos Valley Basin

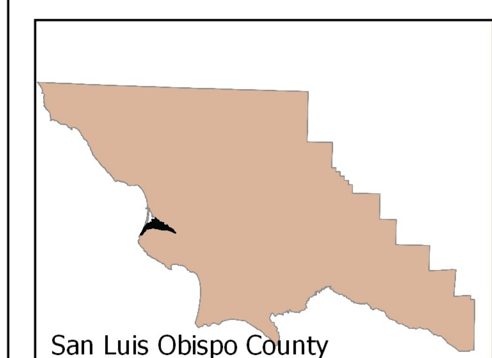
Potential Data Gaps
Shallow Water Bearing Zones

LEGEND

- Los Osos Valley Basin
- "Active" "Non-Confidential" Well
- "Active" "Confidential" Well
- CASGEM Monitoring Well
- Creeks
- US and State Highways
- Data Gap Shallow Zone

Data Gap Priority Level

- 1
- 2
- 3
- Potential Data Gap Well



0 1 2 miles

N

Date: 7/11/2017
Data Sources: Goundwater Basin Boundary, DWR Bullitin 118, 2016

GSI Water Solutions, Inc.

Document Path: P:/Portland/667-County of San Luis Obispo/001-Groundwater Basins Well Index/QGIS/Figures Files/Data Gap/Fig_8_Los Osos_Shallow Data Gaps.qgs

