# Root Creek Water District
# Groundwater Sustainability Agency

# Groundwater Sustainability Annual Report
# (2015-2022)

March 2023

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# Abbreviations

AF .......... Acre-feet

AF/YR .......... Acre-feet per Year

District .......... Root Creek Water District

DWR .......... California Department of Water Resources

ET .......... Evapotranspiration

GIS .......... Geographical Information Systems

GSP .......... Groundwater Sustainability Plan

ITRC .......... Cal Poly Irrigation Training and Research Center

KDSA .......... Kenneth D. Schmidt and Associates

MID .......... Madera Irrigation District

MSL .......... Mean Sea Level

RCWD .......... Root Creek Water District

RCWDGSA .......... Root Creek Water District Groundwater Sustainability Agency

Subbasin .......... Madera Subbasin

USBR .......... United States Bureau of Reclamation

# Executive Summary

Annual reports are a part of the Sustainable Groundwater Management Act legislation, intended to provide updated groundwater condition data to monitor the progress of a groundwater basin toward their sustainability goals set in a Groundwater Sustainability Plan (GSP). This specific report covers groundwater conditions within the boundaries of Root Creek Water District Groundwater Sustainability Agency (RCWDGSA). This is the fourth annual report and specifically covers the 2022 year, but also includes summaries dating back to 2015. Therefore, this report also covers the period for 2015 through 2022. The RCWDGSA is located within the southeastern corner of the Madera Groundwater Subbasin along the banks of the San Joaquin River.
In size, the GSA accounts for less than 3 percent of the land area within the Madera Subbasin. Root Creek Water District (RCWD or District), which lies wholly within the GSA has contracted for surface water supplies from the Madera Irrigation District (MID) and the Wonderful Nut Orchards for up to 17,000 acre-feet (AF) of surface water in a given year and constructed infrastructure to allow for importation and delivery of surface supplies. The purchase and delivery of surface water supplies are crucial to the long-term groundwater sustainability of not only the District and the GSA but also the region and the subbasin.

From the data developed for this report, it is clear that the RCWD has made tremendous strides to becoming sustainable. This can be attributed to RCWD's financial and operational commitments to supporting conjunctive use and effective monitoring. Previous estimates were that 3,400 af/yr needed to be imported to provide the needed resources to address the District's contribution to overdraft in the southeast region of Madera County and the Madera groundwater subbasin. Since 2015, the District has averaged 2,028 af/yr of surface water imports and 1,300 af/yr in average annual agricultural reduction. This closely approximates the previously estimated need for imports to offset overdraft. More recently, estimates of groundwater outflow have been developed and since 2017, when the District began implementing its groundwater sustainability actions, groundwater outflow from the District due to pumping in the adjacent GSA is estimated to have increased by approximately 3,600 AF/yr.
The cost to develop the projects and purchase surface supplies have now totaled almost $15 million. In 2022, surface water supply imported to the RCWD amounted to $1,865,442.60.

# Chapter 1 – Introduction

The purpose of this report is to fulfill the requirements of the California Code of Regulations Article 7 Section 356.2 by providing an annual update on the current conditions of groundwater sustainability within the RCWDGSA. This document provides a brief summary of background information for RCWDGSA, updated data for the latest water year including groundwater elevations, contours, and extraction, surface water use, and total water use by water use sector. Water supply and groundwater data from the latest water year will span from Spring 2015 to Fall 2022. Lastly, progress towards sustainability will be analyzed by taking into consideration the most recent water year data along with any planned or implemented projects or management actions.

RCWDGSA is located in the southeast corner of the Madera Groundwater Subbasin as defined by the California Department of Water Resources (DWR) Bulletin 118 as Subbasin No. 5-22.06. It is also located fully within the boundaries of Madera County as shown on **Figure 1**. The Madera Subbasin is the southernmost subbasin in the San Joaquin Valley Basin, just north of the San Joaquin River. The Sierra Nevada foothills and three groundwater subbasins border the Madera Subbasin north of the San

Joaquin River, including the Merced, Chowchilla, and the Delta-Mendota Subbasins. The Kings Subbasin adjoins the Madera Subbasin south of the San Joaquin River.

RCWD covers 9,674 acres and is coterminous with RCWDGSA. Historically, RCWD has been almost exclusively agricultural land irrigated with surface water from the San Joaquin River and groundwater pumping. In 2014, an in-lieu pipeline was built to deliver surface water, when available, to the north side of RCWD. In 2017, construction began on a 2,000-acre community development on the northeast side of the District called Riverstone. At build out, Riverstone is projected to have commercial and retail zones, parks, and approximately 6,578 housing units on approximately 2,000 acres. Riverstone projects building approximately 300 homes per year until build out. This changes the landscape of water use within RCWD from agricultural groundwater pumping to conjunctive programs to serve the variety of water use sectors. Beneficial users within the RCWDGSA include growers, commercial users or industry, domestic users, and groundwater dependent ecosystems.
RCWD relies on a mixture of surface water and groundwater to meet the demands within the District. The majority of surface water in the subbasin, when available, is supplied from the Fresno and San Joaquin Rivers for agricultural use.

RCWD receives most of its surface water from the San Joaquin River via surface water contracts with the United States Bureau of Reclamation (USBR). Private landowners along the San Joaquin River divert surface water supplies from the San Joaquin River through contracts with the United States Bureau of Reclamation termed “Holding Contracts”. Those landowners actively exercise their holding contract rights, and the volume of water extracted is currently being estimated. More recently with the construction of the In-Lieu pipeline and execution of water supply contracts with Madera Irrigation District (MID), Wonderful, and the USBR for Section 215 water, when available, the District has annually been importing additional surface water supplies to lessen groundwater pumping.

The remaining agricultural water demand and all municipal water demand is supplied by groundwater. RCWDGSA plans to minimize the impact to groundwater levels by implementing strategies such as percolating treated wastewater effluent, using stormwater detention basins for recharge, and water conservation techniques.

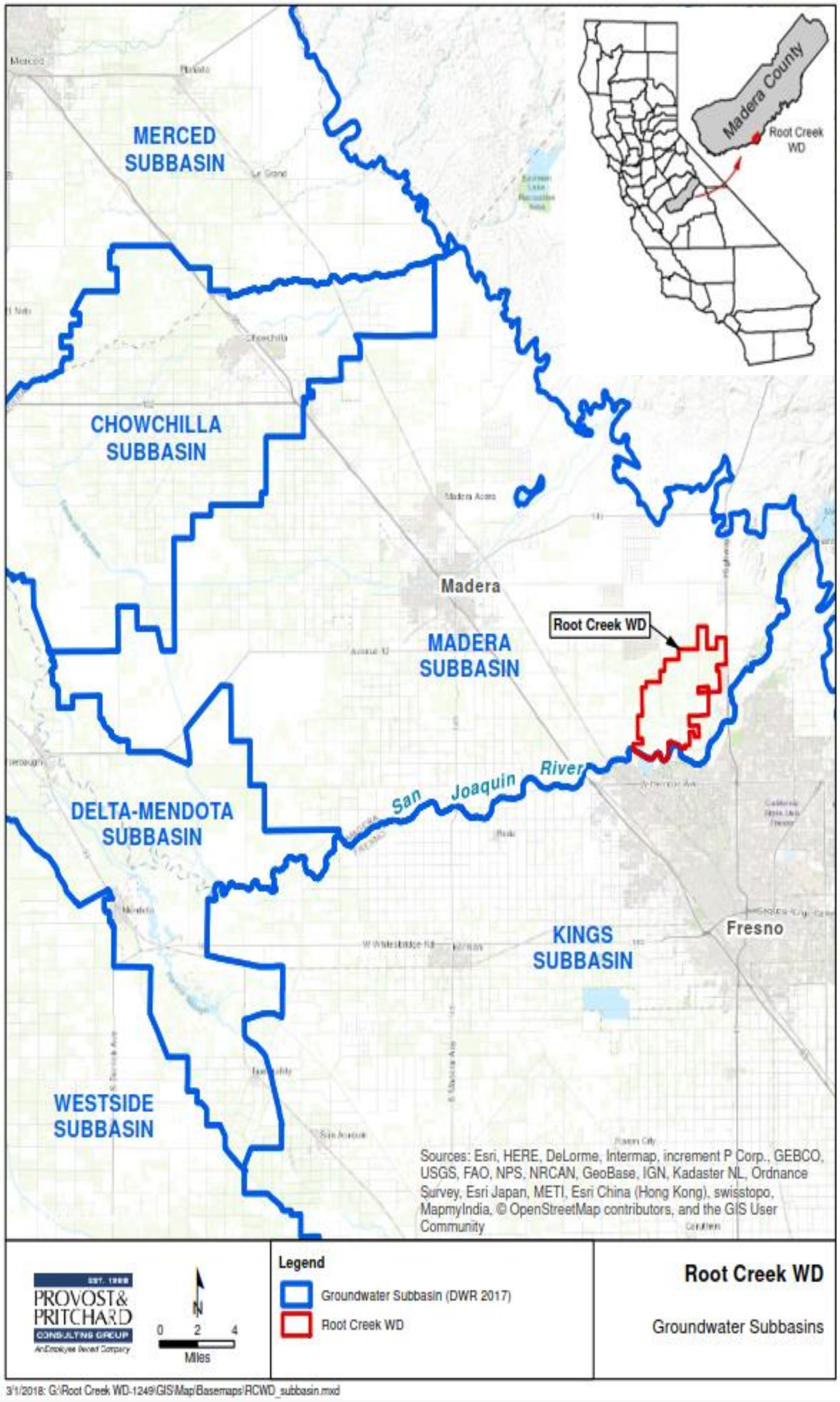


*Figure 1. Root Creek Water District Location Map*

# Chapter 2 – Conditions of the Root Creek Water District GSA

This chapter details the current conditions of RCWDGSA including updated information on land use categories, the various water use sectors, total water use, surface water use, groundwater extraction, groundwater levels, and groundwater storage change. The volume of total water use is largely dependent upon the land use categories, and water use sectors. Other factors influencing total water use include precipitation, evapotranspiration rates, groundwater outflow, water conservation strategies and property development. Groundwater extraction is dependent upon total water use and surface water supply available to fulfill demand. The change in groundwater storage is generally equal to the volume of groundwater extracted minus the volume of water that enters the groundwater system through recharge. Subsurface flow may be estimated using groundwater elevations. In 2022, Kenneth D. Schmidt and Associates (KDSA) estimated the change in groundwater outflow to the north of the District for two periods, Spring 2014 to Spring 2017 and Fall 2017 to Spring 2022. KDSA determined that there was an increase in outflow of approximately 3,600 AF/yr from Spring 2014 to Spring 2017 and Fall 2017 to Spring 2022. This analysis is further discussed in Chapter 3.

## Land Use Categories/Water Use Sectors

As mentioned, RCWDGSA is made up of agricultural, residential, and commercial land, the majority of which remains agricultural. According to a Geographic Information Systems (GIS) estimate, the RCWDGSA is approximately 9,674 acres after the annexation of about 355 acres in 2017. In 2014, approximately 8,474 acres of the District was covered by a crop as shown in **Table 1**. Since then, some land has been taken out of production and in 2017, construction on the Riverstone Development began. 2017 was the first year residents began living in the Riverstone Development and by the end of the year there were 100 homes connected to the water and sewer system. By the end of 2022, Riverstone Development has retired a cumulative total of about 1,600 acres of farmland and completed the construction of 1,301 houses, growing the residential and commercial water use sectors.

The Madera County Agricultural Commissioner provides annual data for cropping within the County and was used through 2019 for RCWD cropping patterns, presented in **Table 1.** From 2020 to present, the District performed its own crop review. The values shown in **Table 1** and depicted on **Figure 2** represent this new source of information. Agricultural land still makes up the majority of RCWDGSA reaching about 6,960 acres. This amount included the annexation of approximately 315 acres of developed agricultural land in 2017. There was a reduction in crop demand by about 19% from 2014 to 2022. Major crops include pistachios, almonds, and citrus.

