

Appendix A-4

Tule Subbasin Coordination Agreement

Attachment 4: Draft-Final Technical Memorandum Re: Technical Support for Addressing Department of Water Resources Comments Regarding Sustainable Management Criteria for Upper Aquifer Groundwater Levels in the Tule Subbasin

Draft-Final Technical Memorandum



To: Tule Subbasin Technical Advisory Committee

From: Thomas Harder, P.G., C.HG.
Thomas Harder & Co.

Date: 17-Jul-24

Re: Technical Support for Addressing Department of Water Resources Comments Regarding Sustainable Management Criteria for Upper Aquifer Groundwater Levels in the Tule Subbasin

1 Introduction

This technical memorandum (TM) summarizes an analysis of significant and unreasonable groundwater level conditions that could impact beneficial uses and users of groundwater in the Tule Subbasin in Tulare County, California (see Figure 1). The TM was prepared in response to comments from the California Department of Water Resources (CDWR) on groundwater sustainability plans (GSPs) prepared by each of the six¹ Groundwater Sustainability Agencies (GSAs) within the Tule Subbasin.

1.1 Background

In their initial review of the Tule Subbasin GSPs,² the CDWR made the following general comments as they relate to groundwater levels:

The GSPs do not define undesirable results or set minimum thresholds and measurable objectives for groundwater levels in a manner consistent with the GSP Regulations.

1. *The GSPs do not describe, with information specific to the Subbasin, the groundwater level conditions that are considered significant and unreasonable and would result in undesirable results. The GSPs do not explain or justify how the quantitative definition*

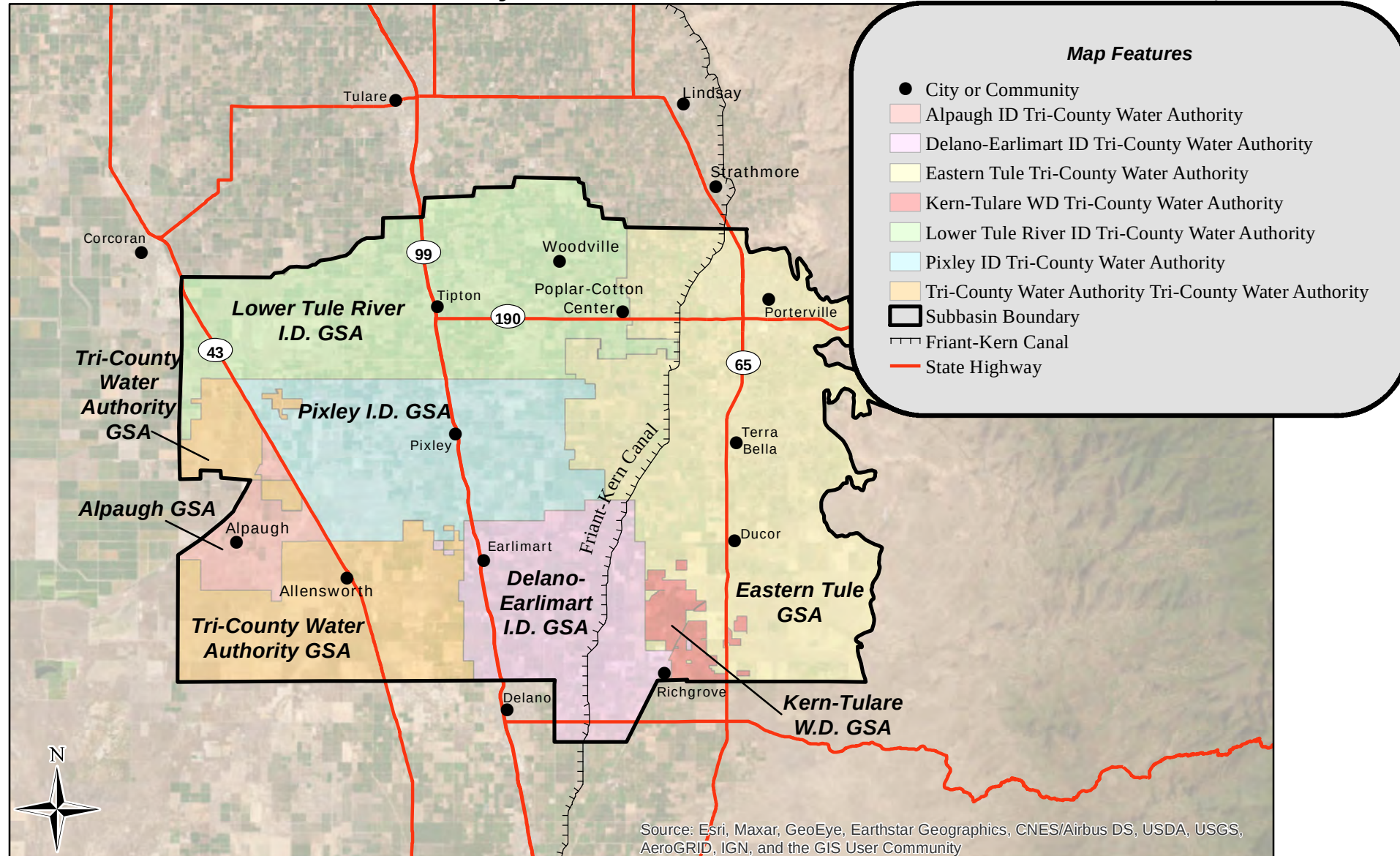
¹ There are now seven GSAs as Kern-Tulare Water District GSA formed after the 2022 GSPs were submitted.

² CDWR, 2022. Incomplete Determination of the 2020 Groundwater Sustainability Plans Submitted for the San Joaquin Valley – Tule Subbasin. Letter dated January 28, 2022.

Technical Support to Address DWR Comments Regarding Upper Aquifer Groundwater Levels

May 2024

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting



0 2.5 5 10
Miles
NAD 83 State Plane Zone 4

**Tri-County Water
Authority Boundaries**

**Figure 1
DRAFT-FINAL**

of undesirable results is consistent with avoiding effects the GSAs have identified as undesirable results.

2. *The GSPs do not explain how minimum thresholds at the representative monitoring sites are consistent with the requirement to be based on a groundwater elevation indicating a depletion of supply at a given location. The GSPs do not demonstrate that the established sustainable management criteria are based on a commensurate level of understanding of the basin setting or whether the interests of beneficial uses and users have been considered.*

In July 2022, the Tule Subbasin GSAs submitted a revised Coordination Agreement and revised GSPs to address the CDWR comments. The revised Coordination Agreement included an updated definition of Undesirable Results and an analysis of wells potentially impacted during the transitional pumping period between 2020 and 2040, at the minimum thresholds proposed at that time.

In their determination letter,³ the CDWR made the following general comments about the revised Coordination Agreement and GSPs:

“...the Plan did not materially revise the method of setting minimum thresholds for groundwater levels for the responsible areas of most of the GSAs and did not explain how and why the selected minimum thresholds would avoid undesirable results for groundwater levels.”

CDWR Inadequate Determination Letter, Pg. 2 D

“For the most part, Department staff still do not read the GSPs to have established minimum thresholds on the basis of groundwater conditions that would cause undesirable results based on significant and unreasonable conditions, but that they are, instead, based on future projected groundwater elevations, and that the GSPs do not establish a nexus between conditions at those predicted elevations and undesirable results the GSAs seek to avoid.”

CDWR Inadequate Determination Letter, Section 4.1.2 Pg. 12 2nd Paragraph

“...the GSPs still lack evidence demonstrating the GSAs considered the interests of beneficial uses and users of groundwater in establishing minimum thresholds.”

CDWR Inadequate Determination Letter, Section 4.1.2 Pg. 12 3rd Paragraph

³ CDWR, 2023. Inadequate Determination of the Revised 2020 Groundwater Sustainability Plans Submitted for the San Joaquin Valley – Tule Subbasin. Letter dated March 2, 2023.



In their Tule Subbasin Probational Hearing Draft Staff Report⁴ the State Water Resources Control Board (SWRCB) agreed with the CDWR findings and identified additional deficiencies necessary to address. The Draft Staff Report also identified potential actions to address the deficiencies. The deficiencies and potential actions are summarized below:

Deficiency GL-1 – The GSPs’ goals appear to allow significant and unreasonable impacts to domestic wells and the people that rely on them. For example, GSPs would allow hundreds of wells to go dry.

Potential Action GL-1 – Revise goals so that they do not allow significant and unreasonable impacts.

Deficiency GL-2 – The GSP’s goals do not achieve sustainability.

Potential Action GL-2 – Revise goals to prevent overdraft. Evaluate feasibility of projects that GSPs rely on to increase water supply.

Deficiency GL-3 – GSPs plan to measure progress against modeled projections rather than goals that avoid harm caused by declining groundwater levels.

Potential Action GL-3 – Revise how progress toward sustainability is measured.

Deficiency GL-4 – Well mitigation plans lack crucial detail.

Potential Action GL-4 – Add detail to well mitigation plans.

Deficiency GL-5 – Demand management plans lack crucial detail.

Potential Action GL-5 – Add detail to demand management plans.

SWRCB deficiencies GL-1 through GL-3 are addressed herein. Deficiency GL-4 is addressed in Tule Subbasin Coordination Agreement Attachment 8 Mitigation Plan. Deficiency GL-5 is addressed in each GSA’s individual GSP.

1.2 Purpose and Scope

The purpose of this TM is to document the process and results for revising the Sustainable Management Criteria (SMC; i.e. minimum thresholds and measurable objectives) and quantification of Undesirable Results for Upper Aquifer groundwater levels in the Tule Subbasin to avoid the significant and unreasonable groundwater level conditions described herein. In so doing, it is further the objective of this TM to address the deficiencies CDWR identified in their

⁴ SWRCB, 2024. Tule Subbasin Probationary Hearing Draft Staff Report. March 2024.



Inadequate Determination letter from March 3, 2023. In the context of avoiding significant and unreasonable conditions for the most vulnerable beneficial users (domestic well owners) and given that domestic wells are typically completed in the Upper Aquifer, the focus of this TM is SMC for the Upper Aquifer to avoid impacts to these wells.

The process and results for determining SMC for Lower Aquifer groundwater levels, land subsidence, groundwater quality and interconnected surface water are addressed in Attachments 5, 6 and 7 of the Tule Subbasin Coordination Agreement.