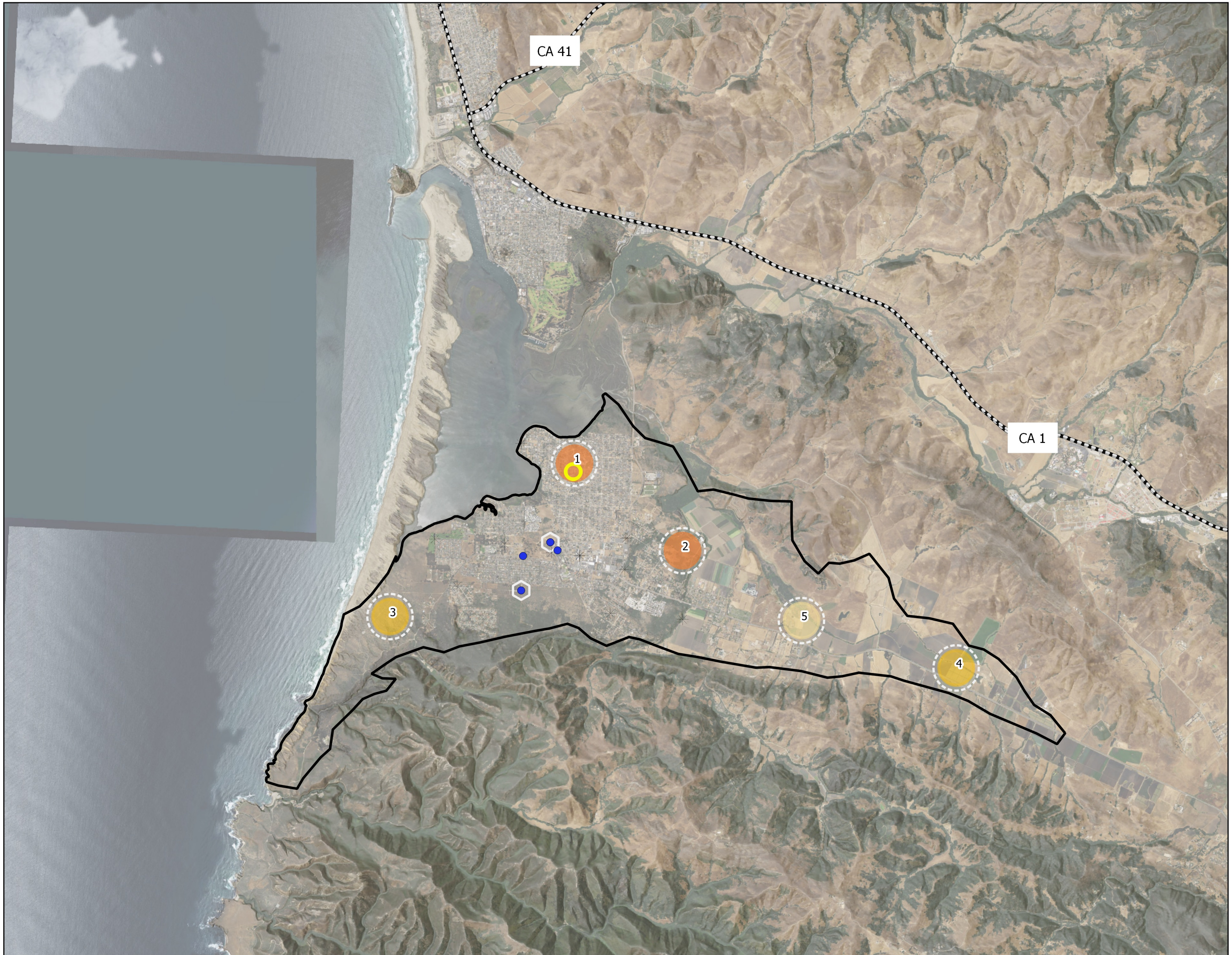


Figure 9

Los Osos Valley Basin

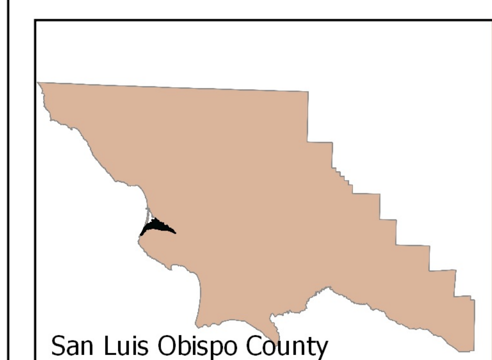
Potential Data Gaps
Deep Water Bearing Zones

LEGEND

- Los Osos Valley Basin
- "Active" "Non-Confidential" Well
- "Active" "Confidential" Well
- CASGEM Monitoring Well
- US and State Highways
- Data Gap Deep Zone

Data Gap Priority Level

- 1
- 2
- 3
- Potential Data Gap Well



0 1 2 miles

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Date: 7/11/2017
Data Sources: Goundwater Basin Boundary, DWR Bullitin 118, 2016

GSI Water Solutions, Inc.

Document Path: P:/Portland/667-County of San Luis Obispo/001-Groundwater Basins Well Index/QGIS/Figures Files/Data Gap/Fig_9_Los Osos_Deep Data Gaps.qgs

Appendix A

Detailed Listings of SGMA Regulations and BMPs Relevant to Evaluating Groundwater Level Monitoring Data

Table A-1. Sustainable Groundwater Management Act Groundwater Level Monitoring Regulations