*Table 1. RCWD Cropping from 2014 - 2022*

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|
| Crop | Acreage*** | | | | | | | | |
| Alfalfa | | | | | | 93.01 | 93.01 | 93 | |
| Almond | 1,740.20 | 2,133.20 | 2,143.20 | 2,133.70 | 2,394.90 | 2,369.20 | 2,364.90 | 2165.9 | 2,012.8 |
| Cherry | 8.5 | 8.5 | 8.5 | 9 | 10.5 | 10.5 | 10.5 | 10.4 | 10.5 |
| Citrus | 2,959.10 | 2,959.10 | 2,959.50 | 2,959.10 | 2,938.40 | 2,887.10 | 2,849.90 | 2,654 | 2,418.2 |
| Date | 1 | 1 | 1 | 1 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Grape | 383.5 | 261.5 | 261.5 | 219.5 | 218.2 | 220 | 220 | 196.9 | 196.9 |
| Nursery Plants | 22.4 | 22.4 | 22.4 | 22.4 | 15.8 | 13.9 | 13.9 | 13.6 | |
| Olive | 214 | 93 | 93 | 93 | 70 | 57.1 | 31.9 | 35.7 | 35.7 |
| Persimmon | 1 | 1 | 1 | 1 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 |
| Pistachio | 2,673.00 | 2,674.00 | 2,674.00 | 2,674.00 | 2,410.90 | 2,390.90 | 2,292.60 | 2,145.4 | 2,106.3 |
| Plum | 4.5 | 4.5 | 7.5 | 6.5 | 8.1 | 3.8 | 3.8 | 4.3 | 4.3 |
| Pomegranate | 6.5 | 6.5 | 6.5 | 7 | 6.9 | 6.9 | 6.9 | 8.3 | 8.3 |
| Wheat* | 460 | 118 | 100 | 100 | 104.2 | 100 | 100 | | 167.2 |
| **Summary Agriculture** | **8,473.70** | **8,282.70** | **8,278.10** | **8,226.20** | **8,179.40** | **8,060.80** | **7,895.80** | **7,235.90** | **6,961.60** |
| | | | | | | | | | |
| Uncultivated | 605.9 | 454.9 | 118.5 | 344.5 | 172.7 | 414.20 | 414 | 1,104.2 | 916.1 |
| Urban/Residential* | 3.6 | 3.6 | 3.6 | 3.6 | 127 | 254 | 400 | 411 | 505.7 |
| Other Non Ag** | 230.8 | 572.8 | 913.8 | 739.7 | 1,195.20 | 945.00 | 964.20 | 922.90 | 1,290.60 |
| **Summary Non-Ag** | **840.0** | **1,031.0** | **1,036.0** | **1,088.0** | **1,495.0** | **1,613.0** | **1,778.0** | **2,438.0** | **2,712.0** |
| | | | | | | | | | |
| **TOTAL** | **9,314.00** | **9,314.00** | **9,314.00** | **9,314.00** | **9,674.00** | **9,674.00** | **9,674.00** | **9,674.00** | **9,674.00** |

*Notes:*

**2014-2017 Estimated from DWR land use survey 2011, from Annual Review. % change is 2016-2020*
***Difference from the sum of the land use and the total area within the RCWD GIS boundary*
****Acreage values rounded to the nearest whole number*

*RCWD GIS boundary acreage corrected to aerial:* 9,314

*****RCWD GIS boundary acreage corrected to annexed areas in 2018:* 9,674

****** Ag land reduction from 2014 to 2022 approximately 19.0%*

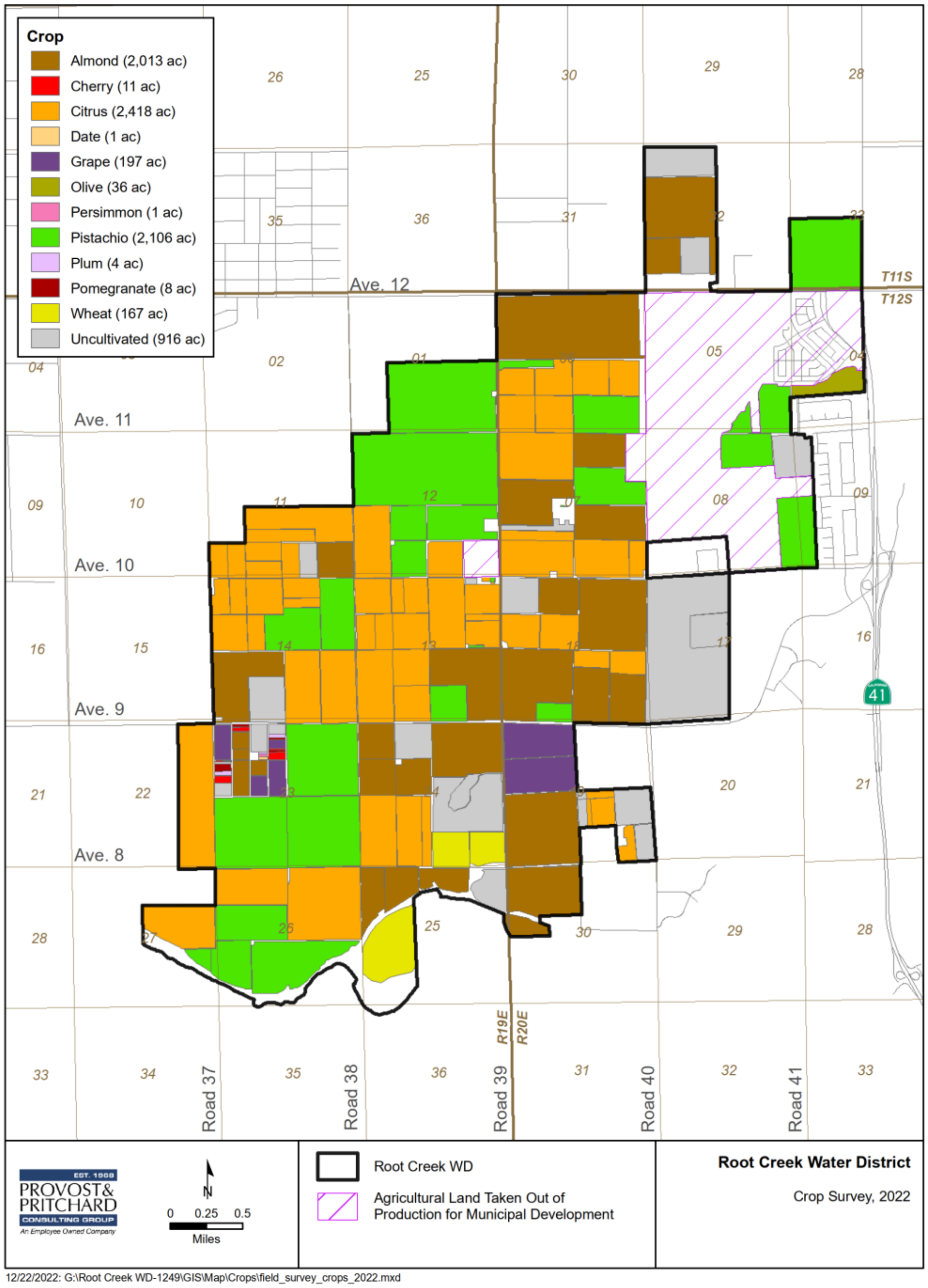


Figure 2. 2022 Agricultural Land Use in RCWD

## Total Water Use

Total water use within the RCWDGSA is composed of municipal, agricultural, and rural residential demand; however rural residential is minimal and can be considered negligible. As more farmland is taken out of production for the Riverstone development, agricultural water use declines and municipal demand grows. Total water use within RCWDGSA is decreasing since the measured municipal demand is less than the water demand of the land that has been taken out of agricultural production, as shown by the data presented in this section.

### Municipal

The municipal water demand in RCWDGSA is currently met solely by water produced with groundwater wells. Residential and commercial water use data was directly measured as the volume of water produced by the municipal wells. Since Riverstone is in the middle of development, new connections are being made monthly as homes, parks, and retail areas are being built. Subsequently, water used in association with these construction efforts, is also a significant source of water consumption. A summary of the water system connections and water use data is presented in **Table 2***.*

*Table 2 Summary of end of year Municipal Water Statistics for Riverstone from 2018 to 2022*

**Root Creek Water District**
Municipal Water Consumption
Summary

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Services:** | **2018** | | **2019** | | **2020** | | **2021** | | **2022** | |
| Residential Connections | 236 | | 436 | | 663 | | 945 | | 1301 | |
| Landscape Irrigation Connections | 19 | | 27 | | 39 | | 56 | | 59 | |
| Commercial Connections | 3 | | 4 | | 3 | | 15 | | 15 | |
| | | | | | | | | | | |
| **Water Deliveries:** | | | | | | | | | | |
| Total (AF) | 134.41 | AF | 213.38 | AF | 289.61 | AF | 389.19 | AF | 482.59 | AF |
| | | | | | | | | | | |
| **Wastewater:** | | | | | | | | | | |
| Treated and Recharged (AF) | 21.78 | AF | 46.25 | AF | 85.00 | AF | 118.59 | AF | 176.11 | AF |
| | | | | | | | | | | |
| Net Riverstone Use (af) | 112.63 | AF | 167.13 | AF | 204.61 | AF | 270.6 | AF | 306.48 | AF |

### Agricultural

Agricultural water use is measured wherever possible and many landowners have been installing meters in RCWDGSA. Prior to 2018, the District estimated total water use using cropping data from the Agricultural Commissioners Crop Survey, evapotranspiration (ET) data, and precipitation data. When needed, the District uses GIS-generated crop acreages and crop ET estimates developed by the Cal Poly Irrigation Training and Research Center (ITRC, see www.itrc.org) for "Irrigation District Water Balances" to estimate total water use. ITRC ET estimates vary based on water year type (wet, typical, or dry) and irrigation method. An irrigation method was assumed for each crop type as shown in **Table 3.**

*Table 3 Assumed Irrigation Methods for RCWDGSA (prior to 2018)*

| Crop | Presumed Irrigation Method |
|---|---|
| Almond | Drip/Micro |
| Cherry | Sprinkler |
| Citrus | Sprinkler |
| Date | Drip/Micro |
| Grape | Drip/Micro |
| Nursery Plants | Drip/Micro |
| Olive | Sprinkler |
| Persimmon | Sprinkler |
| Pistachio | Drip/Micro |
| Plum | Sprinkler |
| Pomegranate | Drip/Micro |
| Wheat | Surface |

The ITRC classifies the ET data by irrigation method, as well as water year type (wet, typical or dry). DWR classifies and publishes a hydrologic classification index each year for the San Joaquin Valley water year based on measured unimpaired runoff from the tributaries feeding the San Joaquin River. The DWR classifications are used to estimate ET values for the year where above normal and below normal equate to a typical year.

After ET data were compiled for each crop and water year, effective precipitation was accounted for. Effective precipitation was calculated for a hydrologically wet year, typical year, and dry year using the following set of equations:

Effective Precipitation
Nov – Feb = -0.54 + (0.94 x Gross Rainfall)
Mar = -1.07 + (0.837 x Gross Rainfall)
Oct = -0.06 + (0.635 x Gross Rainfall)

The calculated value of effective precipitation on an annual basis was subtracted from the ET values for the respective water year type to obtain the crop applied water demands shown in **Table 4**.

*Table 4. Crop Water Consumptive Use After Effective Precipitation- (Applied Water)- ($ET_{aw}$) for Crops in RCWDGSA*

| Crop | Water Year Type Wet (feet) | Typical (feet) | Dry (feet) |
|---|---|---|---|
| Almond | 2.72 | 3.07 | 3.06 |
| Cherry | 2.73 | 3.00 | 3.03 |
| Citrus | 2.48 | 3.02 | 2.85 |
| Date | 2.65 | 2.89 | 2.92 |
| Grape | 2.01 | 2.10 | 2.11 |
| Nursery Plants | 2.65 | 2.89 | 2.92 |
| Olive | 2.80 | 3.03 | 3.00 |
| Persimmon | 2.73 | 3.00 | 3.03 |
| Pistachio | 2.69 | 2.77 | 2.75 |
| Plum | 2.73 | 3.00 | 3.03 |
| Pomegranate | 2.65 | 2.89 | 2.92 |
| Wheat | 0.85 | 1.35 | 1.07 |

Notes: No data in ITRC tables for "Typical year" for pistachios. However, for other crops, Typical is about 1% more than a Dry year.

Finally, the annual crop water demands, in feet, were multiplied by the acres of the respective crop type to estimate total applied water demand in acre-feet (AF), shown in **Table 5**. The total applied water demand for the agricultural sector in 2022 was approximately 19,600 AF for RCWDGSA

In 2018, the District adopted a policy that mandates that as wells are modified and replaced, meters will be required. This policy will improve the water use estimates.

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*Table 5. Applied Crop Water Use for the RCWDGSA from 2015 to 2022*