2 Approach for Determining Sustainable Management Criteria for Upper Aquifer Groundwater Levels

The approach for determining SMCs for Upper Aquifer groundwater levels involved a balancing of total groundwater pumping while ensuring a water supply for private domestic well owners. The process to revise the SMCs involved a coordinated effort between technical consultants, agricultural stakeholders, and non-governmental organizations (NGOs). The process was iterative and included feedback from California State Water Resources Control Board (SWRCB) staff. Key aspects of the process are summarized in Figure 2 and described below.



Figure 2. Approach for Determining Sustainable Management Criteria for Upper Aquifer Groundwater Levels in the Tule Subbasin.

STEP 01**IDENTIFY***Beneficial Users*

Beneficial Uses and Users of Groundwater in the Tule Subbasin include domestic supply, municipal supply, agricultural supply, industrial supply and environmental.

STEP 02**DEFINE***Basin-wide conditions that are significant and unreasonable to beneficial users*

The Tule Subbasin GSAs have revised the definition of Significant and Unreasonable Conditions for the subbasin, as they relate to groundwater levels.

STEP 03**QUANTIFY***Undesirable results*

The Tule Subbasin GSAs updated the quantification of undesirable results for Upper Aquifer groundwater levels as a basis for determining whether the Tule Subbasin sustainability goal has been achieved.

STEP 04**DEVELOP***Coordinated Sustainable Management Criteria to Avoid Significant and Unreasonable Conditions*

Upper Aquifer groundwater level minimum thresholds (MTs) were identified to avoid the significant and unreasonable conditions identified in Step 2. The MTs were determined through an iterative, stakeholder-driven process that balanced minimizing impacts to domestic wells with the feasibility of mitigating impacted wells and the cost of projects and management actions to maintain groundwater levels above the MTs.



3 Beneficial Uses and Users of Groundwater in the Tule Subbasin

Beneficial uses and users of groundwater in the Tule Subbasin include domestic supply, municipal supply, agricultural supply, industrial supply and environmental.

4 Definition of Significant and Unreasonable Groundwater Level Conditions

A key driver of the analysis presented herein to address CDWR comments is protection of the basic human right to water. As stated in the California Water Code Section 106.3, “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.” In the Tule Subbasin, many private residences in the small communities of the area rely on private wells to meet their domestic water supply needs. As these wells are typically shallow, they are vulnerable to, among other things, lowered groundwater levels from overdraft conditions. While seasonal conditions can influence groundwater levels, the Tule Subbasin has been shown to be in long-term overdraft, primarily from agricultural pumping. A primary objective of the Tule Subbasin GSAs is the sustainable management of groundwater levels to avoid impacts to all beneficial uses and users in the Tule Subbasin, including private domestic wells. While the Sustainable Groundwater Management Act (SGMA) provides for achieving groundwater sustainability by 2040, it is recognized that this access to water must be protected during that transitional time if additional overdraft occurs.

In consideration of the above, the Tule Subbasin GSAs have revised their definition of significant and unreasonable conditions, as it relates to Upper Aquifer groundwater levels, as follows:

“Lowering of groundwater levels from groundwater pumping that results in unmitigated impacts to beneficial uses and users.”

While this definition applies to all beneficial uses and users of groundwater (including municipal, domestic, agricultural and industrial types), a primary focus of the Tule Subbasin GSAs is protection of the most vulnerable populations, which are residents who rely on individual domestic wells for their water supply.

5 Quantification of Undesirable Results

Groundwater levels in the Tule Subbasin have shown a general chronic lowering since approximately 1987. The primary cause of groundwater conditions that have led to chronic lowering of groundwater levels is groundwater production in excess of natural and artificial recharge over a multi-year period that includes both wetter than average and drier than average conditions. This condition has been exacerbated during natural drought-cycles when access to imported water supplies is restricted and



groundwater production increases. Restricted access to imported surface water can occur due to a variety of factors, including but not limited to, increased requirements in the Delta, which may increase the likelihood imported supplies from Millerton Lake will be delivered outside the Tule Subbasin. Climate change may also affect the availability and rate upon which natural and artificial recharge is available.

As per SGMA, an undesirable result is quantified through MT exceedances. For the Tule Subbasin, the criteria for determining groundwater level conditions that represent an undesirable result are either the occurrence of (1) or (2) as follows:

1a. Groundwater levels drop below the MT in any three RMS wells in any given year.

AND

1b. More than 38 domestic wells require mitigation in any given year. If 38 wells require mitigation for multiple years, no more than 258 wells shall be impacted cumulatively by 2040.

OR

2. If a GSA is unable to meet mitigation needs

Three RMS wells correlates to the number of potentially impacted domestic wells that a GSA can afford to mitigate in a single year, including the Porterville area which has the highest density of potentially impacted private domestic wells (approximately 30). The number of potentially impacted domestic wells per RMS if groundwater levels are at the minimum threshold is approximately 11, based on the spatial distribution of wells (258 total potentially impacted wells divided by 23 RMS wells). If the maximum annual number of impacted domestic wells requiring mitigation is approximately 38 (see Section 7.4), then this would correlate to three RMS minimum threshold exceedances. If either metric for criterion 1 (including both 1a and 1b) or 2 is exceeded or is not otherwise met, it would indicate that sustainability planning and implementation is not sufficient and therefore is an undesirable result.

6 Sustainable Management Criteria

The process to determine SMCs for Upper Aquifer groundwater levels focused on avoiding impacts to domestic wells. Starting with the groundwater level MTs previously published in the 2022 GSP revision, TH&Co conducted a series of analyses to estimate the number of wells potentially impacted in the Tule Subbasin at progressively shallower groundwater level MTs. During various iterations of the analysis, the results were presented to stakeholders, including the GSA managers, GSA Boards and stakeholder committees, NGO groups, and SWRCB staff for review and comment. Key goals of the exercise were to:



- Minimize potential domestic well impacts from groundwater pumping,
- Ensure the financial feasibility of funding the mitigation of wells that could potentially be impacted, and
- Ensure the feasibility of projects and management actions necessary to maintain groundwater levels to avoid impacts.

The financial feasibility of funding mitigation of potentially impacted wells was evaluated in the context of the Tule Subbasin Mitigation Plan. The Mitigation Plan ensures that funds will be available to address wells potentially impacted as a result of groundwater pumping (see Section 7 herein) and that impacted parties will not be without water (see Coordination Agreement Attachment 8).

6.1 Upper Aquifer Groundwater Level Minimum Thresholds

Based on comments from the CDWR in their March 2023 determination letter,⁵ the methodology to determine MTs previously identified in the Tule Subbasin GSAs was not coordinated as some GSAs had different methodologies than others. To address this, a coordinated process to determine MTs was developed based in part on measured groundwater levels reflecting recent low conditions and model forecasts of future groundwater levels.

The new coordinated methodology included the following steps:

1. Historical groundwater level hydrographs were prepared for each of the Upper Aquifer Representative Monitoring Site (RMS) wells in the subbasin (see Figure 3 for example).
2. The groundwater level measured at each RMS well in Fall 2022 was selected as representative of recent low groundwater conditions (see Table 1).
3. An updated version of the calibrated groundwater flow model of the Tule Subbasin⁶ was used to estimate the model-predicted change in groundwater levels forecast at each Representative Monitoring Site (RMS) well between 2022 and 2040. The forecast incorporated each GSA's project and management actions, as outlined in the 2022 GSPs.
4. The revised coordinated MT at each RMS well was established as the difference between the 2022 measured groundwater elevation at that well and the model-forecasted groundwater elevation in 2040 (see Figure 3; Table 1).
5. The MTs for the RMS wells were contoured via kriging in Geographic Information System (GIS) to develop a MT surface across the subbasin (see Figure 4).

⁵ CDWR, 2023. Inadequate Determination of the Revised 2020 Groundwater Sustainability Plans Submitted for the San Joaquin Valley – Tule Subbasin. Letter dated March 2, 2023.

⁶ TH&Co, 2021. Update to the Groundwater Flow Model of the Tule Subbasin. Prepared for the Tule Subbasin Technical Advisory Committee. Dated July 29, 2021. Attachment 3 to the Tule Subbasin Coordination Agreement.



Revised Coordinated Upper Aquifer Groundwater Level Minimum Thresholds

GSA	RMS Well	A	B	C ²	D	E ³
		Fall 2022 GWL (ft asml)	Model-Predicted 2020 to 2040 Change in GWL ¹ (ft)	Revised Coordinated MT (ft asml)	Previous 2022 GSP MT (ft asml)	Difference (ft)
DEID	23S/26E-29D01	68	14	54	54	0
DEID	24S/25E-35H01	165	21	144	149	-5
DEID	24S/26E-04P01	83	25	58	61	-3
DEID	24S/26E-11	163	37	126	106	20
DEID	24S/26E-32G01	156	27	129	83	46
DEID	M19-U	170	23	147	196	-49
ETGSA	C-1	348	15	333	314	19
ETGSA	R-11	238	-43	281	281	0
ETGSA	22S/26E-13R01	238	93	145	58	87
LTRID	22S/23E-30J01	-6	54	-60	-71	11
LTRID	21S/23E-32K01	96	47	49	13	36
LTRID	21S/24E-35A01	109	42	67	53	14
LTRID	21S/25E-03R01	190	45	145	58	87
LTRID	21S/26E-32B02	159	45	114	103	11
LTRID	21S/26E-34	242	9	233	231	2
LTRID	LTRID TSS U	180	53	127	101	26
PID	22S/24E-28J02	84	55	29	15	14
PID	22S/25E-25N01	2	25	-23	-51	28
PID	23S/25E-08G01	49	26	23	0	23
PID	PIDGSA-01 U	120	21	99	77	22
TCWA	22S/23E-25C01 (E20)	-17	37	-54	-102	48
TCWA	TSMW-5U	113	35	78	78	0