Item No.	Source	Section	Text	Relevance to District Data Gaps Analysis
1	GSP Emergency Regulations	§ 352.4(c)(2) Data and Reporting Standards	If an Agency relies on wells that lack casing perforations, borehole depth, or total well depth information to monitor groundwater conditions as part of a Plan, the Agency shall describe a schedule for acquiring monitoring wells with the necessary information, or demonstrate to the Department that such information is not necessary to understand and manage groundwater in the basin.	Wells lacking construction information can only be relied up initially.
2	GSP Emergency Regulations	§ 354.32 Introduction to Monitoring Networks	The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.	Monitoring well locations should support basin and surface water characterization and changes over time.
3	GSP Emergency Regulations	§ 354.34(a) Monitoring Network	Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.	Monitoring well locations should support trend evaluation at different time scales (short-term, seasonal, and long-term).
4	GSP Emergency Regulations	§ 354.34(b) Monitoring Network	Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:	See specific items below.
5	GSP Emergency Regulations	§ 354.34(b)(1) Monitoring Network	Demonstrate progress toward achieving measurable objectives described in the Plan.	Monitoring wells should be located in the areas where the GSA identifies measureable objectives.
6	GSP Emergency Regulations	§ 354.34(b)(2) Monitoring Network	Monitor impacts to the beneficial uses or users of groundwater.	Monitoring wells should be located in areas where active wells or surface water diversions are susceptible to impacts related to declining groundwater levels.
7	GSP Emergency Regulations	§ 354.34(b)(3) Monitoring Network	Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.	Monitoring well locations should be located in the areas where the GSA identifies measureable objectives and minimum thresholds.
8	GSP Emergency Regulations	§ 354.34(b)(4) Monitoring Network	Quantify annual changes in water budget components.	Monitoring wells should be located in pumping centers, recharge areas, and discharge areas with sufficient spatial density to support quantification of the various water budget components in the basin.
9	GSP Emergency Regulations	§ 354.34(c) Monitoring Network	Each monitoring network shall be designed to accomplish the following for each sustainability indicator:	Monitoring well locations should be located in the areas where the GSA identifies measureable objectives and minimum thresholds.

10	GSP Emergency Regulations	§ 354.34(c)(1)(A) Monitoring Network	Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods: (A) A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.	Monitoring wells should be located in areas where groundwater level declines have been observed historically or could occur in the future. Generally, this means locating monitoring wells near areas of concentrated pumping, but also across the basin to characterize overall changes in groundwater levels.
11	GSP Emergency Regulations	§ 354.34(c)(2) Monitoring Network	Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.	Groundwater levels are the primary input for change in annual groundwater storage calculations. Monitoring wells should be located in areas where the greatest storage changes occur (unconfined areas, pumping centers, recharge areas, and discharge areas) with sufficient spatial density to adequately characterize groundwater storage changes.
12	GSP Emergency Regulations	§ 354.34(c)(3) Monitoring Network	(3) Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.	§ 354.36(b) states that groundwater elevations may be used as a proxy for monitoring other sustainability indicators. Monitoring wells should be located in coastal areas in each principal aquifer that is hydraulically connected to the ocean.
13	GSP Emergency Regulations	§ 354.34(c)(5) Monitoring Network	Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.	§ 354.36(b) states that groundwater elevations may be used as a proxy for monitoring other sustainability indicators. Monitoring wells should be located in areas and confined aquifers with the subsidence risk.
14	GSP Emergency Regulations	§ 354.34(c)(6) Monitoring Network	Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions.	Monitoring wells should be located adjacent to interconnected surface water features at the appropriate depths necessary to characterize groundwater-surface water interaction.
15	GSP Emergency Regulations	§ 354.34(d) Monitoring Network	The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.	Monitoring well locations should be located in the areas where the GSA identifies measureable objectives and minimum thresholds.
16	GSP Emergency Regulations	§ 354.34(e) Monitoring Network	A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.	The District's groundwater level monitoring program could be an integral part of the monitoring program for a GSP, but, by itself, does not necessarily need to meet all of the SGMA requirements.
17	GSP Emergency Regulations	§ 354.34(f) Monitoring Network	The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the	Density of groundwater level monitoring locations is dependent on multiple factors, including