| | 2015 Critical | | | 2016 Dry | | | 2017 Wet | | | 2018 Below Normal | | | 2019 Wet | | | 2020 Dry | | | 2021 Dry | | | 2022 Dry | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Crop** | Acres | Etc | Estimated demand | Acres | Etc | Estimated demand | Acres | Etc | Estimated demand | Acres | Etc | Estimated demand | Acres | Etc | Estimated demand | Acres | Etc | Estimated demand | Acres | Etc | Estimated | Acres | Etc | Estimated |
| **Almond** | 2133.2 | 3.06 | 6527.59 | 2143 | 3.06 | 6557.58 | 2134 | 2.72 | 5804.48 | 2395 | 2.82 | 6753.90 | 2334 | 2.72 | 6348.48 | 2365 | 3.06 | 7236.90 | 2165.9 | 3.06 | 6627.65 | 2012.8 | 3.06 | 6159.17 |
| **Cherry** | 8.5 | 3.03 | 25.76 | 9 | 3.03 | 27.27 | 9 | 2.73 | 24.57 | 11 | 2.74 | 30.14 | 10 | 2.73 | 27.30 | 11 | 3.03 | 33.33 | 10.4 | 3.03 | 31.51 | 10.5 | 3.03 | 31.82 |
| **Citrus** | 2959.1 | 2.85 | 8433.44 | 2960 | 2.85 | 8436.00 | 2959 | 2.48 | 7338.32 | 2938 | 2.77 | 8138.26 | 2887 | 2.48 | 7159.76 | 2850 | 2.85 | 8122.50 | 2654 | 2.85 | 7563.90 | 2418.2 | 2.85 | 6891.87 |
| **Date** | 1 | 2.92 | 2.92 | 1 | 2.92 | 2.92 | 1 | 2.65 | 2.65 | 1 | 2.50 | 2.50 | 1 | 2.65 | 2.65 | 1 | 2.92 | 2.92 | 0.7 | 2.92 | 2.04 | 0.7 | 2.92 | 2.04 |
| **Grape** | 261.5 | 2.11 | 551.77 | 262 | 2.11 | 552.82 | 220 | 2.01 | 442.20 | 218 | 1.86 | 405.48 | 220 | 2.01 | 442.20 | 220 | 2.11 | 464.20 | 196.9 | 2.11 | 415.46 | 196.9 | 2.11 | 415.46 |
| **Nursery Plants** | 22.4 | 2.92 | 65.41 | 22 | 2.92 | 64.24 | 22 | 2.65 | 58.30 | 16 | 2.64 | 42.24 | 14 | 2.65 | 37.10 | 14 | 2.92 | 40.88 | 13.6 | 2.92 | 39.71 | | | |
| **Olive** | 93 | 3.00 | 279 | 93 | 3.00 | 279 | 93 | 2.80 | 260.4 | 70 | 0.67 | 46.9 | 57 | 2.80 | 159.6 | 32 | 3.00 | 96 | 35.7 | 3.00 | 107.1 | 35.7 | 3.00 | 107.1 |
| **Persimmon** | 1 | 3.03 | 3.03 | 1 | 3.03 | 3.03 | 1 | 2.73 | 2.73 | 1 | 2.64 | 2.64 | 1 | 2.73 | 2.73 | 1 | 3.03 | 3.03 | 0.7 | 3.03 | 2.12 | 0.7 | 3.03 | 2.12 |
| **Pistachio** | 2674 | 2.75 | 7353.5 | 2674 | 2.75 | 7353.5 | 2674 | 2.69 | 7193.06 | 2411 | 2.47 | 5955.17 | 2217 | 2.69 | 5963.73 | 2292 | 2.75 | 6303 | 2145.4 | 2.75 | 5899.85 | 2106.3 | 2.75 | 5792.325 |
| **Plum** | 4.5 | 3.03 | 13.64 | 8 | 3.03 | 24.24 | 7 | 2.73 | 19.11 | 8 | 2.64 | 21.12 | 4 | 2.73 | 10.92 | 4 | 3.03 | 12.12 | 4.3 | 3.03 | 13.03 | 4.3 | 3.03 | 13.03 |
| **Pomegranate** | 6.5 | 2.92 | 18.98 | 7 | 2.92 | 20.44 | 7 | 2.65 | 18.55 | 7 | 2.64 | 18.48 | 7 | 2.65 | 18.55 | 7 | 2.92 | 20.44 | 8.3 | 2.92 | 24.236 | 8.3 | 2.92 | 24.236 |
| **Wheat** | 118 | 1.07 | 126.26 | 100 | 1.07 | 107.00 | 100 | 0.85 | 85.00 | 104 | 0.03 | 3.12 | 100 | 0.85 | 85.00 | 100 | 1.07 | 107.00 | 118 | 1.07 | 126.26 | 167.2 | 1.07 | 178.90 |
| **Alfalfa** | | | | | | | | | | | | | | | | 93 | 3.00 | 279 | 93 | 3.00 | 279 | | | |
| | 8283 | | 23401 | 8280 | | 23428 | 8227 | | 21249 | 8180 | | 21420 | 7852 | | 20258 | 7990 | | 22721 | 7447 | | 21132 | 6962 | | 19618 |

*Crop demands includes computation including in the holding contract.

## Surface Water

### Lateral 6.2

RCWD completed the construction of an in-lieu pipeline in 2014 to serve surface water to the Northern part of the district with a service area of approximately 2,500 acres. Imported surface water supplies brought into RCWD is directed through the MID Lateral 6.2 which distributes water from the Madera Canal and ultimately the San Joaquin River. As mentioned, RCWD has surface water contracts with MID, Wonderful, and the USBR. The contract with MID allows RCWD to buy excess surface water at a contracted price, while the surface water from the contract with Wonderful is always available at a higher cost. The contract with USBR only allows RCWD to purchase section 215 flow which is classified as flood flow, and only occurs once every few years on average. In 2022, RCWD purchased 900 AF of surface water from Wonderful. **Table 6** shows the amount of water into the District as measured at the turnout on MID Lateral 6.2. Included as

**Table** 7 is District purchased or contracted surface water lost or percolated in the canal system included within the County GSA area that the RCWD has intentionally recharged.

*Table 6. Surface Water Supply through Lateral 6.2 for RCWD from 2015-2022*

| Year | Agricultural Use *(AF)* | Municipal Use *(AF)* | Intentional Recharge *(AF)* | Total *(AF)* | Five Year Average *(AF)* | Average (AF) |
|---|---|---|---|---|---|---|
| **2014** | 502 | - | - | 502 | | 502 |
| **2015** | - | - | - | - | | 251 |
| **2016** | - | - | - | - | | 167 |
| **2017** | 6,636 | - | 178 | 6,814 | | 1,734 |
| **2018** | 1,361 | - | - | 1,361 | 1,735 | 1,670 |
| **2019** | 7,607 | - | 601 | 8,208 | 3,277 | 2,684 |
| **2020** | 0 | - | 0 | 0 | 3,277 | 2,301 |
| **2021** | 1,250 | - | 0 | 1,250 | 3,371 | 2,170 |
| **2022** | 900 | - | 0 | 900 | 2,344 | 2,028 |

Surface water diverted for Root Creek Water District also is intentionally recharged outside of the Root Creek Water District GSA boundary. The surface water is recharged within the neighboring Madera County GSA. Unlike RCWDGSA which has access to both surface water and groundwater, Madera County GSA relies only on groundwater. Therefore, supporting Madera County GSA's groundwater storage through recharge benefits RCWDGSA indirectly by reducing the groundwater outflow. Approximately 3% of surface water diverted for RCWDGSA is estimated to recharge Madera County GSA groundwater.

Table 7 outlines the District's surface water volume that is recharged within Madera County GSA's boundary annually associated with delivery of surface water to the District.

*Table 7. Root Creek Surface Water Recharged in Madera County GSA*

| Year | Recharged Amt (AF) |
|---|---|
| 2014 | 15 |
| 2015 | 0 |
| 2016 | 0 |
| 2017 | 199 |
| 2018 | 41 |
| 2019 | 228 |
| 2020 | 0 |
| 2021 | 34 |
| 2022 | 27 |
| **TOTAL** | **544** |

### San Joaquin River

The RCWD does not directly divert surface water from the San Joaquin River. However, a number of other landowners adjacent to the river entered into holding contracts with the United States Bureau of Reclamation for diversion of surface supplies in place of their right to pump. Those landowners actively exercise their holding contract rights, but these supplies are currently not measured in their totality and estimates of the total diversions are found in **Table 9**.

## Change in Water Budget - Riverstone

Total water use in RCWDGSA is changing on an annual basis due to the land use conversion of farmland to residential development in the Riverstone Development area. As mentioned, at build out, Riverstone will consist of approximately 2,000 acres of residential space including houses, parks, and commercial zones. Municipal water use is generally lower than agricultural water use on a per acre basis. Furthermore, municipal wastewater is treated, and a portion of this water then reenters the groundwater system through percolation ponds. **Table 8** documents the estimated change to the water budget for Riverstone based on actual municipal demand and estimated agricultural reduction in demand from fallowed land.

*Table 8. Water Use Changes for Riverstone*

| | Reclaimed Water | | Change in Land Use | | | | | Change in Water Budget |
|---|---|---|---|---|---|---|---|---|
| Year | **Ponds** | **Reuse** | **Irrigated Lands** | **Fallowed Land** | **Change in Irrigation Demand** | **Municipal Area** | **Municipal Demand** | *(AF)* |
| | *(AF)* | *(AF)* | *(acres)* | *(acres)* | *(AF)* | *(acres)* | *(AF)* | |
| **2014** | - | - | 1,885 | 1 | (27) | - | - | (27) |
| **2015** | - | - | 1,798 | 88 | (252) | - | - | (252) |
| **2016** | - | - | 1,638 | 248 | (562) | - | - | (562) |
| **2017** | 1 | - | 1,538 | 348 | (936) | 30 | 70 | (867) |
| **2018** | 22 | - | 1,490 | 396 | (1,115) | 82 | 186 | (951) |
| **2019** | 46 | - | 1,421 | 465 | (1,288) | 254 | 238 | (1,096) |
| **2020** | 85 | - | 1,176 | 510 | (1,412) | 400 | 290 | (1,208) |
| **2021** | 119 | - | 1,176 | 690 | (1,910) | 411 | 389 | (1,640) |
| **2022** | 176 | - | 557 | 1,074 | (3,854) | 431 | 483 | (3,547) |

Approximately 315 acres annexed into the RCWD and Riverstone Development in 2018

## Groundwater Extraction

Groundwater extraction for RCWDGSA is estimated by the total applied water demand minus the volume of water supplied by surface water sources. Water demand and surface water supply have been discussed separately in the preceding sections (see Table 2, Table 5, and Table 6). **Table 9** presents water demand, surface water supply, and groundwater extraction by water use sector for the years 2015 to 2022. This table includes the volume of surface water used for intentional recharge. Groundwater extraction is the sum of both agricultural and municipal groundwater use. Groundwater extraction for agricultural use is estimated by taking the difference of crop consumptive use after effective precipitation and total surface water use.

*Table 9. Groundwater Extraction in RCWDGSA from 2015 to 2022*

| Water Year | Water Demand (AF) | | | Surface Water Use (AF) | | | | Groundwater Extraction (AF) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Crop Demand Estimate[1] | Actual Municipal Demand[2] | Total | Agricultural In-Lieu | | Reclaimed Water[5] | Total[6] | Agricultural | Municipal | Total |
| | | | | Lateral 6.2[3] | San Joaquin River – Holding Contracts[4] | | | | | |
| 2015 | 23,401 | 0 | 23,401 | 0 | 5,802 | | 5,802 | 17,599 | 0 | 17,599 |
| 2016 | 23,423 | 0 | 23,423 | 0 | 5,802 | | 5,802 | 17,621 | 0 | 17,621 |
| 2017 | 21,247 | 70 | 21,317 | 6,814 | 5,802 | 1 | 12,617 | 8,631 | 70 | 8,701 |
| 2018 | 21,418 | 186 | 21,604 | 1,361 | 5,802 | 22 | 7,185 | 14,255 | 186 | 14,441 |
| 2019 | 20,604 | 238 | 20,842 | 8,208 | 5,802 | 46 | 14,056 | 6,594 | 238 | 6,832 |
| 2020 | 21,039 | 290 | 21,329 | 0 | 5,802 | 85 | 5,887 | 15,237 | 290 | 15,527 |
| 2021 | 19,571 | 390 | 19,961 | 1,250 | 6,072 | 119 | 7,441 | 12,639 | 390 | 13,029 |
| 2022 | 19,618 | 483 | 20,101 | 900 | 6,072 | 176 | 7,148 | 12,470 | 483 | 12,953 |
| Average | 21,290 | 207 | 21,497 | 2,317 | 5,870 | 449 | 8,242 | 13,131 | 207 | 13,338 |

Note 1) Values from Table 5
Note 2) Values from Table 2
Note 3) Values from Table 6
Note 4) Values calculated from cropping with Holding Contracts
Note 5) Values from Table 2
Note 6) Numbers changed from 2019 Annual Report to reflect San Joaquin River diversions – Numbers are estimated

Water demand for agricultural use from groundwater pumping was estimated as discussed previously and has an approximate accuracy of about ±20%. Municipal water use was directly measured by electromagnetic flow meters at each of the wells and have an accuracy of about ±0.5%. Lastly, surface water deliveries were measured by propeller flow meter at the diversion point into RCWD on Lateral 6.2 and has an associated accuracy of about ±2% and estimates of supply from the San Joaquin River are thought to be similar to the estimates of agricultural demand at ±20%.

# Chapter 3- Groundwater Conditions

## Department of Water Resources Airborne Electromagnetic (AEM) Surveys

To improve the understanding of aquifer structures in California's high and medium-priority groundwater basins, the Department of Water Resources is conducting helicopter airborne electromagnetic (AEM) surveys. Data from the resulting surveys will be used to develop and refine hydrogeologic conceptual models, identify areas for potential groundwater recharge basins, and to assist in SGMA implementation. Preliminary data were made available to the public in 2022 and can be viewed in **Appendix B.** The maps were modified to show the RCWD boundary.

## Groundwater Outflow

Quantification of inflows and outflows is an on-going effort for estimating the average annual overdraft in the District and to maintain District sustainability. Prior to major development, groundwater in the subbasin flowed from the northeast to the southwest. In recent years, steepening declines in groundwater elevation towards the northern edge of the District has caused a north to northwesterly groundwater outflow direction. This outflow is influenced by activities adjacent to the District. To better quantify the outflow to the north leaving the District, Kenneth D. Schmidt and Associates (KDSA) estimated average transmissivity in the north part of the District to evaluate the acre-feet per year outflow. The following is a summary of recent calculations by Dr. Schmidt.

An average transmissivity value of 77,000 gallons per day per foot was determined by analyzing data from several pump tests in the area. Using the average transmissivity value and average hydraulic gradients near the north edge of the District, an estimated outflow to the north was determined for the periods of Spring 2014 to Spring 2017 and Fall 2017 to Spring 2022. The results of the evaluation are summarized in **Table 10**.