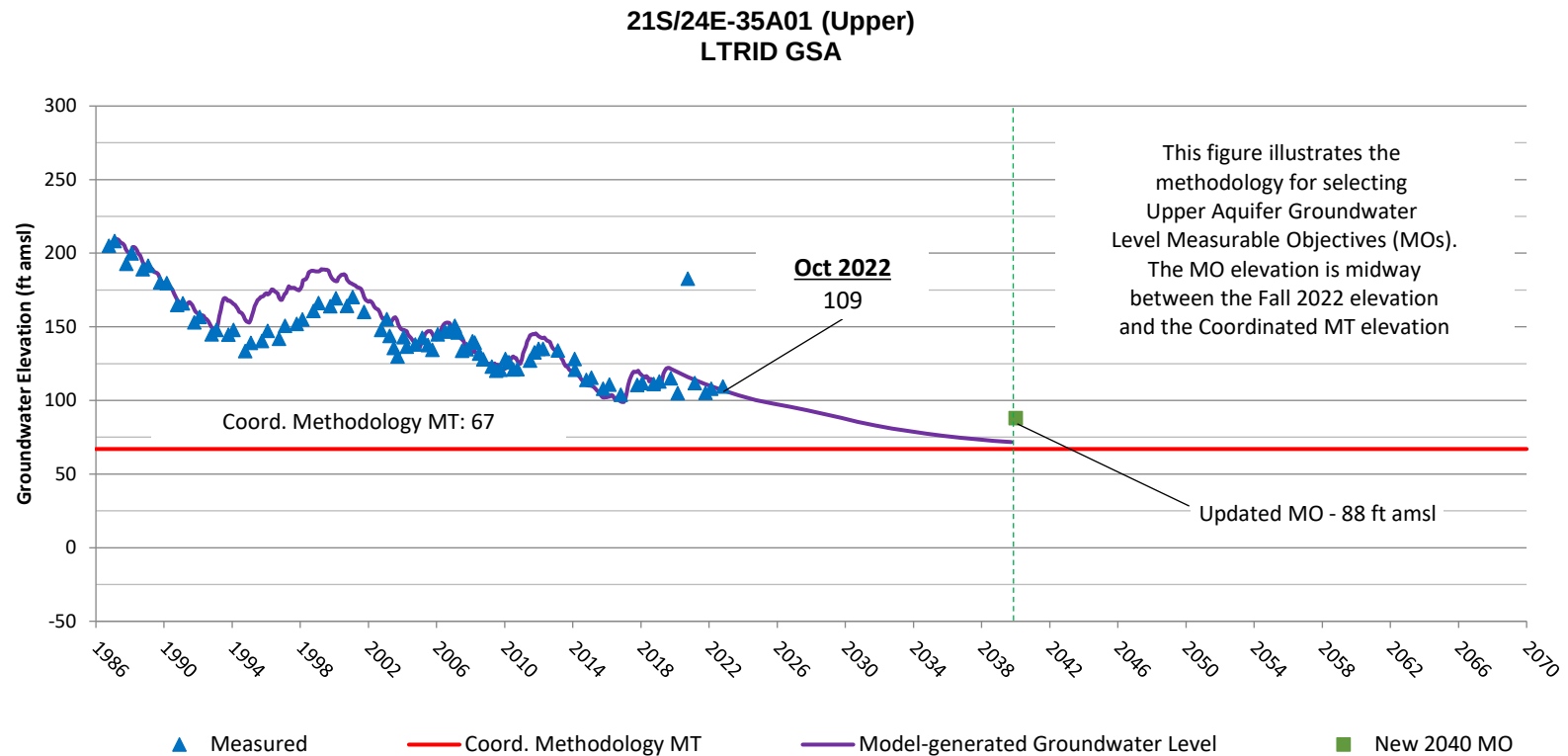
Notes:

¹ TH&Co, 2021. Update to the Groundwater Flow Model of the Tule Subbasin. Technical Memorandum Dated 7/30/21.

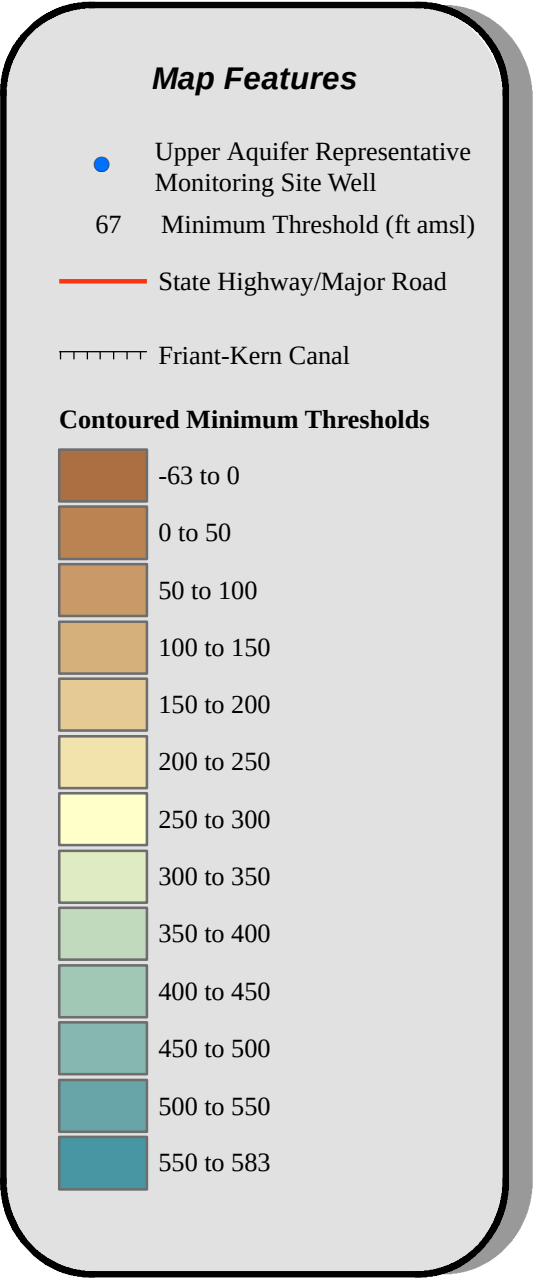
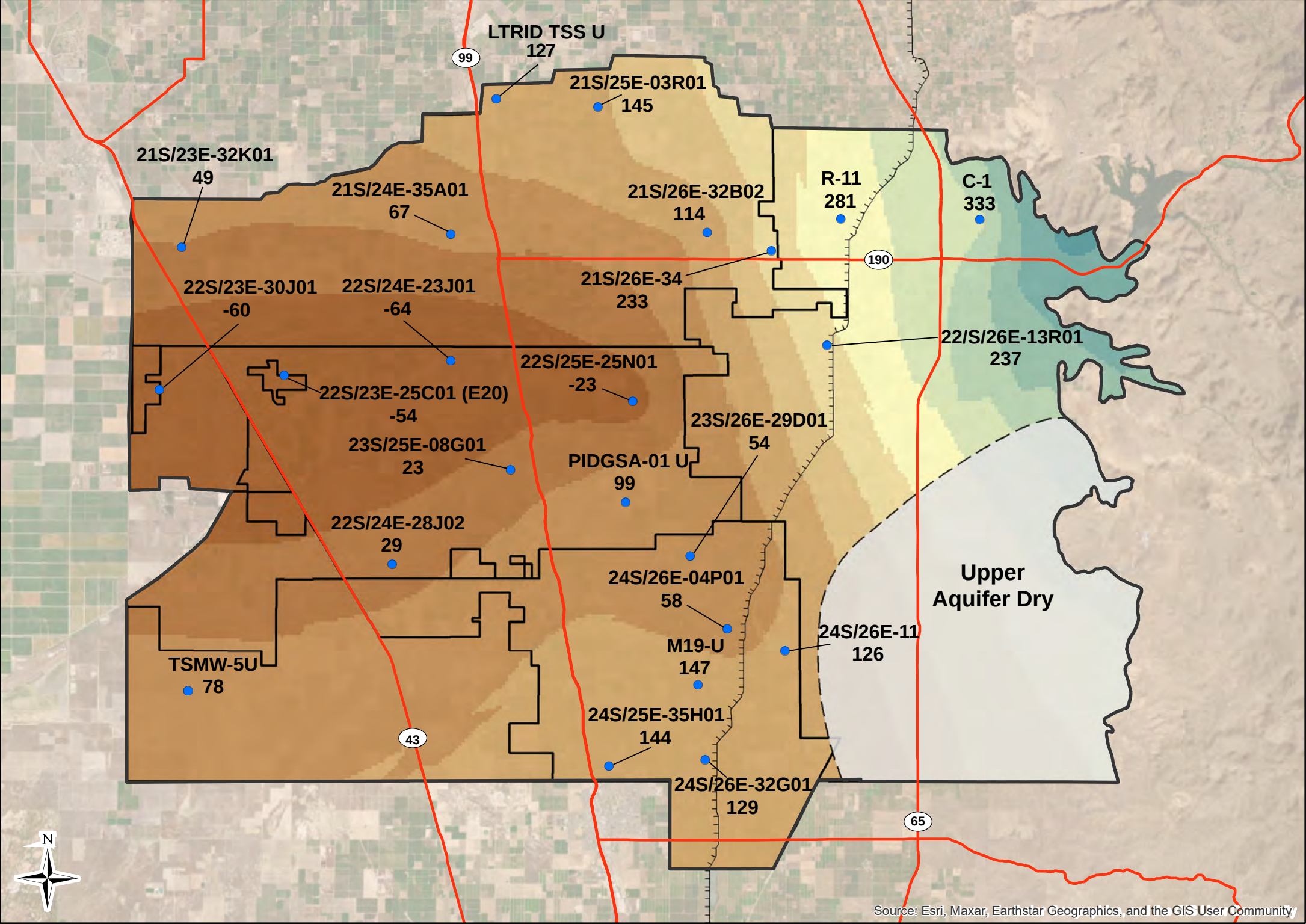
² C = A - B

³ E = C - D

Measurable Objective - Example



Notes:



6. The MT contour map was used to estimate the number of wells potentially impacted if groundwater levels were lowered to the MTs (see Section 6.2 herein).

A notable exception to the methodology was implemented in the Porterville area, where groundwater levels are already relatively shallow and forecasted changes in groundwater level are small. In the two Porterville RMS wells (C-1 and R-11), the MTs were based on the historical low groundwater levels measured at those locations in 2016 and 2015, respectively.