			following factors: (1) Amount of current and projected groundwater use. (2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow. (3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal. (4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.	groundwater use, aquifer characteristics and groundwater flow, potential impacts to beneficial users of groundwater and surface water, and pre-existing understanding of aquifer responses.
18	GSP Emergency Regulations	§ 354.34(g)(1) Monitoring Network	Each Plan shall describe the following information about the monitoring network: (1) Scientific rationale for the monitoring site selection process.	Future additions to the monitoring network, particularly where a significant investment is required to add as site (i.e. drilling a dedicated monitoring well) should be made based on the scientific analysis of monitoring needs described in the GSP for the basin.
19	GSP Emergency Regulations	§ 354.38(a) Assessment and Improvement of Monitoring Network	Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.	The District should participate in five-year reviews of the monitoring networks by the GSAs.
20	GSP Emergency Regulations	§ 354.38(b) Assessment and Improvement of Monitoring Network	Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.	The District should participate in the identification and characterization of data gaps with the GSAs.
21	GSP Emergency Regulations	§ 354.38(c) Assessment and Improvement of Monitoring Network	If the monitoring network contains data gaps, the Plan shall include a description of the following: (1) The location and reason for data gaps in the monitoring network. (2) Local issues and circumstances that limit or prevent monitoring.	The District should participate in the identification and characterization of data gaps with the GSAs.
22	GSP Emergency Regulations	§ 354.38(d) Assessment and Improvement of Monitoring Network	Each Agency shall describe steps that will be taken to fill data gaps before the next five year assessment, including the location and purpose of newly added or installed monitoring sites.	The District should coordinate with the GSAs to fill data gaps over time to avoid unnecessary redundancy with monitoring programs implemented by others.
23	GSP Emergency Regulations	§ 354.38(e) Assessment and Improvement of Monitoring Network	Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following: (1) Minimum threshold exceedances. (2) Highly variable spatial or temporal conditions. (3) Adverse impacts to beneficial uses and users of groundwater. (4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.	The District should participate in the GSAs' efforts to assess and improve the monitoring networks.

24	GSP Emergency Regulations	§ 356.2(b)(1)(A) Annual Reports	The annual report shall include the following components for the preceding water year: (b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan: (1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows: (A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.	Monitoring wells should be located to provide adequate data to map the potentiometric surface of each principal aquifer in each basin.
25	GSP Emergency Regulations	§ 356.2(b)(5)(A) Annual Reports	The annual report shall include the following components for the preceding water year: (b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan: (5) Change in groundwater in storage shall include the following: (A) Change in groundwater in storage maps for each principal aquifer in the basin.	Groundwater levels are the primary input for change in annual groundwater storage mapping. Monitoring wells should be located in areas greatest storage changes occur (unconfined areas, pumping centers, recharge areas, and discharge areas) with sufficient spatial density to adequately characterize groundwater storage changes.
26	GSP Emergency Regulations	§ 357.2.(b) Interbasin Agreements	Two or more Agencies may enter into an agreement to establish compatible sustainability goals and understanding regarding fundamental elements of the Plans of each Agency as they relate to sustainable groundwater management. Interbasin agreements may be included in the Plan to support a finding that implementation of the Plan will not adversely affect an adjacent basin's ability to implement its Plan or impede the ability to achieve its sustainability goal. Interbasin agreements should facilitate the exchange of technical information between Agencies and include a process to resolve disputes concerning the interpretation of that information. Interbasin agreements may include any information the participating Agencies deem appropriate, such as the following: (b) Technical information: (1) An estimate of groundwater flow across basin boundaries, including consistent and coordinated data, methods and assumptions. (2) An estimate of stream-aquifer interactions at boundaries. (3) A common understanding of the geology and hydrology of the basins and the hydraulic connectivity as it applies to the Agency's determination of groundwater flow across basin boundaries and description of the different assumptions utilized by different Plans and how the Agencies reconciled those differences.	Monitoring wells should be located near boundaries between basins.

Table Notes:

GSA = Groundwater Sustainability Agency

GSP = Groundwater Sustainability Plan

SGMA = Sustainable Groundwater Management Act

Table A-2. Sustainable Groundwater Management Act Groundwater Level Monitoring Best Management Practices