*Table 10. Change in Groundwater Outflow from RCWD to the North*

| Period | Hydraulic Gradient [Ft/Mile] | Outflow [Acre-Feet/Year] |
|---|---|---|
| Spring 2014 – Spring 2017 | 42 | 15,200 |
| Fall 2017 – Spring 2022 | 52 | 18,800 |
| | **Change in Outflow** | **3,600** |

Since Riverstone Development began construction in 2017, agricultural land decreased about 1,300 acres (**Table 1**). Despite this reduction in demand, the groundwater water levels are influenced by activities adjacent to the District. These activities include agricultural pumping, which tends to have a large effect on water levels. This pumping can change the water slope within an aquifer, which is evidenced in the District. Even with the influence of the surrounding area on the aquifer, the District is trending towards sustainability with the actions it is taking.

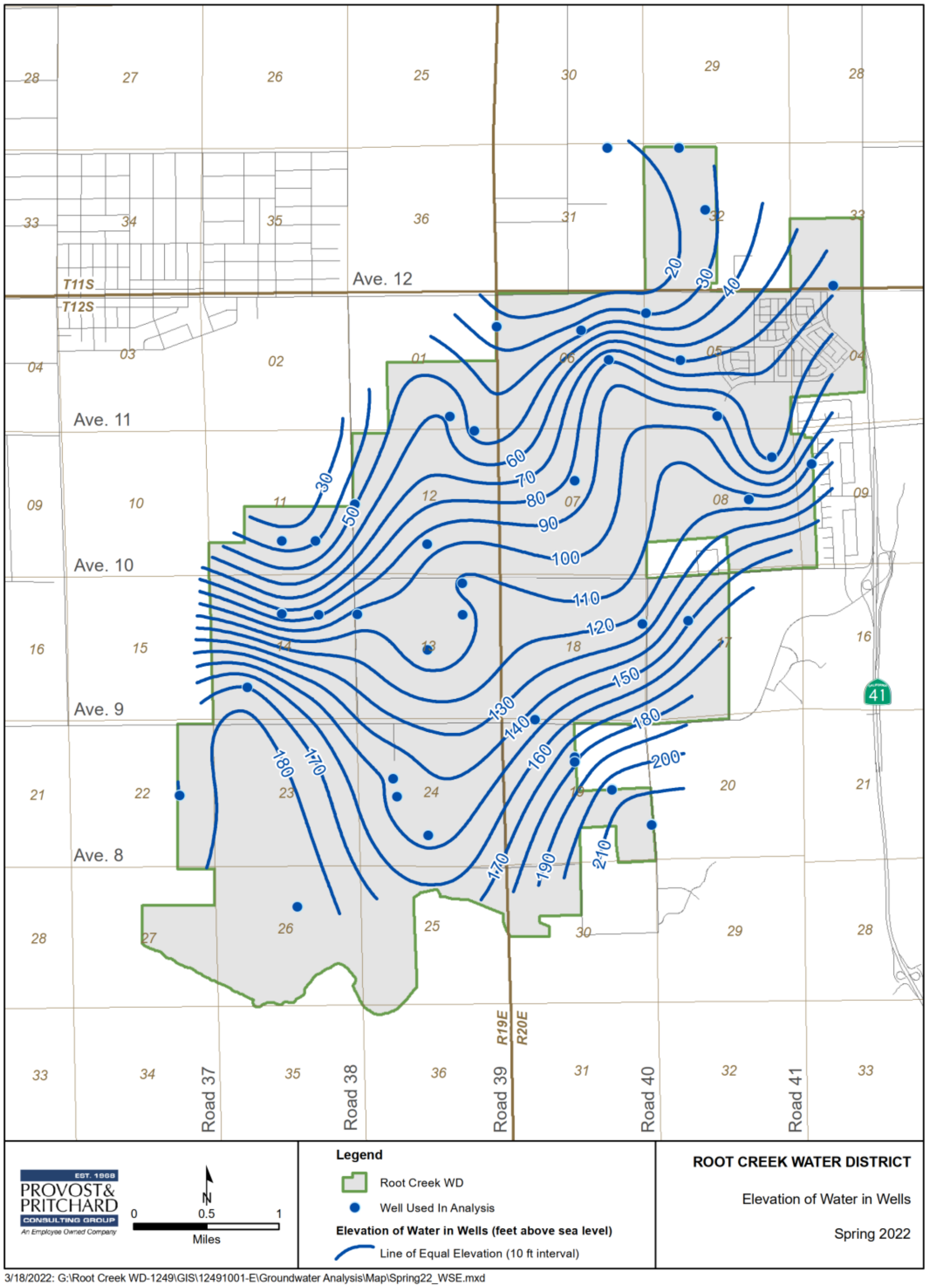


*Figure 3. Groundwater Elevation Contours for RCWDGSA - Spring 2022*

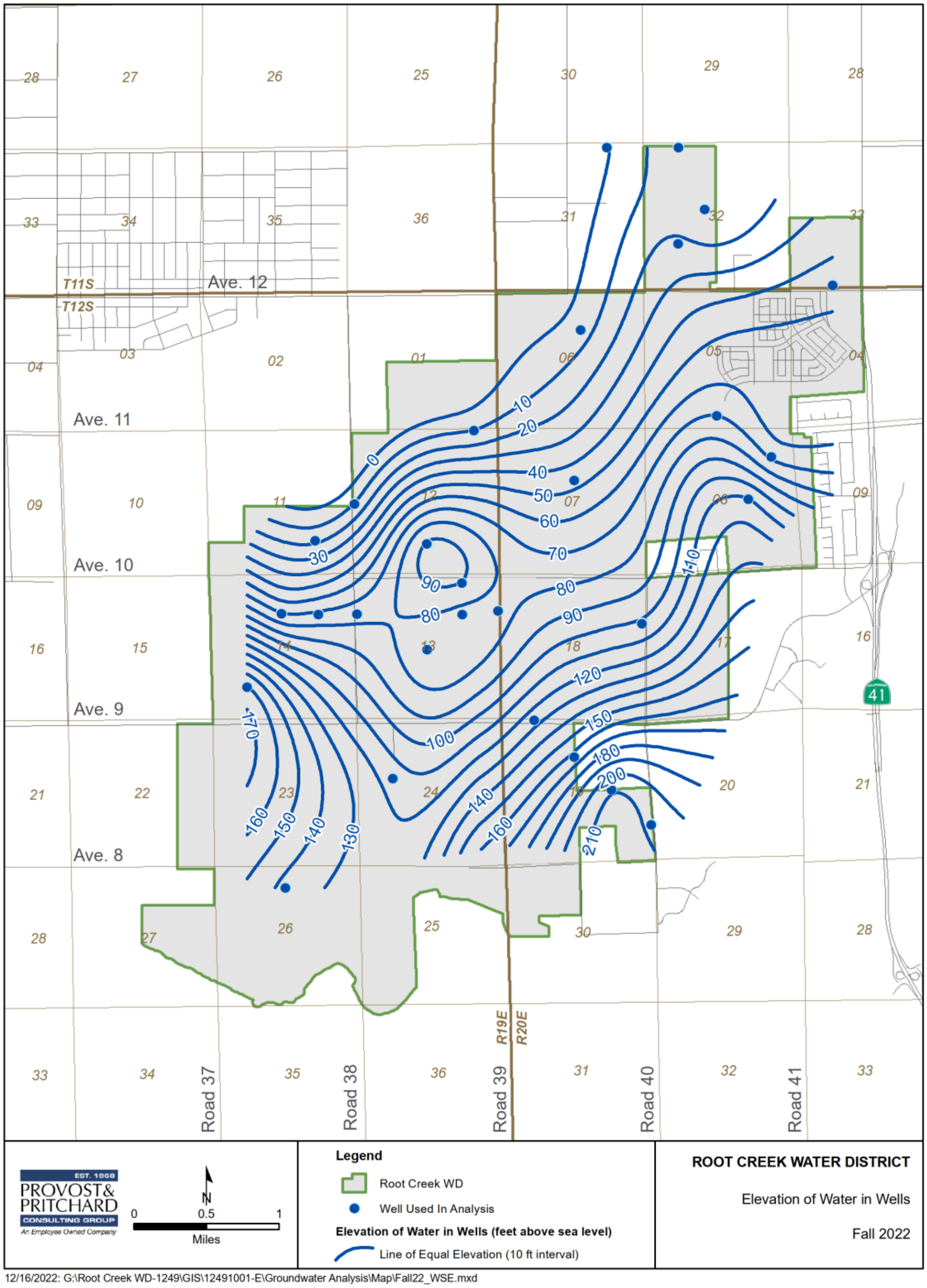


*Figure 4. Groundwater Elevation Contours for RCWDGSA - Fall 2022*

# Chapter 4 – GSP Progress Towards Implementation

In October 2020, the RCWDGSA submitted its GSP. Successful implementation of the GSP over the implementation period (2020-2040) will require ongoing sustainable management by the GSA as well as cooperation and enactment of projects and management actions by the other GSA's within the basin. The District could achieve all of its projects and management actions. However, if the other GSA's in the Subbasin aren't able to meet their objectives, overdraft could still be realized within the District boundaries due to subsurface outflow. Data from the current water year are presented in this Progress Towards Implementation to show that the RCWDGSA is trending towards sustainability. Meaning that the District has enacted many of the projects and management actions, resulting in almost 5,700 af of demand reduction in 2022. Prior to 2014 the average water level change was a drop of about 3.5 ft/yr has been reduced to about 1.0 ft/yr. For example, the Fall 2021 level measurement at the RMS well in the Madera Basin Joint GSP, located northwest and outside of the Root Creek WD GSP, compared to the 2025 Interim Milestone is 65.1 feet deeper than anticipated with four years to go, thus providing evidence that the balance of the Subbasin isn't making progress towards sustainability and achieving their project and management actions.

## Basin Coordination

The GSAs that collectively represent the entire Subbasin have been meeting since the passage of the Sustainability Groundwater Management Act (SGMA) in 2014. GSAs must work together to maintain the viability of the aquifers beneath the Subbasin. To that end, the Subbasin has made progress towards basin-wide coordination by providing annual report updates on current groundwater conditions and how they relate to sustainability within the Subbasin. The Subbasin's GSAs also coordinated on project identification and sustainable groundwater management implementation grant development in 2022 and are in the process of completing the projects that are covered under the funding award with DWR.

The GSAs of the Madera Subbasin are also in the process of coordinating on GSP updates in response to DWR's determination that the Basin's GSPs were incomplete and could benefit from improvements. Much of DWR's comments requested increased coordination among the various GSAs on methodologies and reporting.

## Projects and Management Actions

The Madera Subbasin has been identified by DWR as being "Critically Overdrafted." In order to eliminate systematic overdraft within the RCWDGSA, the District has continued to operate and implement the projects and management actions in the GSP that balance average annual groundwater withdrawals with average annual groundwater recharge. The most impactful effort has been the use of surface water in place of groundwater when available. RCWD is contributing to the Subbasin overall balance and sustainability by importing surface water when available. In addition to successful implementation of management actions, the Madera Subbasin and RCWDGSA have made progress towards various projects since the last Annual Report which are further discussed below.

### Completed Project (2022): Storm Basin Modification Project

Reshaped and dredged three existing basins within the RCWD boundary to increase percolation. The three basins are sourced by Riverstone discharges. No recharge volumes are currently tracked. **Figure 5** shows an aerial image of this project.

*Figure 5 Aerial Imagery of Storm Basin Modification Project*

### Future Project (Late 2023): Agriculture System Expansion/In-Lieu Recharge Project

This project was awarded funding by the Round 1 Sustainable Groundwater Management Implementation grant submitted by the Madera Subbasin. The project includes incorporation of a 2-mile pipeline to increase in-lieu recharge of approximately 1,800 AF/yr and an additional diversion of 275 AF/yr for groundwater recharge. The in-lieu pipeline was built in 2014 to increase the ability of the RCWD to implement conjunctive use in wet years. Furthermore, the tiered pricing structure for groundwater pumping, set by the Board of Directors in December 2020, at $95/AF plus approximately $140/AF in energy costs for a total of about $235/af total compared to surface water cost at $138/AF will encourage growers to use surface water when available**.** Over the past nine years the District has imported 19,035 AF of surface water. This relates to an average annual import of 3,371 AF since 2017. The conversion of agricultural land to municipal uses is occurring and contributes as of this date about 1,631 AF reduction in groundwater pumping since construction began in 2017 (**Table 5**). **Table 11** includes the associated costs with the projects and management actions taken by the District. **Figure 6** shows the existing conveyance pipelines and distribution facilities within the District.

*Table 11. Associated Costs*

| Year | Capital Cost | Water Purchase | Note |
|---|---|---|---|
| 2002-2013 | 650,000 | | MID Contract |
| 2006-2017 | 1,122,822 | 2,182,571 | Westside Mutual Contract |
| 2014 | 5,376,008 | | In-Lieu Pipeline |
| 2015 | | | |
| 2016 | | | |
| 2017 | | 923,060 | Water Purchases |
| 2018 | | 793,360 | Water Purchases |
| 2019 | | 2,544,750 | Water Purchases |
| 2020 | | 100,000 | Water Purchases |
| 2021 | | 1,380,247 | Water Purchases |
| 2022 | | 1,865,442 | Water Purchases |
| **TOTALS** | **$ 7,148,830** | **$ 9,789,430** | |

### Future Project (as of 2023 Revised GSP): Well Mitigation Program

To address any potential Undesirable Results, a domestic well mitigation program will be adopted and implemented. The program will be modelled after the draft domestic well mitigation program for the Madera Subbasin found in Appendix 3.D of the Madera Subbasin Joint GSP. The program objectives are based on results of the Madera Subbasin groundwater model for the 2020-2040 implementation period and subsequent 50-year sustainability period. The program will replace wells that are impacted by falling groundwater levels over the GSP implementation timeline. Well owners will be required to sign up for the program and mitigation actions may include replacing or lowering existing wells, and in cases where feasible, connecting groups of wells to a community water system, or development of public water systems to serve the impacted community. The program would be funded by fees and external support including grants and low interest loans. For the Madera Subbasin, the majority of wells potentially impacted are domestic wells but also include small community wells.