Revised Upper Aquifer groundwater level MTs are shown on Figure 4 and summarized in Table 1. As a result of the revised methodology, except for the RMS wells in the City of Porterville, MTs in most RMS wells were raised relative to those published in the 2022 GSPs (see Table 1). The Tule Subbasin GSAs determined that it was feasible to raise the funds necessary to mitigate the wells potentially impacted at the revised MTs developed based on the above methodology and shown in Table 1 (see Sections 6.2 and 7.0 herein). As such, the updated Upper Aquifer MT surface represents the level at which significant and unreasonable conditions occur that the GSAs seek to avoid.

6.2 Analysis of Wells Potentially Impacted at the Revised Coordinated Upper Aquifer Groundwater Level Minimum Thresholds

The GSAs understand that further lowering of groundwater levels during the SGMA transition period may result in impacts to some domestic well owners. To ensure that the water supply for these well owners is maintained, the GSAs have developed a mitigation plan to ensure that anyone affected by lowered groundwater levels has access to potable drinking water. Funds to support mitigation needs will be raised through pumping fees. An estimate of the funds necessary to address mitigation needs was developed, in part, based on an estimate of the number of wells that could be impacted, in the worst-case scenario, if groundwater levels were drawn down to the MTs throughout the subbasin.

While it is not possible at this time to identify exactly how many wells in the Tule Subbasin would be impacted by lowering groundwater levels to the MTs, it is possible, using the best available data provided by the CDWR and United States Geological Survey (USGS), to estimate the number of wells that would be potentially impacted. Further, the available databases have been used to assess the beneficial uses served by the impacted wells, whether agricultural, domestic, industrial, or municipal supply.

6.2.1 Sources of Data

The analysis presented herein relied on the following data:



- CDWR's Online System of Well Completion Reports (OSWCR) database,⁷
- USGS well completion report database,⁸
- Upper Aquifer groundwater levels for Spring 2015 from GSAs, CASGEM database, DCTRA, and other databases
- Geographic Information System (GIS) shapefiles of the subbasin and GSA boundaries and wells,
- Specific capacity data for wells in the Tule Subbasin from GSAs and the OWSCR database.⁹

The analysis of potentially impacted wells is based on a combination of the CDWR's OSWCR and the portion of the OSWCR database that was revised by the USGS to include more accurate well locations and additional well completion data. There were approximately 600 wells in the OSWCR database not included in the USGS database. TH&Co relied on the USGS database first and then supplemented it with the OSWCR wells not common to both databases.

6.2.2 Methodology

The methodology to estimate the number of wells potentially impacted by lowering Upper Aquifer groundwater levels to the MTs included the following steps and assumptions:

- The MTs for each aquifer, as designated at representative monitoring sites, were contoured via kriging in Geographic Information System (GIS) to develop a MT surface across the subbasin (see Figure 4).
- There is a total of 8,996 Tule Subbasin wells in the combined OSWCR/USGS well databases. Of the total wells in these databases, 4,476 wells were removed from the analysis because the records did not include total depth information, they were non-pumping wells or wells documented for uses other than agricultural, private domestic, industrial, or municipal, (e.g., contaminant remediation, injection, monitoring), or they were destroyed.
- 42 wells were added to the database based on records from the City of Porterville and KTWD GSA.
- Within the City of Porterville Urban Development Boundary, the city has implemented a program to connect homes to the municipal water supply system that previously relied on domestic wells for water supply. As a requirement of connecting to the public water supply, domestic well owners are required to destroy their wells. By correlating homes

⁷ CDWR, 2023. <https://data.ca.gov/dataset/well-completion-reports>, v. 3.

⁸ Borkovich, J.G., Arroyo-Lopez, J., Haugen, E., Stork, S.V., McGregor, A.M., Balkan, M., Peng, S., Jasper, M., Lor, V., Soldavini, A., Estrada, C., McVey, C., Grechkokey, D., Koepke, J., Oldham, N., Vroman, R., Handley, R., Bennett, G.L., Faulkner, K., Luckett, J., Mitchell, H., and Wenrick, S., 2023, Attributed California Water Supply Well Completion Report Data for Selected Areas, Derived from CA WCR OSCWR Data (ver. 3.0, June 2023): U.S. Geological Survey data release, <https://doi.org/10.5066/P93ICKAF>.

⁹ TH&Co, 2020. Groundwater Flow Model of the Tule Subbasin. Report prepared for the Tule Subbasin MOU Group. Dated January 2020.



with water supply connections to well locations in the USGS database, 18 wells were removed from consideration in the analysis of potentially impacted wells as they have likely been destroyed (see Figure 5).

- A total of 4,544 wells were used in the analysis. The wells are plotted on Figure 6 according to the location information in the USGS database. For wells with only township, range and section information, the well was plotted in the middle of the section.
- As per SGMA¹⁰ GSPs are not required to address wells potentially impacted at groundwater conditions that existed prior to January 1, 2015. Thus, 486 wells that would have been impacted prior to this time were removed from the analysis (see Figure 7). The Upper Aquifer groundwater surface used as a basis for removing wells prior to January 1, 2015, was developed based on a manually contoured groundwater elevation contour map using groundwater levels measured in Spring 2015 (see Figure 8). Only wells constructed within the Upper Aquifer, as defined in the Tule Subbasin groundwater flow model¹¹, were used to develop the contour map.

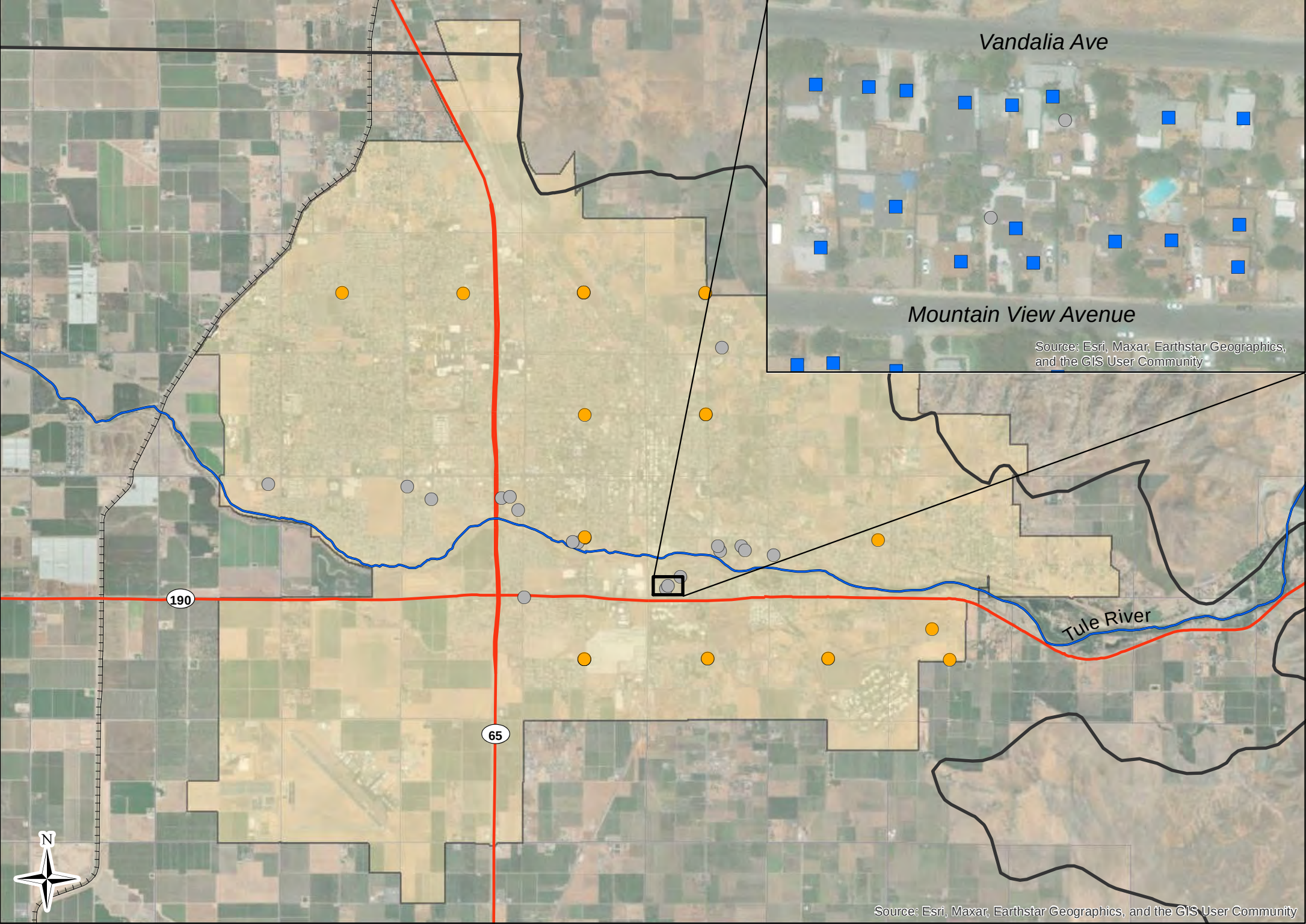
Wells at which the total depth or bottom of perforations were above the MT or where the total depth/bottom of perforations were below the MT but could not support pumping with a static groundwater level at the MT were considered “potentially impacted” (see Figure 9). Criteria for determining whether a well could support pumping when the static groundwater level was at the MT were the following:

- The pumps in all wells were assumed to be installed, or capable of being installed, within 10 feet of the bottom of the wells.
- It was assumed that the pumping groundwater level would need to be at least 20 feet above the pump intake to avoid cavitation or entrained air.
- In addition to the pumping support assumptions above, allowance was given to support pumping drawdown based on specific capacity data from available wells and pumping rates reported in the USGS updated version of the OSWCR database.
- For each GSA, TH&Co used an average specific capacity from wells with available data in that GSA. The pumping drawdown allowance for agricultural wells was assigned based on average pumping rates from agricultural wells in each mile square section. The pumping drawdown allowance for domestic wells was assigned based on average pumping rates for domestic wells in each mile square section.

¹⁰ California Water Code Part 2.74, Ch. 6, Section 10727.2 (b) (4)

¹¹ TH&Co, 2021. Update to the Groundwater Flow Model of the Tule Subbasin. Prepared for the Tule Subbasin Technical Advisory Committee. Dated July 29, 2021. Attachment 3 to the Tule Subbasin Coordination Agreement.