Item No.	Source	Page	Text	Relevance to District Data Gaps Analysis
1	Monitoring Networks and Identification of Data Gaps Best Management Practice	6 8	GSAs should first evaluate their existing monitoring network and existing datasets when developing the monitoring network for their GSP, such as the California Statewide Groundwater Elevation Monitoring (CASGEM) program… The use of existing monitoring networks established during implementation of CASGEM, Irrigated Lands Reporting Program (IRLP), Groundwater Ambient Monitoring and Assessment Program (GAMA), National Groundwater Monitoring Network, Existing Groundwater Management Planning, and other local programs could be used for a base monitoring network from which to build. These networks should be evaluated for compliance with GSP Regulations and DQOs.	The District's groundwater level monitoring program could be an integral part of the monitoring program for a GSP, but, by itself, does not necessarily need to meet all of the SGMA requirements. The District should participate in the identification and characterization of data gaps with the GSAs.
2	Monitoring Networks and Identification of Data Gaps Best Management Practice	6	<u>Degree of monitoring</u>. The degree of monitoring should be consistent with the level of groundwater use and need for various levels of monitoring density and frequency. Areas that are subject to greater groundwater pumping, greater fluctuations in conditions, significant recharge areas, or specific projects may require more monitoring (temporal and/or spatial) than areas that experience less activity or are more static.	Density of monitoring wells may need to be greater in areas with greater pumping.
3	Monitoring Networks and Identification of Data Gaps Best Management Practice	6	<u>Adjacent Basins</u>. Understanding conditions at or across basin boundaries is important. GSAs should coordinate with adjacent basins on monitoring efforts to be consistent both temporally and spatially. Coordinated efforts and shared data will help GSAs understand their basins' conditions better and potentially better understand groundwater flow conditions across boundaries.	Monitoring wells should be located near boundaries between basins.
4	Monitoring Networks and Identification of Data Gaps Best Management Practice	6	<u>Consider all sustainability indicators</u>. GSAs should look for ways to efficiently use monitoring sites to collect data for more than one or all of the sustainability indicators. Similarly, when installing a new monitoring site, GSAs should take that opportunity to gather as much information about the subsurface conditions as possible.	Monitoring well locations should be located in the areas where the GSA identifies measureable objectives and minimum thresholds.
5	Monitoring Networks and Identification of Data Gaps Best Management Practice	6	There are many other considerations that GSAs must understand when developing monitoring networks that are specific to the various sustainability indicators: chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, or depletions of interconnected surface waters.	Monitoring well locations and depths should be carefully selected to provide the specific data necessary to support evaluation of the sustainability indicators.
6	Monitoring Networks and Identification of Data Gaps Best Management Practice	6	In addition, establishment of a monitoring network should be evaluated in conjunction with the Monitoring Protocols, Standards, and Sites; Hydrogeologic Conceptual Model (HCM); Water Budget; and Modeling BMPs when considering the data needs to meet GSP measurable objectives and the sustainability goal.	Monitoring well locations and depths should be carefully selected to support development of conceptual models, numerical models, and water budget calculations.
7	Monitoring Networks	8	The monitoring network will consist of an adequate magnitude of monitoring locations that	Monitoring well locations should be selected to

<table>
<tr><td></td><td>and Identification of Data Gaps Best Management Practice</td><td></td><td>will characterize the groundwater flow regime such that a GSA will have the ability to predict sustainability indicator responses to management actions and document those results.</td><td>characterize groundwater flow in each principal aquifer.</td></tr>
<tr><td>8</td><td>Monitoring Networks and Identification of Data Gaps Best Management Practice</td><td>8</td><td>Professional judgement will be essential to determining the degree of monitoring that will be necessary to meet the needs for the GSP. This BMP provides guidance, but should be coupled with site-specific monitoring needs to address the complexities of the groundwater basin and DQOs.</td><td>Determination of monitoring needs for each GSP, and, hence, data gaps, will rely heavily on professional judgment during the GSP development process.</td></tr>
<tr><td>9</td><td>Monitoring Networks and Identification of Data Gaps Best Management Practice</td><td>9</td><td>Wells that are part of the monitoring program should be dedicated groundwater monitoring wells with known construction information. If existing wells are used, the perforated intervals should be known to be able to utilize water level or other data collected from that well. Development of the monitoring well network must evaluate and consider both unconfined and confined aquifers, and assess where pumping wells are screened that affect monitoring at these locations. Agricultural or municipal wells can be used temporarily until either dedicated monitoring wells can be installed or an existing well can be identified that meets the above criteria. If agricultural or municipal wells are used for monitoring, the wells must be screened across a single water-bearing unit, and care must be taken to ensure that pumping drawdown has sufficiently recovered before collecting data from a well.</td><td>Preferred monitoring wells are dedicated (not pumped), have known construction details, are screened in a single, principal aquifer, and are not directly influenced by nearby pumping or injection.</td></tr>
<tr><td>10</td><td>Monitoring Networks and Identification of Data Gaps Best Management Practice</td><td>9</td><td>There is no definitive rule for the density of groundwater monitoring points needed in a basin. Table 1 was adopted from the CASGEM Groundwater Elevation Monitoring Guidelines (DWR, 2010)…Professional judgement will be essential to determining an adequate level of monitoring, frequency, and density based on the DQOs and the need to observe aquifer response to high pumping areas, cones of depression, significant recharge areas, and specific projects.