Currently, there are only six domestic wells located within the RCWD area. Consequently, impacts to domestic wells would not be significant, and, therefore, the financial burden to RCWD GSA would not be large to implement the program[1]. While there are a large number of agricultural wells in the RCWD area, these wells tend to be deeper and are not expected to be affected or go dry. In addition, the RCWD area is planned to be developed into residential neighborhoods in the long-term, therefore domestic wells located within the RCWDGSA will eventually be converted to a municipal system. This program will be implemented over the next 50 years.

### Future Project (as of 2023 Revised GSP): Monitoring Well Program – Interconnected Surface Water

[1] The cost of well replacement is based off the estimate provided in the Madera Subbasin Joint GSP. $25,000 for replacement x 6 domestic wells = $150,000.

The Monitoring Well Program will be designed to monitor the interconnectivity of surface water and groundwater. This Program will involve the construction of two nested monitoring well sites. The location are yet to be determined but are expected to include a site near the river and another at a distance from the river outside the Holding Contract area. These wells will include data loggers to assist with filling the data gap of interconnected surface water. The addition of these new monitoring wells will added to the RMS.

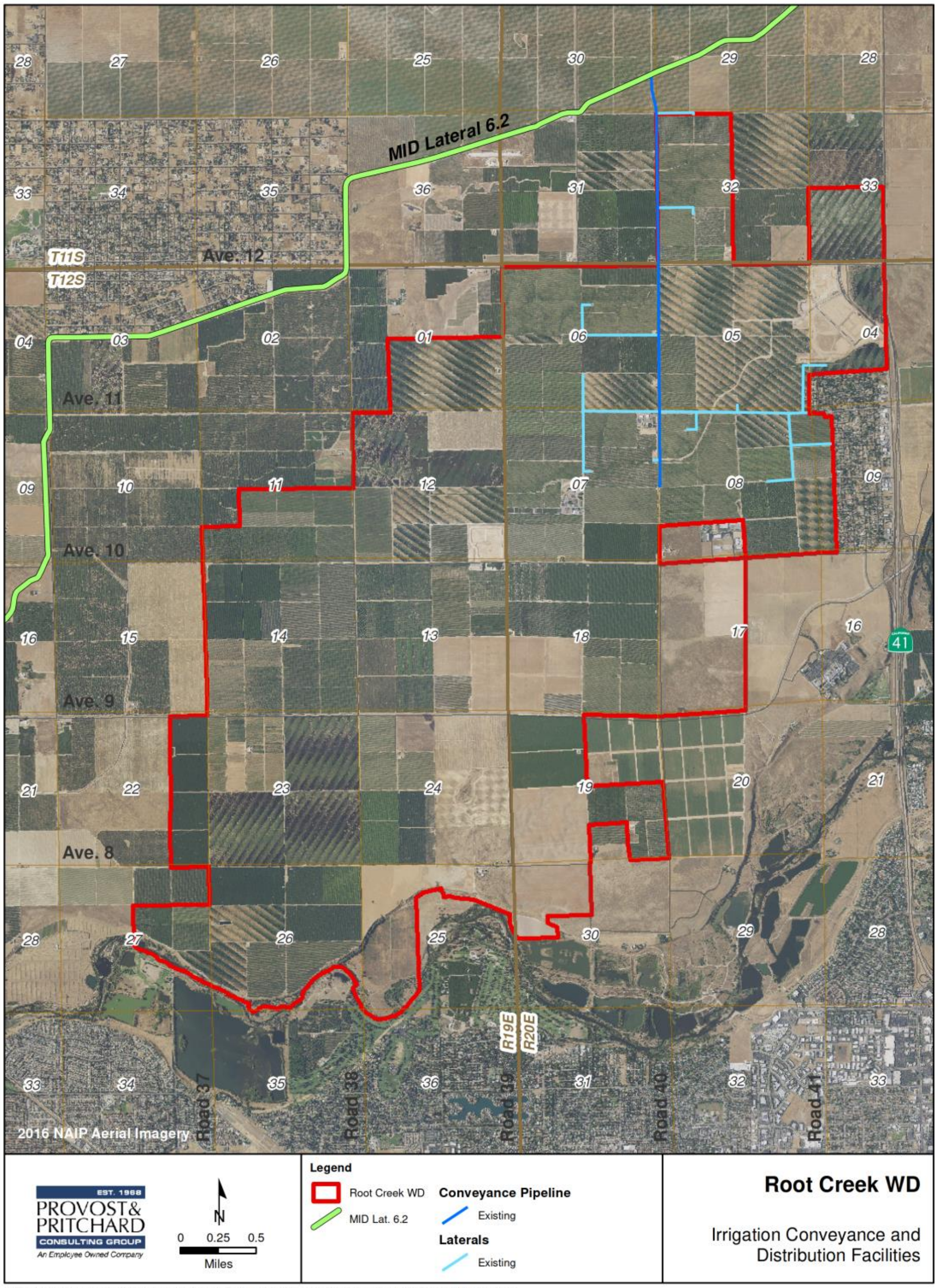


*Figure 6 RCWD Conveyance and Distribution Facilities*

## DWR Determination

DWR made the determination that the Madera Subbasin GSPs were incomplete in September 2022, prompting the 180-day response period. The 180-day response period allows basins to respond to DWR's comments and make updates to their GSPs. DWR's determination letter for the Madera Subbasin encouraged increased coordination on methodology and messaging amongst the GSAs. As a result, the consulting groups of the Subbasin have developed an ad-hoc group to identify actionable improvements to the methodology and reporting coordination. The Subbasin GSAs will continue to update their respective GSPs and meet to ensure collaboration is effective through March 2023, when the revised GSPs must be resubmitted to DWR.

## Sustainable Management Criteria

This report is used to demonstrate progress towards achieving interim milestones and measurable objectives described in the RCWDGSA GSP.

### Groundwater Levels

Seasonal groundwater elevation contour maps for the 2022 calendar year are presented as

**Figure** 3 and **Figure 4**. Historical groundwater contour maps for Spring 2015 – Spring 2021 are shown in **Appendix A**. Generally, groundwater flow continues to trend away from the San Joaquin River, flowing in the northerly direction with a slight westerly component. A further evaluation of groundwater outflow to the north is provided in the Groundwater Conditions section. Groundwater elevations in the RCWDGSA ranged from 220 feet to 30 feet above mean sea level (msl) in Spring 2022 and from 210 to 5 feet above msl in Fall 2022. The difference in groundwater elevations between the seasons is due to groundwater pumping during the summer months to irrigate crops.

The wells being monitored for sustainable management criteria have remained the same as in the RCWDGSA GSP. There are six wells total, located throughout the area as shown in **Figure 8.** The hydrographs associated with each of the representative monitoring wells are presented as **Figure 9** through **Figure 14**. The hydrographs include historical groundwater elevation trends along with recent data compared to the interim milestones, measurable objectives, and minimum thresholds set by RCWDGSA. The most recent groundwater elevation data for the representative monitoring wells is presented in Table 12 along with the minimum thresholds and measurable objectives.

*Table 12. 2022 Fall Groundwater Surface Elevation Compared to Sustainability Management Criteria*

| | Well | Spring 2022 | Fall 2022 | Minimum Threshold | Measurable Objective |
|---|---|---|---|---|---|
| **Southern** | 83 | NM | NM | 162 | 180 |
| | 22 | 216 | 208 | 218 | 220 |
| **Central** | 85 | 39 | 18 | 68 | 87 |
| **Northern** | 113 | 83 | 47 | 56 | 66 |
| | 65 | 92 | 70 | 56 | 80 |
| | 130 | 36 | 5.7 | 38 | 67 |
| **Water Surface Elevation (WSE) measured in feet above mean sea level** | | | | | |

**Figure 7** is a hydrograph that is developed from information gained from the use of a data logger. Well 65 used to be an agricultural well that was used to supply water for agricultural production. The well is in the center of the Riverstone development and has been converted to a monitor well. Thus it demonstrates how the conjunctive use management actions have supported the GSA to trend sustainably through groundwater rebound. From 2019 to 2021 the rebound was made to the same levels. 2022 saw some drop and it remains to be seen what will occur in 2023. This well and the information generated will give an excellent representation on the effectiveness of the project and management actions of the District and GSA.

Dropping groundwater levels and negative change in storage in the District are a result of pumping to the Northwest and outside of the Root Creek Water District boundary. The Root Creek Water District will experience negative impacts if other Subbasin agencies are not successful in implementation of project and management actions.

In September 2019, Well 65 was discontinued as an irrigation well and was converted to a monitor well. A transducer was installed to collect daily water level data. The hydrograph for those data is included as **Figure 7.** The transducer readings allow determination of the shallowest and deepest water levels each year. The spring shallowest level was about the same in 2020 and 2021 and fell slightly in 2022. The lowest water level in the summer fell about five feet from 2020 to 2021 and was about the same in 2021 and 2022.