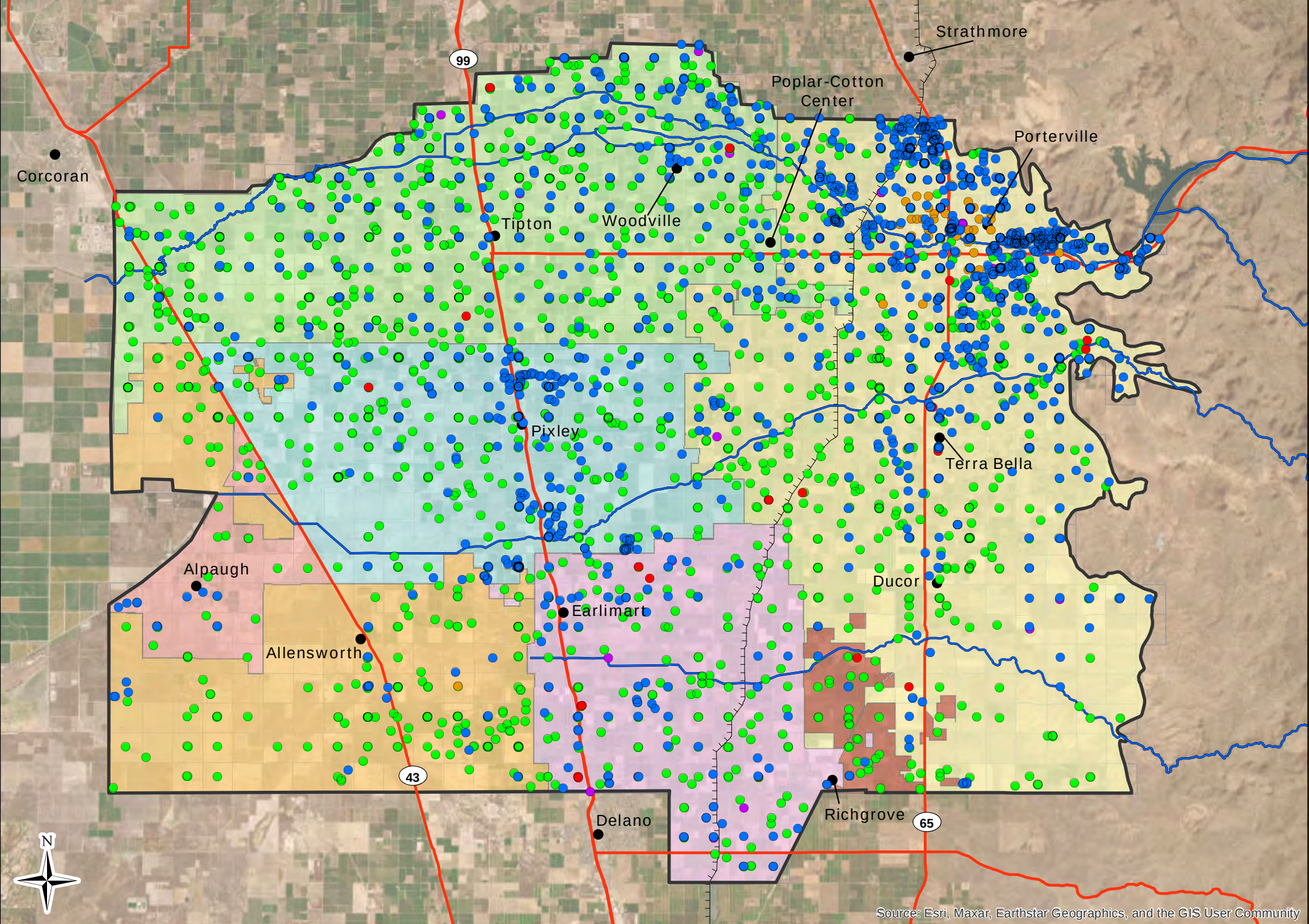
Map Features

- Well Included in Impact List
- Well Removed from Impacted List
- Serviced Address Corresponding to Nearby Wells
- Major Hydrologic Feature
- State Highway/Major Road
- Friant-Kern Canal
- City of Porterville Urban Development Boundary
- Subbasin Boundary

Note: Well data from the USGS 07/2023
<https://www.sciencebase.gov/catalog/item/64958d73d34ef77fcb01dc8f>

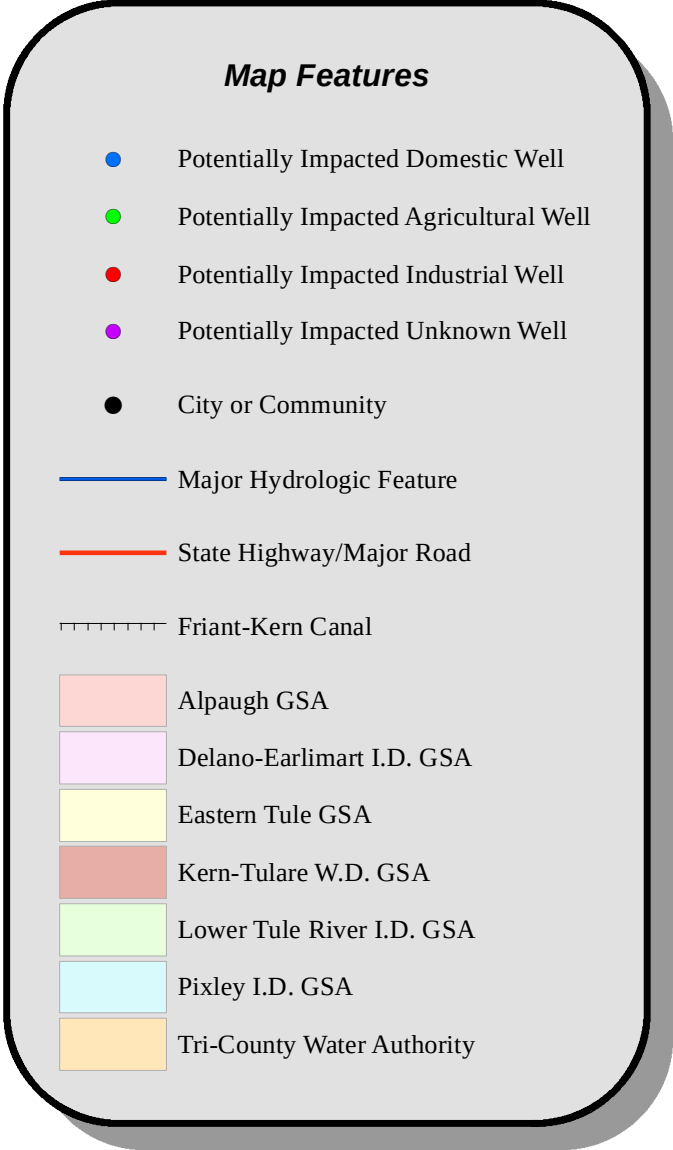
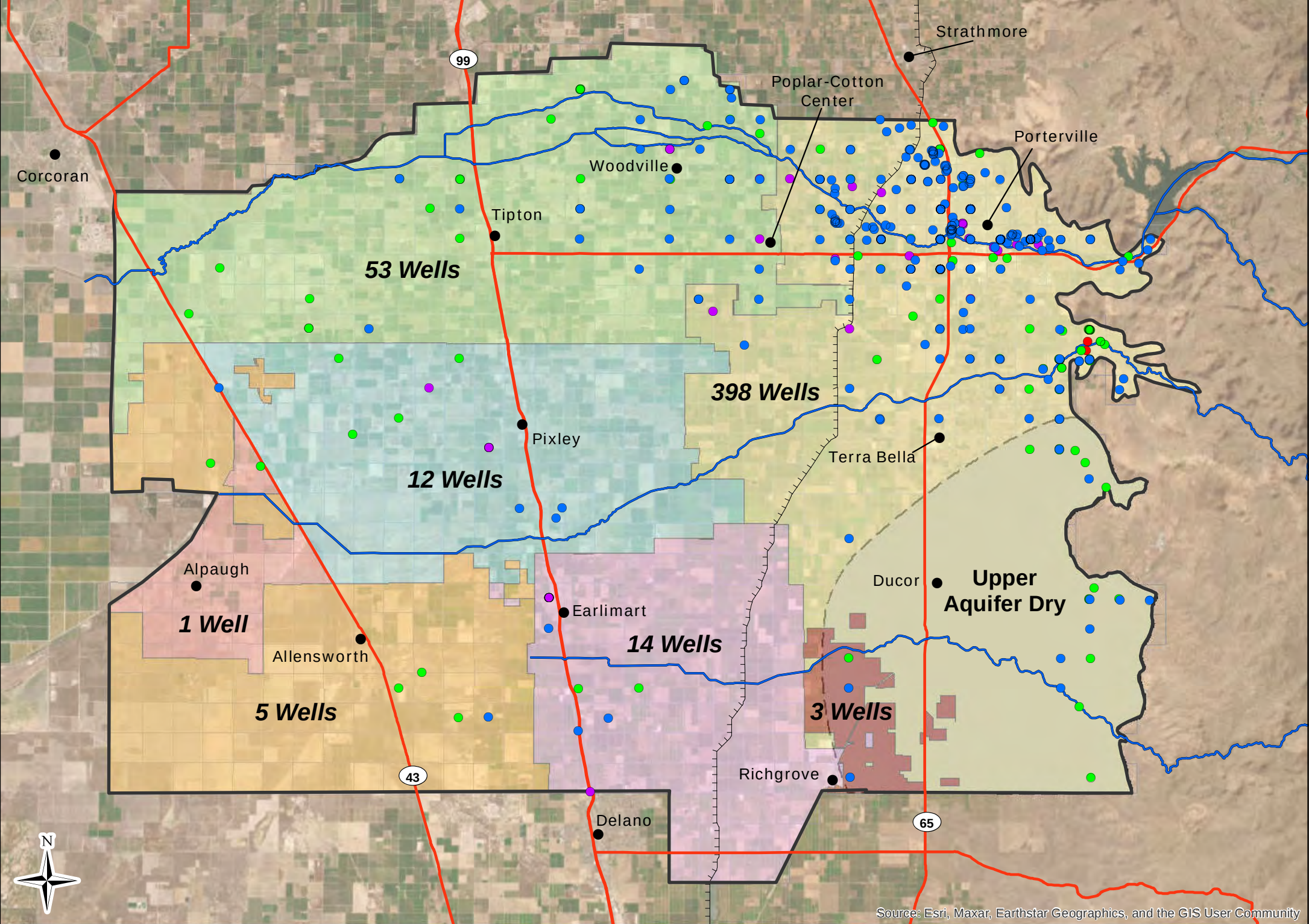
Each well location in the USGS database corresponds to an address connected to the Porterville water system.