Table 1. Monitoring Well Density Considerations
<table>
<tr><th>Reference</th><th>Monitoring Well Density (wells per 100 miles²)</th></tr>
<tr><td>Heath (1976)</td><td>0.2 - 10</td></tr>
<tr><td>Sophocleous (1983)</td><td>6.3</td></tr>
<tr><td>Hopkins (1984)
Basins pumping more than 10,000 acre-feet/year per 100 miles²</td><td>4.0</td></tr>
<tr><td>Basins pumping between 1,000 and 10,000 acre-feet/year per 100 miles²</td><td>2.0</td></tr>
<tr><td>Basins pumping between 250 and 1,000 acre-feet/year per 100 miles²</td><td>1.0</td></tr>
<tr><td>Basins pumping between 100 and 250 acre-feet/year per 100 miles²</td><td>0.7</td></tr>
</table></td><td>Monitoring well density is not prescribed in either the SGMA GSP regulations or BMPs. This is because the application of a density metric by itself would not ensure the monitoring network would meet all of the GSP data quality objectives. For example, monitoring well density may be high in certain areas to support evaluation of the sustainability indicators and low in areas with little risk of undesirable results.</td></tr>
<tr><td>11</td><td>Monitoring Networks and Identification of Data Gaps Best Management</td><td>12</td><td>Groundwater level data will be collected from each principal aquifer in the basin.

Groundwater level data must be sufficient to produce seasonal maps of potentiometric surfaces or water table surfaces throughout the basin that clearly identify changes in</td><td>Monitoring well locations should be selected to characterize groundwater flow in each principal aquifer.</td></tr>
</table>

	Practice		groundwater flow direction and gradient.	
12	Monitoring Networks and Identification of Data Gaps Best Management Practice	13	Data must be sufficient for mapping groundwater depressions, recharge areas, and along margins of basins where groundwater flow is known to enter or leave a basin.	Monitoring wells should be located in pumping centers, recharge areas, and discharge areas with sufficient spatial density to support quantification of the various water budget components in the basin.
13	Monitoring Networks and Identification of Data Gaps Best Management Practice	13	Well density must be adequate to determine changes in storage.	Groundwater levels are the primary input for change in annual groundwater storage calculations. Monitoring wells should be located in areas greatest storage changes occur (unconfined areas, pumping centers, recharge areas, and discharge areas) with sufficient spatial density to adequately characterize groundwater storage changes.
14	Monitoring Networks and Identification of Data Gaps Best Management Practice	13	Data must be able to demonstrate the interconnectivity between shallow groundwater and surface water bodies, where appropriate.	Monitoring wells should be located adjacent to interconnected surface water features at the appropriate depths and locations necessary to characterize groundwater-surface water interaction.
15	Monitoring Networks and Identification of Data Gaps Best Management Practice	13	Data must be able to map the effects of management actions, i.e., managed aquifer recharge or hydraulic seawater intrusion barriers.	Monitoring wells should be located projects identified in the GSP.
16	Monitoring Networks and Identification of Data Gaps Best Management Practice	13	Data must be able to demonstrate conditions at basin boundaries.	Monitoring wells should be located near boundaries between basins.
17	Monitoring Networks and Identification of Data Gaps Best Management Practice	13	Agencies may consider characterization and continued impacts of internal hydraulic boundary conditions, such as faults, disconformities, or other internal boundary types.	Monitoring wells should be located on both sides of known or suspected groundwater flow barriers.
18	Monitoring Networks and Identification of Data Gaps Best Management Practice	13	Data must be able to characterize conditions and monitor adverse impacts as they may affect the beneficial uses and users identified within the basin.	Monitoring wells should be located in areas where active wells or surface water diversions are susceptible to impacts related to declining groundwater levels.
19	Monitoring Networks and Identification of	17,18	Land Subsidence - As with most sustainability indicators, conditions of subsidence, or lack thereof, can be correlated to groundwater levels as a surrogate…The screening of subsidence	Monitoring wells should be located in confined aquifers in areas with the subsidence risk.