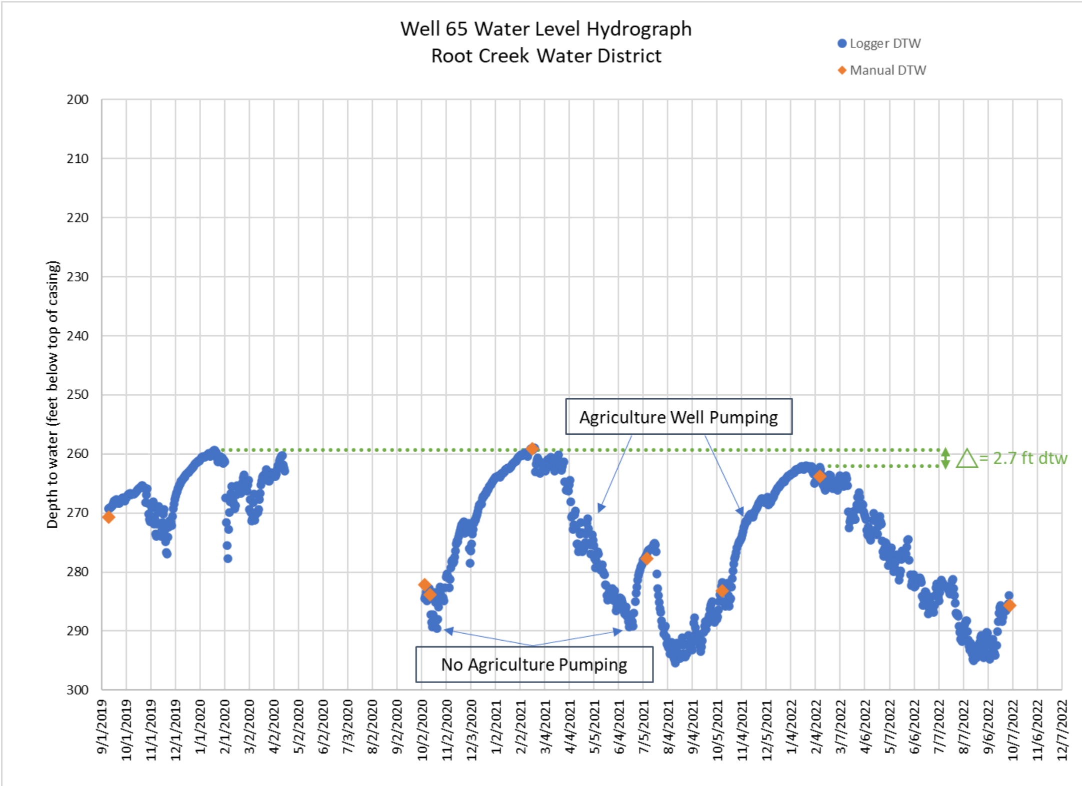


*Figure 7 Well 65 Hydrograph from Transducer*

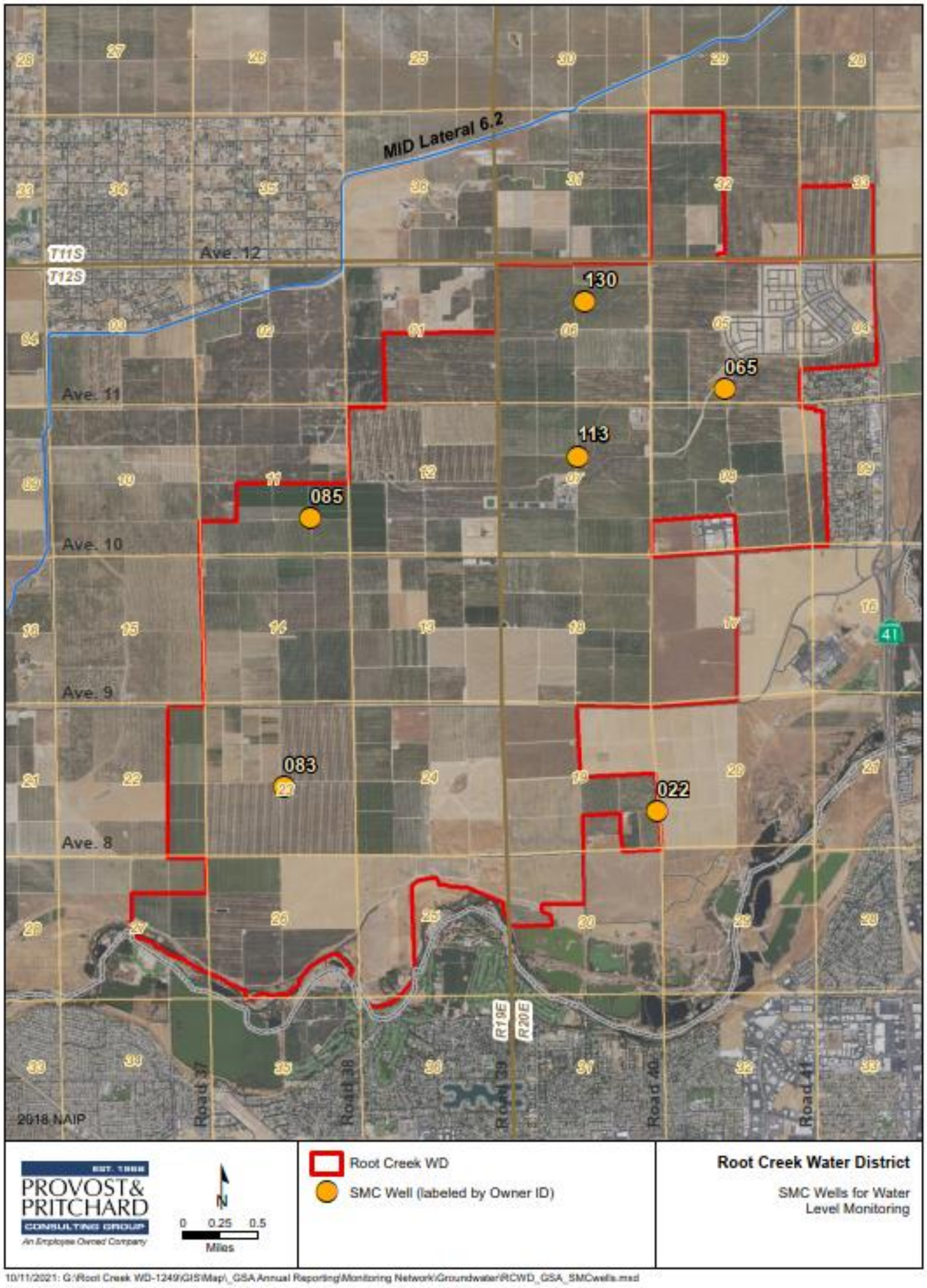


*Figure 8. Location of Water Level SMC Wells in RCWDGSA*

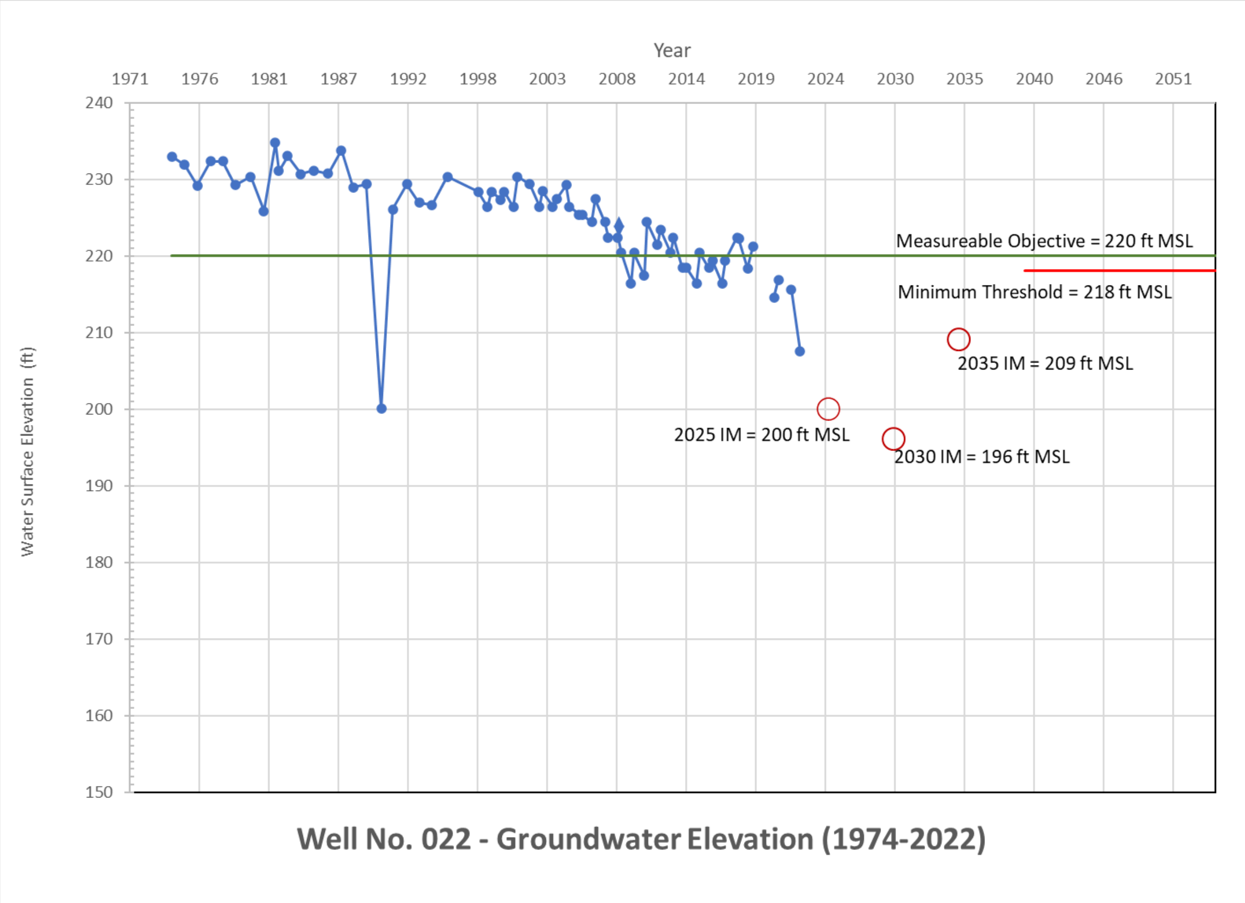


*Figure 9. Well 22 Hydrograph (1974-2022)*

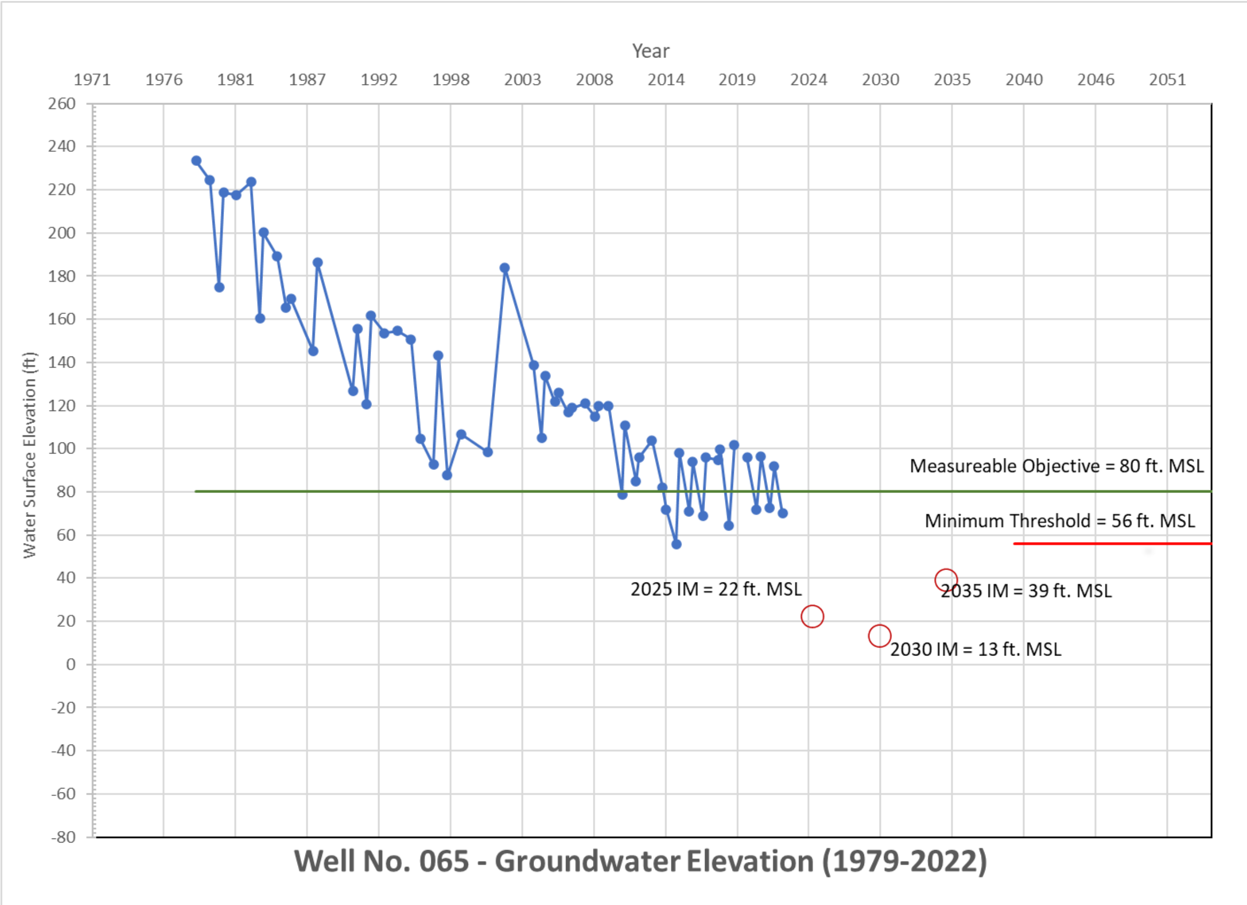


*Figure 10. Well 65 Hydrograph (1979-2022)*

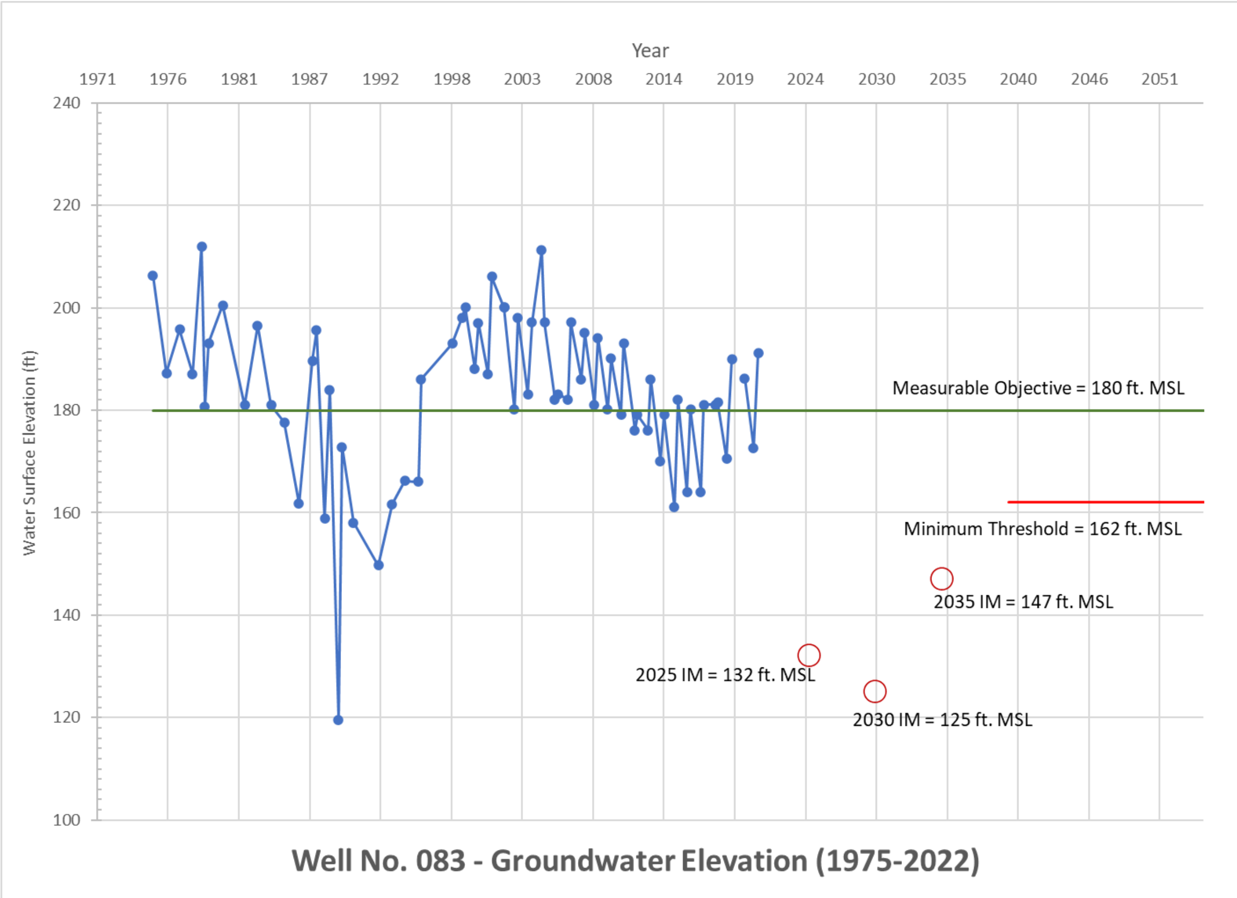


*Figure 11. Well 83 Hydrograph (1975-2022)*

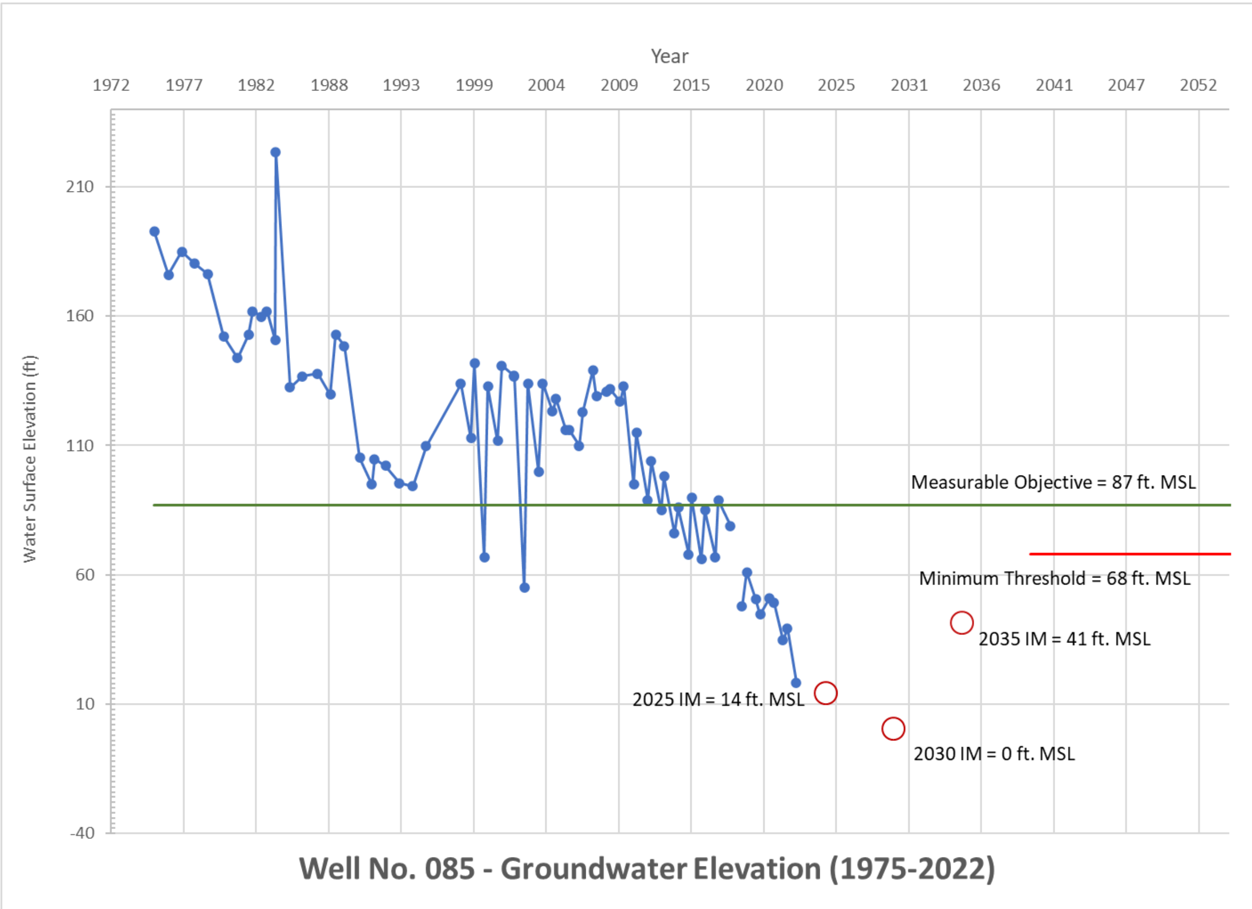


*Figure 12. Well 85 Hydrograph (1975-2022)*

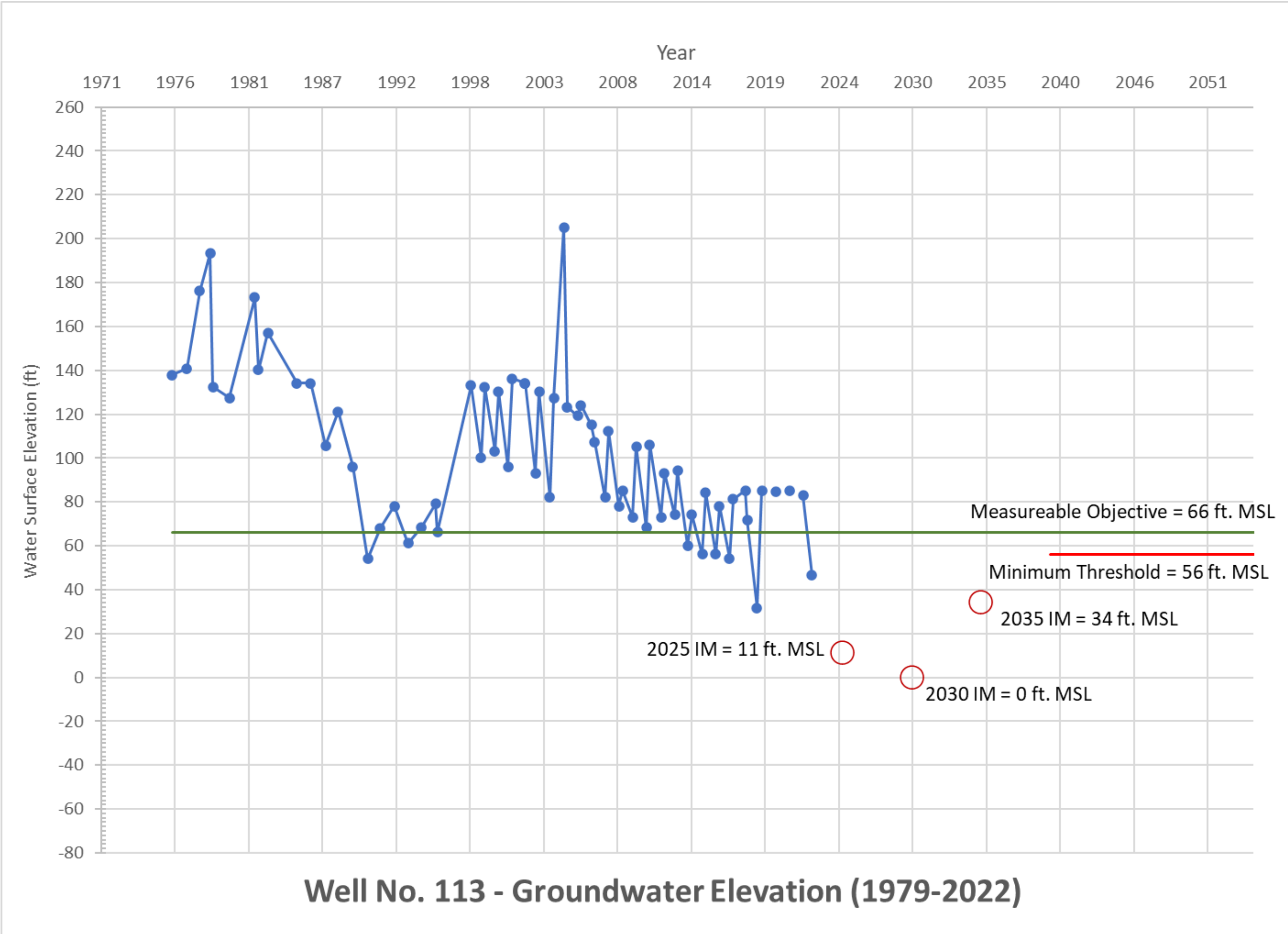


*Figure 13. Well 113 Hydrograph (1976-2022)*


*Figure 14. Well 130 Hydrograph (1998-2022)*

A general downward trend has persisted over the last 40 years; however, in the last 5 years water levels seem to become more stable with the exception of two wells; one on the westerly side of the central area and one in the north. Four of the six wells are at or above the projected measurable objective line, indicating that RCWDGSA is on track to meet interim milestones and sustainability goals. The two wells below the interim milestone are close to the measurable objective and above the projected minimum threshold. Well 130 is near the northern district boundary and is thought to be impacted by practices of the neighboring Groundwater Sustainability Agency. In general, water levels fell during the summer as expected but rebounded well by the Fall of 2022. This is in part due to RCWDGSA's efforts to increase conjunctive use of surface water and groundwater and the availability of surface water. Water year type, presented in **Table 13**, can be related to groundwater elevation trends seen in the hydrographs. Additionally, in order to continue monitoring groundwater pumping throughout the District, the Board adopted the Agricultural Water Flow Meter and Water Level Measurement Policy in January of 2018. Those data will assist in filling known data gaps and will enhance groundwater contouring efforts, thus strengthening their annual reporting.