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Sources of Data: California Department of Water Resources
Online System of Well Completion Records (OSWCR);
United States Geological Survey; Kern-Tulare Water
District; City of Porterville

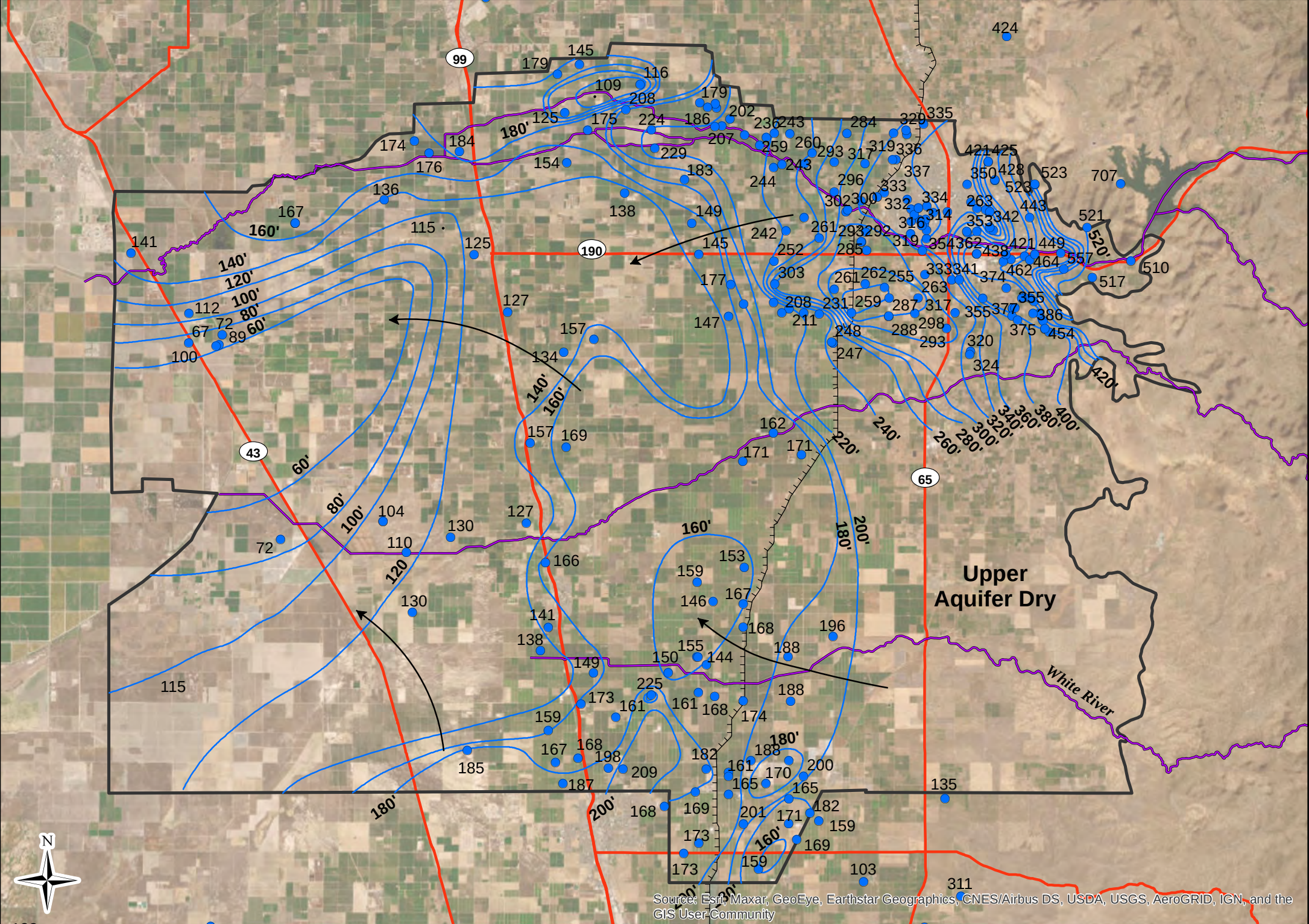
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Note: See Figure 6 for well database sources. See text for drawdown and submergence assumptions to estimate potentially impacted wells

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Impacted Wells at the 2015
Spring Groundwater Levels
Figure 7



Map Features

- Upper Aquifer
- 100'** Groundwater Contour, Dashed where approximate (ft amsl)
- Major Hydrologic Feature
- ← Groundwater Flow Direction
- State Highway/Major Road
- Friant-Kern Canal

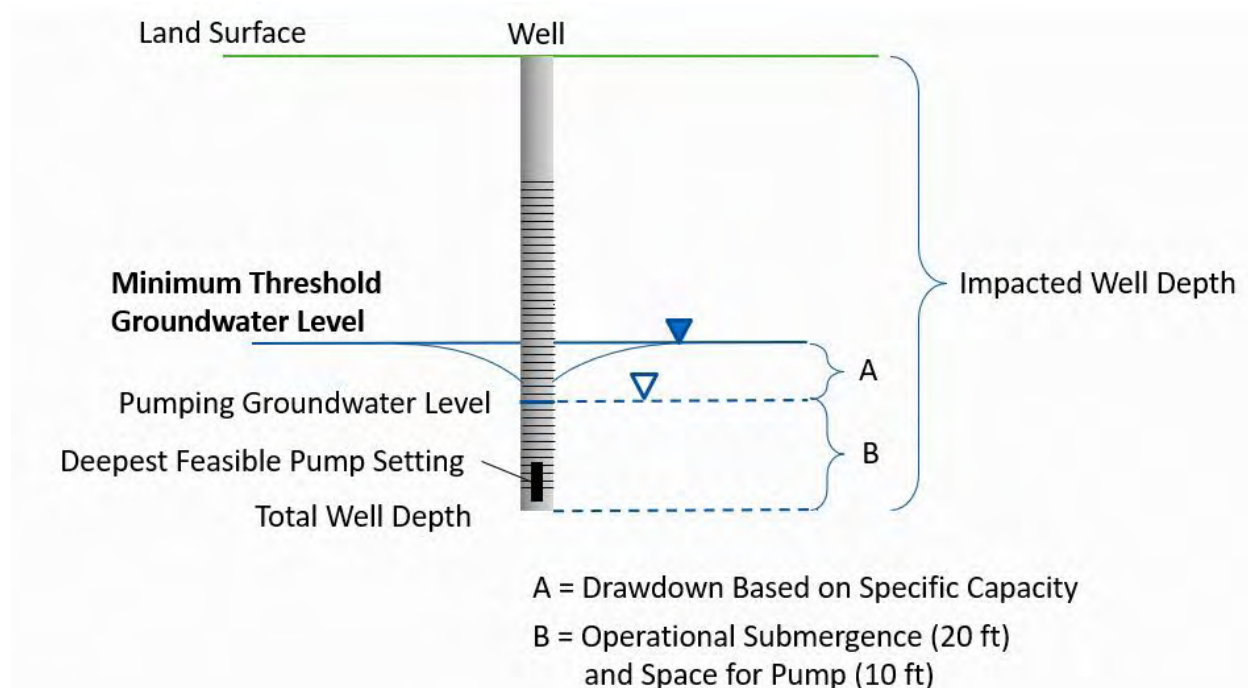


Figure 9. To be counted as potentially impacted, any given well in the databases had to be shallower than the groundwater level minimum threshold plus the sum of estimated well drawdown, operational submergence, and space for the pump.

6.3 Measurable Objectives

Measurable objectives (MOs) at each RMS well were also raised relative to the 2022 GSPs. The MOs at each RMS well was established as the midpoint between the 2022 groundwater level and the MT. The MOs are designed such that sustainably managed groundwater levels provide operational flexibility above the MT. Revised MOs are shown on Figure 10.

6.4 Results

Within the Tule Subbasin as a whole, 4,544 wells were identified from the combined OSWCR/USGS database as having adequate data for use in the analysis (see Figure 6). Of the 4,544 wells, 486 wells would have already been impacted prior to January 2015. The remaining 4,058 wells were included in the analysis.