	Data Gaps Best Management Practice		occurrence should include…Review of historic range of groundwater levels in the principal aquifers of the basin.	
20	Monitoring Networks and Identification of Data Gaps Best Management Practice	21	Depletion of Interconnected Surface Water - Establish a shallow groundwater monitoring well network to characterize groundwater levels adjacent to connected streams and hydrogeologic properties. o Network should extend perpendicular and parallel to stream flow to provide adequate characterization to constrain model development. o Monitor to capture seasonal pumping conditions in vicinity-connected surface water bodies.	Monitoring wells should be located adjacent to interconnected surface water features at the appropriate depths and locations necessary to characterize groundwater-surface water interaction.
21	Monitoring Networks and Identification of Data Gaps Best Management Practice	24	Network assessment and improvements are commonly identified as 'data gaps' in the monitoring network and refer to "a lack of information that significantly affects the understanding of basin setting or evaluation of the efficacy of the Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed."	Data gaps are defined in terms of developing an understanding of the basin setting (hydrogeologic conceptual model, groundwater conditions, and water budget), proposed minimum thresholds and measurable objectives, and assessing whether a basin is being sustainably managed as opposed to a singular monitoring well density metric.
22	Monitoring Networks and Identification of Data Gaps Best Management Practice	24	GSAs should consider previous analyses of data gaps of their monitoring network through existing programs, such as CASGEM monitoring plans.	The District's groundwater level monitoring program could be an integral part of the monitoring program for a GSP, but, by itself, does not necessarily need to meet all of the SGMA requirements. The District should participate in the identification and characterization of data gaps with the GSAs.
23	Monitoring Networks and Identification of Data Gaps Best Management Practice	26	Professional judgment will be needed from GSAs to identify possible data gaps in their monitoring network of the sustainability indicators.	Determination of monitoring needs for each GSP, and, hence, data gaps, will rely heavily on professional judgment during the GSP development process.
24	Monitoring Networks and Identification of Data Gaps Best Management Practice	27	Poor quality data may also be the cause of data gaps. Data must be of sufficient quality to enable scientifically defensible decisions. Poor quality data may at times be worse than no data because it could lead to incorrect assumptions or biases. Some things to consider when questioning the quality of data include: collection conditions and methods, sampling quality assurance/quality control, and proper calibration of meters/equipment.	The District's monitoring wells and monitoring procedures should be reviewed to evaluate consistency with DQOs identified in the GSPs.
25	Monitoring Networks and Identification of Data Gaps Best Management Practice	27	Agencies are required to assess their monitoring networks every five years. During those assessments, data gaps may also be identified as agencies monitor the progress of their management actions/projects and the status of their interim milestones. These regular assessments will allow the GSAs to adaptively manage, focus, and prioritize future monitoring.	The District should participate in the GSAs' efforts to assess and improve the monitoring networks.