Included with this report is a hydrograph using data from a transducer for Well 65. Well 65 is now completely surrounded by residential properties and is no longer a production agricultural well and has been converted to a monitoring well.

*Table 13. DWR Water Year Type Classification for San Joaquin Valley*

| Year | WY Type | Year | WY Type | Year | WY Type |
|---|---|---|---|---|---|
| **1975** | W | **1991** | C | **2007** | C |
| **1976** | C | **1992** | C | **2008** | C |
| **1977** | C | **1993** | W | **2009** | BN |
| **1978** | W | **1994** | C | **2010** | AN |
| **1979** | AN | **1995** | W | **2011** | W |
| **1980** | W | **1996** | W | **2012** | D |
| **1981** | D | **1997** | W | **2013** | C |
| **1982** | W | **1998** | W | **2014** | C |
| **1983** | W | **1999** | AN | **2015** | C |
| **1984** | AN | **2000** | AN | **2016** | D |
| **1985** | D | **2001** | D | **2017** | W |
| **1986** | W | **2002** | D | **2018** | BN |
| **1987** | C | **2003** | BN | **2019** | W |
| **1988** | C | **2004** | D | **2020** | BN |
| **1989** | C | **2005** | W | **2021** | BN |
| **1990** | C | **2006** | W | **2022** | D |

*Note: C = critical, D = dry, BN = below normal, AN = above normal, W = wet*

More recent information has been recorded at the municipal wells that serve the Riverstone development. Since these new wells have been constructed, data loggers installed in the wells take measurements frequently. **Figure 15** shows daily readings from these devices. At times the readings reflect the dynamic or pumping condition as indicated by the lower readings in the chart and the higher readings reflect a condition where the well is not operating. These charts show the dynamic nature of the change in levels of the groundwater and indicate that in general the highest levels are observed in the March and April months and the lowest levels correlate to July and August. While the levels fluctuate, the readings indicate that the levels, as of the end of Fall 2022, rebound to 290-310 feet depth to water for Well #2 and 200 feet depth to water for Well #1 since 2017. Well #4 was decommissioned in Fall 2021.