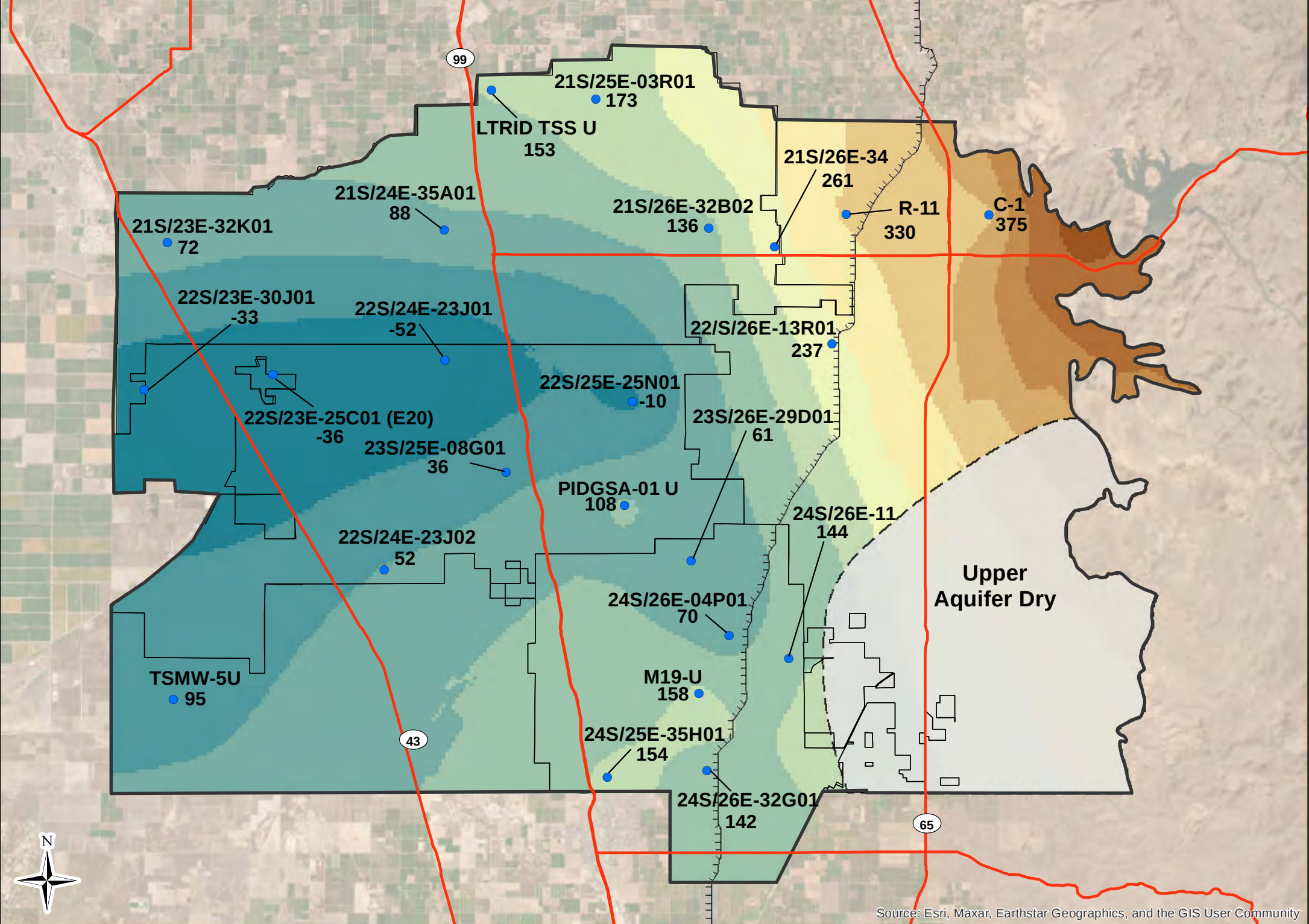
Of the 4,058 wells in the analysis, 257 wells would potentially be impacted if groundwater levels were lowered to the MTs throughout the subbasin using the evaluation criteria described herein (see Table 2; Figure 11). Of the 257 wells potentially impacted, in the worst-case scenario, an estimated 173 would be domestic wells. There are also 12 unknown wells potentially impacted in the analysis, which are assumed for planning purposes to be domestic wells. These values became

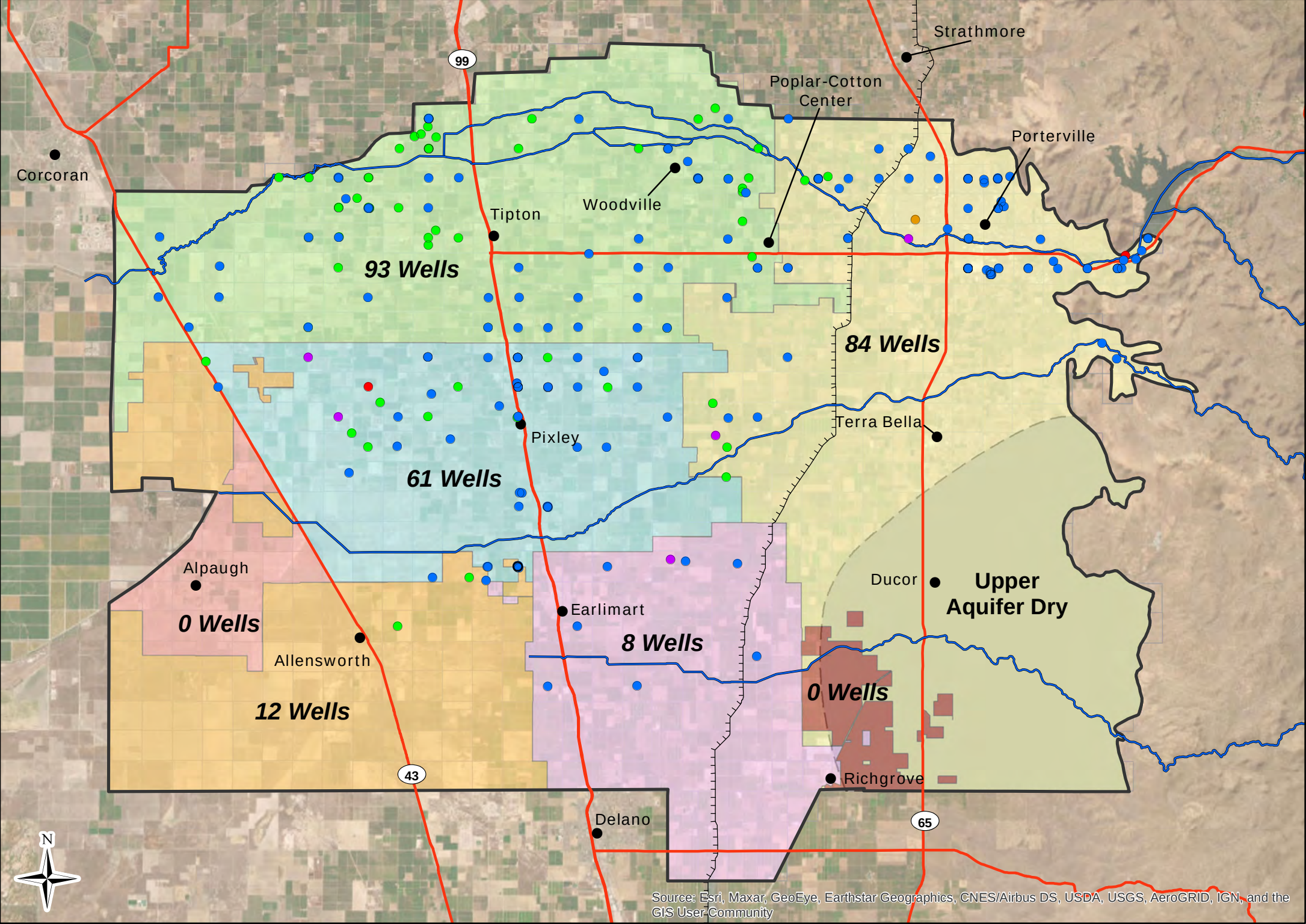
**Tule Subbasin Wells Potentially Impacted After 2015 if Groundwater Levels Lowered to the Upper Aquifer
Minimum Thresholds**

GSA	Agricultural	Domestic	Municipal	Industrial	Unknown	Total Wells Impacted	Total Wells in Analysis	% Impacted by GSA
Alpaugh	0	0	0	0	0	0	38	0
DEID	0	7	0	0	1	8	246	3
ETGSA	10	65	0	2	6	83	1750	5
LTRID	46	47	0	0	0	93	1180	8
KTGSA	0	0	0	0	0	0	37	0
Pixley	11	44	0	1	5	61	559	11
TCWA	2	10	0	0	0	12	248	5
Total Impacted	69	173	0	3	12	257	4058	6
Total Well Type	2264	1658	35	38	63			
% Impacted by Well Type	3	10	0	8	19			

Notes:

- ¹ Based on the USGS Database, OSCWR Database, KTGSA Domestic Wells, and Municipal Wells
- ² Wells potentially impacted prior to 2015 were removed from the total of this well analysis.
- ³ Includes drawdown and submergence assumptions.
- ⁴ Connected domestic wells have been removed from the count





Map Features

- Potentially Impacted Domestic Well
- Potentially Impacted Agricultural Well
- Potentially Impacted Municipal Well
- Potentially Impacted Industrial Well
- Potentially Impacted Unknown Well
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road
- Friant-Kern Canal
- Alpaugh GSA
- Delano-Earlimart I.D. GSA
- Eastern Tule GSA
- Kern-Tulare W.D. GSA
- Lower Tule River I.D. GSA
- Pixley I.D. GSA
- Tri-County Water Authority

Note: See Figure 6 for well database sources. See text for drawdown and submergence assumptions to estimate potentially impacted wells.

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Potentially Impacted Wells at the
Minimum Thresholds
Figure 11

the basis for developing cost estimates for raising the funds necessary to mitigate any wells that are impacted and ensure impacted parties have access to water.

Potentially impacted wells based on groundwater levels lowered to the MOs are shown on Figure 12 and summarized in Table 3. As the number of potentially impacted wells at the MOs (136) is approximately half of the number of wells potentially impacted at the MTs, and as the GSAs intend to manage groundwater levels to the MOs, it is anticipated that raising mitigation funds based on the MTs will be sufficient to ensure that money is available to address any claims that are processed through the mitigation plans.

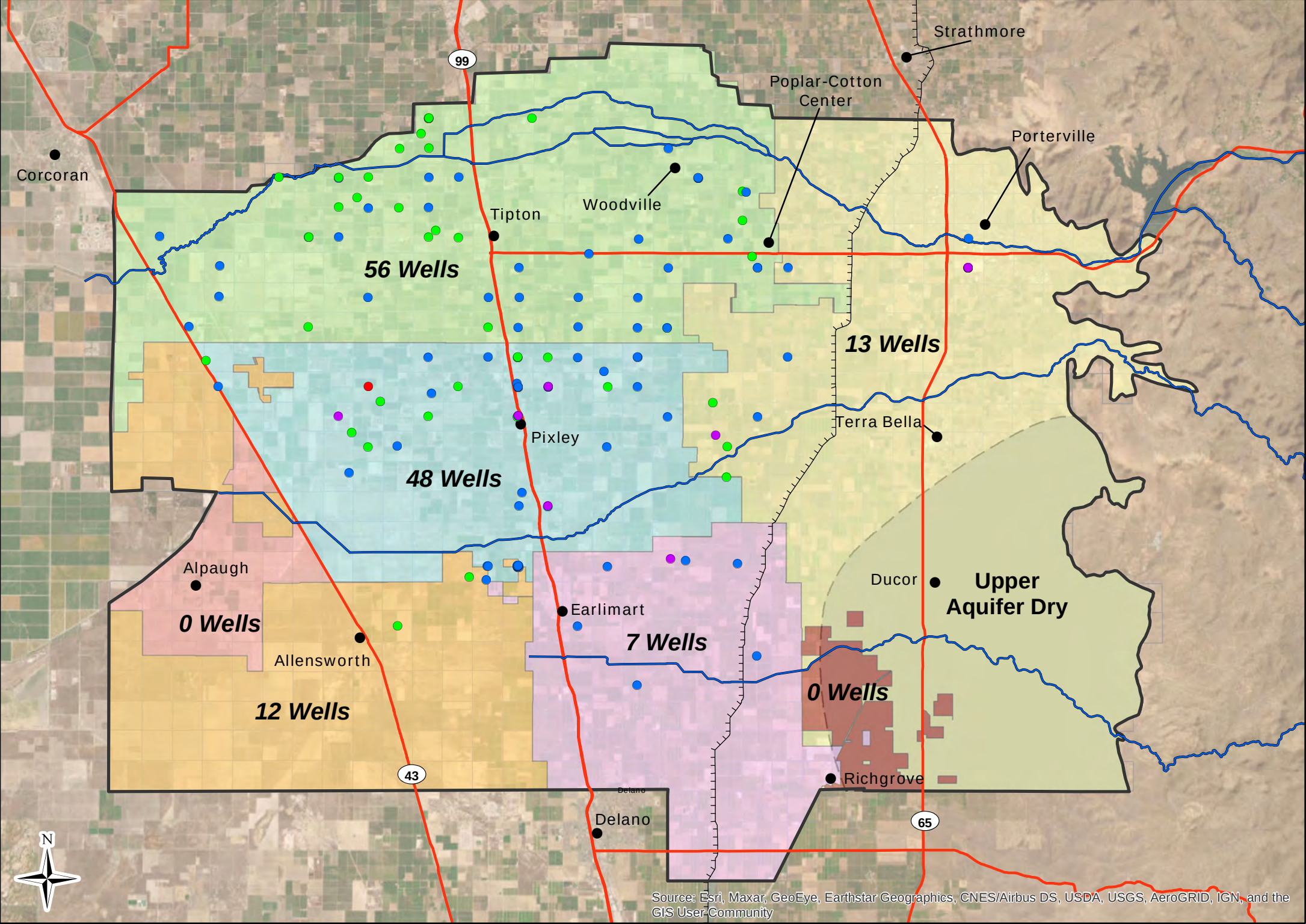


**Tule Subbasin Wells Potentially Impacted After 2015 if Groundwater Levels Lowered to the Upper Aquifer
Measurable Objectives**

GSA	Agricultural	Domestic	Municipal	Industrial	Unknown	Total Wells Impacted	Total Wells in Analysis	% Impacted by GSA
Alpaugh	0	0	0	0	0	0	38	0
DEID	0	6	0	0	1	7	246	3
ETGSA	3	5	0	0	5	13	1750	1
LTRID	22	34	0	0	0	56	1180	5
KTGSA	0	0	0	0	0	0	37	0
Pixley	11	32	0	1	4	48	559	9
TCWA	2	10	0	0	0	12	248	5
Total Impacted	38	87	0	1	10	136	4058	3
Total Well Type	2264	1658	35	38	63			
% Impacted by Well Type	2	5	0	3	16			

Notes:

- ¹ Based on the USGS Database, OSCWR Database, KTGSA Domestic Wells, and Municipal Wells
- ² Wells potentially impacted prior to 2015 were removed from the total of this well analysis.
- ³ Includes drawdown and submergence assumptions.
- ⁴ Connected domestic wells have been removed from the count



Map Features

- Potentially Impacted Domestic Well
- Potentially Impacted Agricultural
- Potentially Impacted Industrial Well
- Potentially Impacted Unknown Well
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road
- Friant-Kern Canal
- Alpaugh GSA
- Delano-Earlimart I.D. GSA
- Eastern Tule GSA
- Kern-Tulare W.D. GSA
- Lower Tule River I.D. GSA
- Pixley I.D. GSA
- Tri-County Water

Note: See Figure 6 for well database sources. See text for drawdown and submergence assumptions to estimate potentially impacted wells

7 Well Mitigation Cost Estimates

An estimate of the funds necessary to mitigate wells impacted by lowered groundwater levels and ensure the availability of water to all potentially impacted beneficial users was developed based on the number of potentially impacted wells and the costs needed to investigate, mitigate and/or provide technical assistance in accordance with the Tule Subbasin Mitigation Plan (Attachment 7 of the Coordination Agreement). The number of potentially impacted wells (257 wells) was described in Section 6.2.3 herein. Cost estimates for mitigating wells assume the following:

7.1 Cost Basis for Domestic Wells

The basis for cost estimates for raising funds to mitigate domestic wells impacted by lowered groundwater levels is different than the cost basis for agricultural, industrial and municipal wells. The potential cost liability to mitigate impacted domestic wells will be based on the cost to drill and replace all the potentially impacted domestic and unknown wells in the analysis (173 plus 12 wells; 185 total wells). While the mitigation for many of these wells may ultimately involve less expensive measures (such as lowering a pump), the higher cost estimate will be used to ensure adequate funds are available in the worst-case scenario.

Per well costs for domestic well replacements were based on input from Self Help Enterprises (SHE) regarding their recent experience in mitigating wells.¹² A breakdown of these typical costs includes the following:

Table 4
Domestic Well Mitigation Costs (per Well)

Technical Support Labor	\$12,500
Well Drilling and Construction	\$60,000
Tank/Pump Installation	\$5,500
Hauled Interim Water (Assume 12 Months)	\$9,500
Bottled Water (Assume 12 Months)	\$400
Other	\$2,500
Total	\$90,400

Source: Self Help Enterprises, 2023

¹² Self Help Enterprises, 2023. Email correspondence with Emily McCaque, 12/7/23.



Multiplying the number of potentially impacted wells (185) by the per well mitigation cost estimate (\$90,400) results in a total potential domestic well cost liability of \$16,724,000¹³ (see Table 5).

Table 5
Potential Well Mitigation Costs

Well Type	Number of Potentially Impacted Wells	Mitigation Cost per Well	Total Cost
Domestic	185	\$90,400	\$16,724,000
Agricultural, Industrial and Municipal	72	\$20,000	\$1,440,000
Total			\$18,164,000

7.2 Cost Basis for Agricultural, Industrial, and Municipal Wells

The cost liability to be used as a basis for raising funds to mitigate impacted agricultural, industrial and municipal wells will be based on providing technical assistance to identify a suitable mitigation measure to restore water supply. For these well types, per the Tule Subbasin Mitigation Plan, funds will not be raised to mitigate these types of wells but rather provide technical assistance in finding a suitable mitigation solution. The per well cost estimate for these types of wells is \$20,000 and includes funds to investigate the claim and provide technical assistance to identify a mitigation solution. Multiplying the number of potentially impacted wells (72) by the per well mitigation cost estimate (\$20,000) results in a total potential agricultural, industrial and municipal well cost liability of \$1,440,000 (see Table 5).

7.3 Total Estimated Cost Liability for Mitigating Potentially Impacted Wells

As shown in Table 5, the total potential cost liability for mitigating all well types, in the worst-case scenario where groundwater levels are lowered to the MTs throughout the subbasin, is approximately \$18,164,000. The GSAs intend to raise these funds through the implementation of land-owner based fees, such as groundwater pumping allocations or other options. The fees are calculated on a per acre-ft basis as the total cost liability specific to each GSA divided by their respective planned groundwater pumping before 2040.

¹³ All costs presented in this section are relative to 2024 dollars.



7.4 Schedule for Funds

Self Help Enterprises has indicated that they have a 2024 backlog of impacted wells in the Tule Subbasin of 49 wells.¹⁴ The maximum number of well impact claims they have received in any given year was 38 (2015). While it is not known how many of these well impacts are associated with groundwater overdraft, conservatively it is feasible that the GSAs would need to have funds initially available for up to 38 wells (\$3,435,200) upon implementation of the updated Tule Subbasin Mitigation Plan. As GSP implementation proceeds through 2040, it is anticipated that the potential for impacted wells, and the associated funding requirements, will decrease. To be conservative, the GSAs have determined that impacts to more than 38 wells in any given year is the basis for undesirable results as any more than this would exceed the funding available to mitigate them (see Section 6 herein).

8 Stakeholder Engagement

Stakeholder engagement has been an integral part of the process to address DWR deficiencies and revise groundwater level SMC in the Tule Subbasin. This has included monthly presentations to GSA Boards and stakeholder committees and quarterly meetings of the Tule Subbasin Technical Advisory Committee, all of which were publicly noticed meetings held in accordance with the Brown Act. In addition to these meetings, the technical team noticed and conducted the following additional meetings:

- 12/5/23 - Meeting with NGO groups including Community Water Center, Self Help Enterprises, the Central California Environmental Justice Network, and The Leadership Council
- 12/7/23 – Meeting with SHE
- 1/23/23 - Meeting with NGO groups

The Tule Subbasin GSAs also met with SWRCB staff on a regular basis to present revised technical approaches to determining groundwater level SMCs and receive feedback. These meetings were held on:

- June 5, 2023
- August 8, 2023
- September 27, 2023
- November 8, 2023
- January 12, 2024
- March 13, 2024

¹⁴ Email correspondence with Self Help Enterprises July, 2024.



9 Summary and Conclusions

The analysis of Upper Aquifer groundwater level SMC presented herein has resulted in the following conclusions:

- The Tule Subbasin GSAs have identified the groundwater beneficial uses and users that could be impacted by lowered Upper Aquifer groundwater levels.
- The GSAs have collectively identified the significant and unreasonable groundwater level conditions they are working to avoid.
- The GSAs have developed a coordinated methodology for determining Upper Aquifer groundwater level MTs to avoid significant and unreasonable conditions.
- Throughout most of the Tule Subbasin, the revised MTs are higher than previously published in the 2022 GSPs and result in fewer potential well impacts from lowered groundwater levels.
- The Tule Subbasin GSAs have determined that raising the funds necessary to mitigate the wells potentially impacted at the coordinated minimum thresholds is feasible. This is supported by the fact that the GSAs intend to manage groundwater levels to the MOs, which should result in fewer impacts than accounted for in the fund-raising methodology.
- The scope of mitigating potentially impacted wells has been reviewed and coordinated with the NGOs in the area, including Community Water Center, Self Help Enterprises, the Central California Environmental Justice Network, and The Leadership Council.
- The GSAs have collectively identified an undesirable result for Upper Aquifer groundwater levels to ensure that sustainability planning and implementation is sufficient to avoid significant and unreasonable conditions.