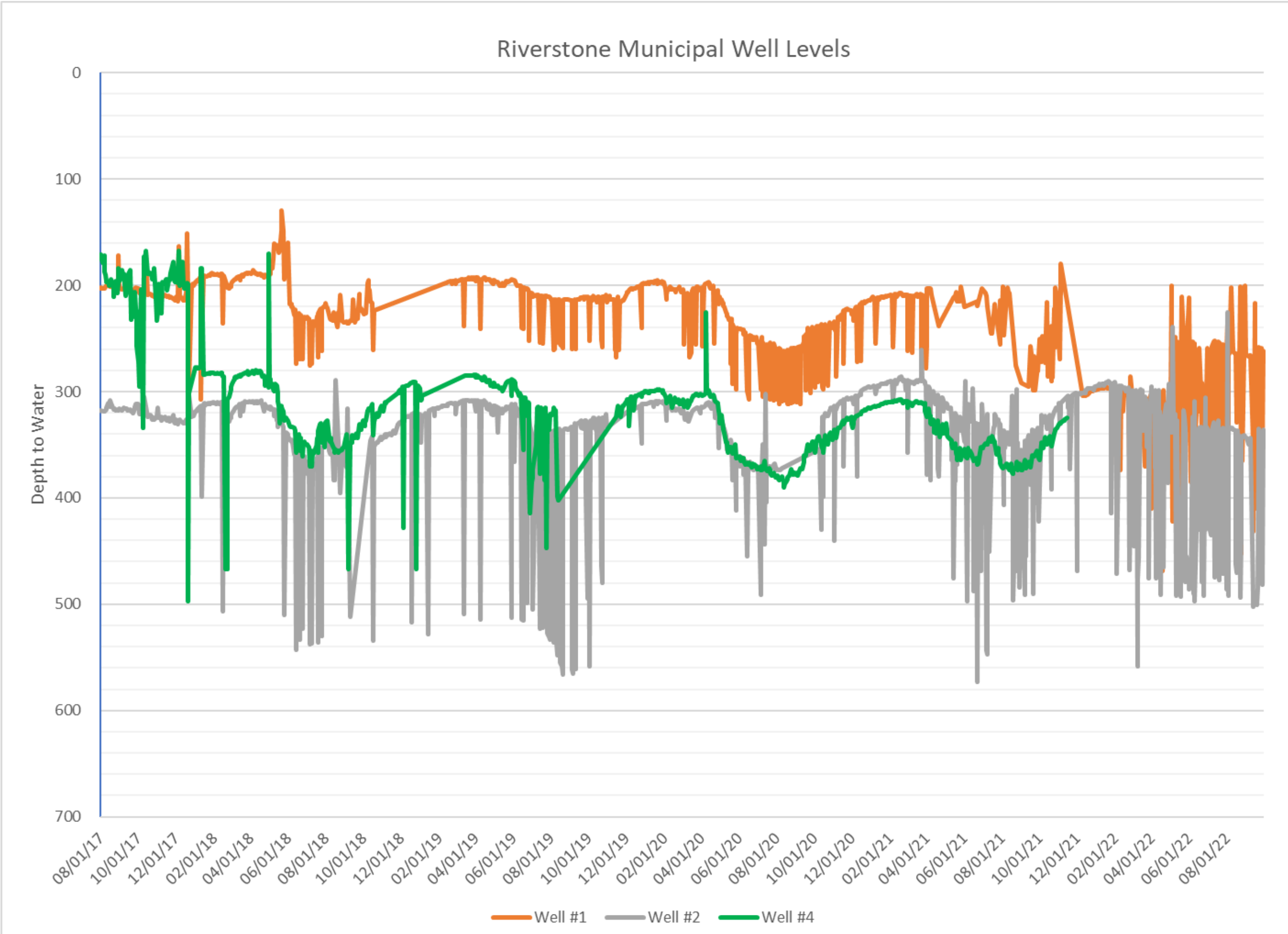


*Figure 15. Riverstone Municipal Well Levels*

## Groundwater Storage Change

Change in groundwater storage is calculated by using the weighted average method on a GIS-generated surface with the assistance of hydrogeological interpretation. Included in this analysis are the six representative monitoring sites for groundwater storage. Change in groundwater storage is caused by extracting more groundwater than recharged or vice versa. RCWDGSA has two main sources of groundwater extraction as discussed in preceding sections: residential water use and agricultural irrigation. More recently, practices such as intentional recharge, stormwater detention, and treated wastewater effluent percolation have been implemented which help to balance the volume of groundwater extracted. Additionally, recharge occurs through seepage from the San Joaquin River. Due to the listed water management strategies by RCWDGSA and others discussed in the preceding sections, groundwater storage change over the last 5 years has been relatively balanced as shown in **Table 14**.

Based on groundwater elevation measurable objectives set by RCWDGSA, the objective for groundwater storage change is not to exceed a total depletion of approximately 55,000 AF by 2040, after which there should be no net storage change. The data presented in **Table 14** shows that the storage has been in a slight decline with a net loss in storage of -13,612 AF using the fall data. From 2015 to 2022, the spring data suggests that there is a net loss in storage of approximately -9,466 AF. The spring values are considered better to use, as they indicate more static conditions. As noted on the hydrographs, there is a cyclic nature to the measurements at differing times of the year and that the Interim milestones, and thus the storage change, will reflect these changing measurements. Recognizing these variations, it could be suggested that these last four years indicate that the operations have resulted in potentially sustainable operations going forward. As the County GSA establishes policies on pumping and implements programs for recharge the resulting change in storage is expected to provide positive results throughout the Subbasin. This data strongly indicates that RCWDGSA is on track to meet its interim milestones and overall sustainability goal set in the GSP.

*Table 14. Groundwater Storage Change from 2015-2022*

| Time Period | Average Change (ft) | Surface Area of Analysis (ac) | Assumed Specific Yield | Annual Change (AF) | Cumulative Storage Change (AF) |
|---|---|---|---|---|---|
| Fall 2014-Fall 2015 | 10.5 | 7,569 | 0.12 | 9,500 | 9,500 |
| Fall 2015-Fall 2016 | -13.2 | 7,601 | 0.12 | -12,000 | -2,500 |
| Fall 2016-Fall 2017 | 18.8 | 7,601 | 0.12 | 17,100 | 14,600 |
| Fall 2017-Fall 2018 | -25.0 | 7,598 | 0.12 | -22,800 | -8,200 |
| Fall 2018-Fall 2019 | 10.9 | 7,598 | 0.12 | 10,000 | 1,700 |
| Fall 2019-Fall 2020 | 0.7 | 7,728 | 0.12 | 600 | 2,300 |
| Fall 2020-Fall 2021 | -8.4 | 7,732 | 0.12 | -7,800 | -5,500 |
| Fall 2021-Fall 2022 | -8.4 | 8,145 | 0.12 | -8,200 | **-13,700** |
| **Average** | -1.8 | | | -1,700 | |
| Spring 2014-Spring 2015 | 7.8 | 7,596 | 0.12 | 7,100 | 7,100 |
| Spring 2015-Spring 2016 | -4.8 | 7,596 | 0.12 | -4,300 | 2,700 |
| Spring 2016-Spring 2017 | -4.5 | 7,598 | 0.12 | -4,100 | -1,400 |
| Spring 2017-Spring 2018 | 10.2 | 7,598 | 0.12 | 9,300 | 7,900 |
| Spring 2018-Spring 2019 | -10 | 7,598 | 0.12 | -9,100 | -1,200 |
| Spring 2019-Spring 2020 | -5.7 | 8,860 | 0.12 | -6,000 | -7,300 |
| Spring 2020-Spring 2021 | 2.1 | 8,852 | 0.12 | 2,200 | -5,100 |
| Spring 2021-Spring 2022 | -4.2 | 8,831 | 0.12 | -4,500 | **-9,600** |
| | -1.1 | | | -1,200 | |

**Figure 16** shows the annual change in groundwater storage next to groundwater use as a bar graph along with cumulative storage change within RCWDGSA boundaries since the 2015 water year. The corresponding water year type is shown below the year. **Figure 17** displays the groundwater storage change throughout the area between Spring 2021-2022, while **Figure 18** displays the groundwater storage between Fall 2021 and Fall 2022. Dropping groundwater levels in the district are a result of pumping to the West and North of the Root Creek Water District boundary. The Root Creek Water District experiences impacts as a result of the Subbasin GSA's implementation of projects and management actions.

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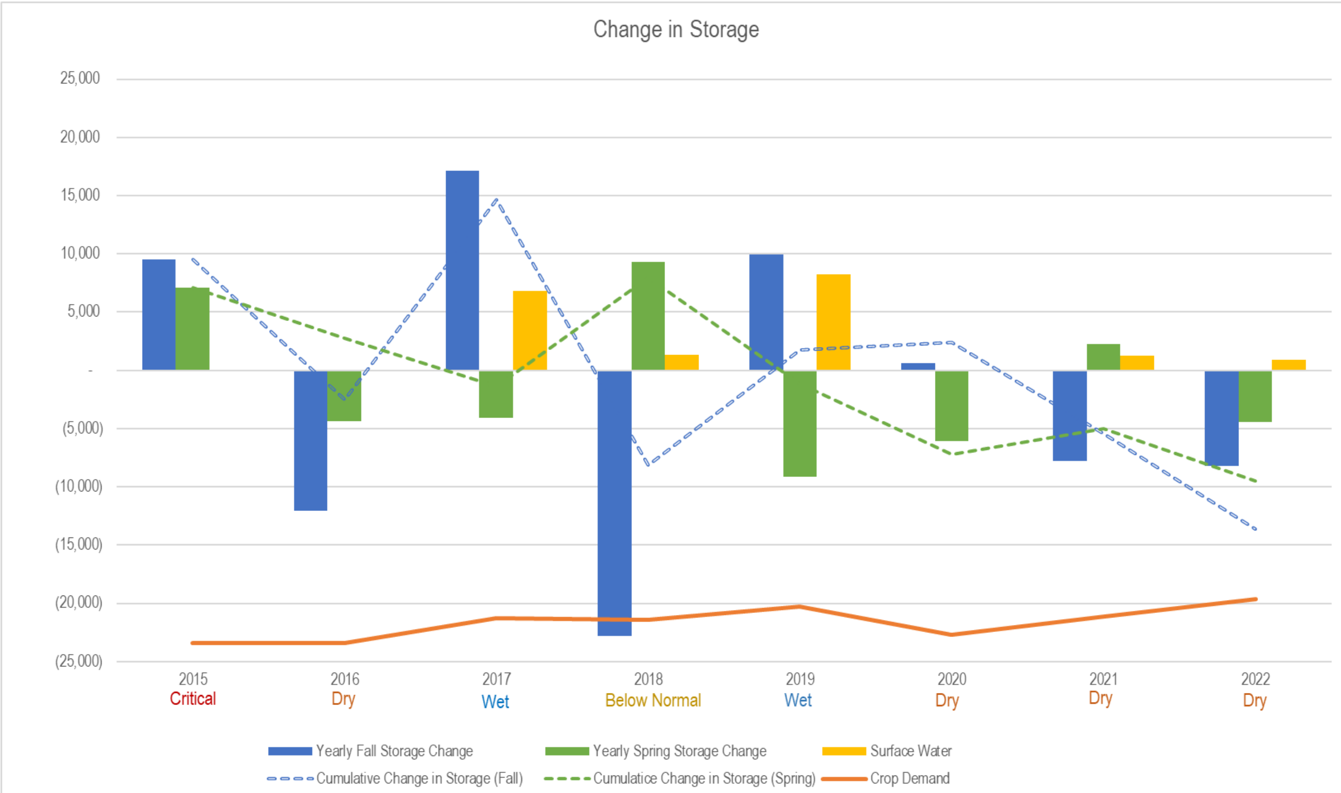



*Figure 16. Groundwater Storage Change Between Fall Seasons 2015 to 2022*

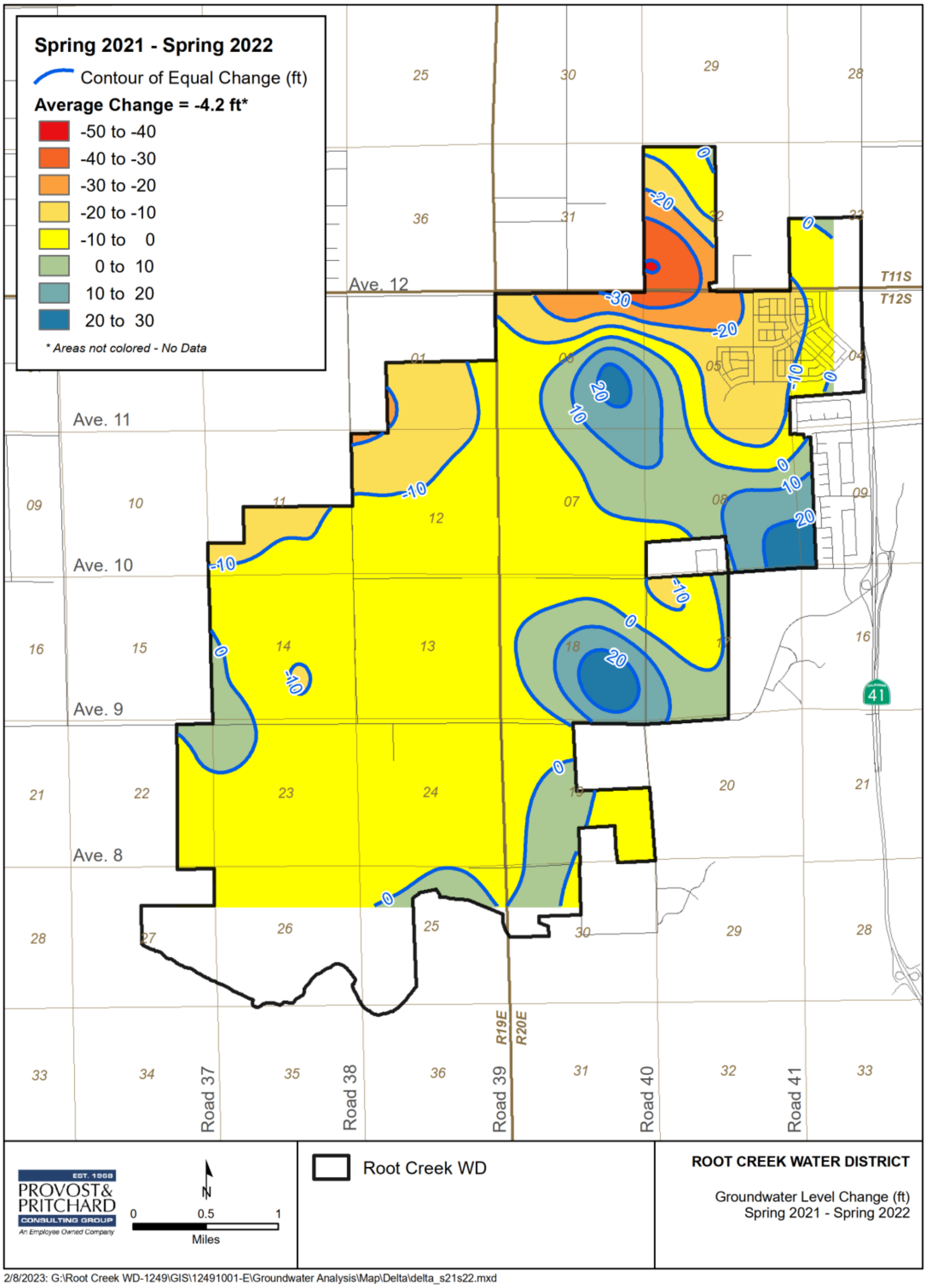



*Figure 17. Change in Groundwater Storage in RCWDGSA - Spring 2021 to Spring 2022*

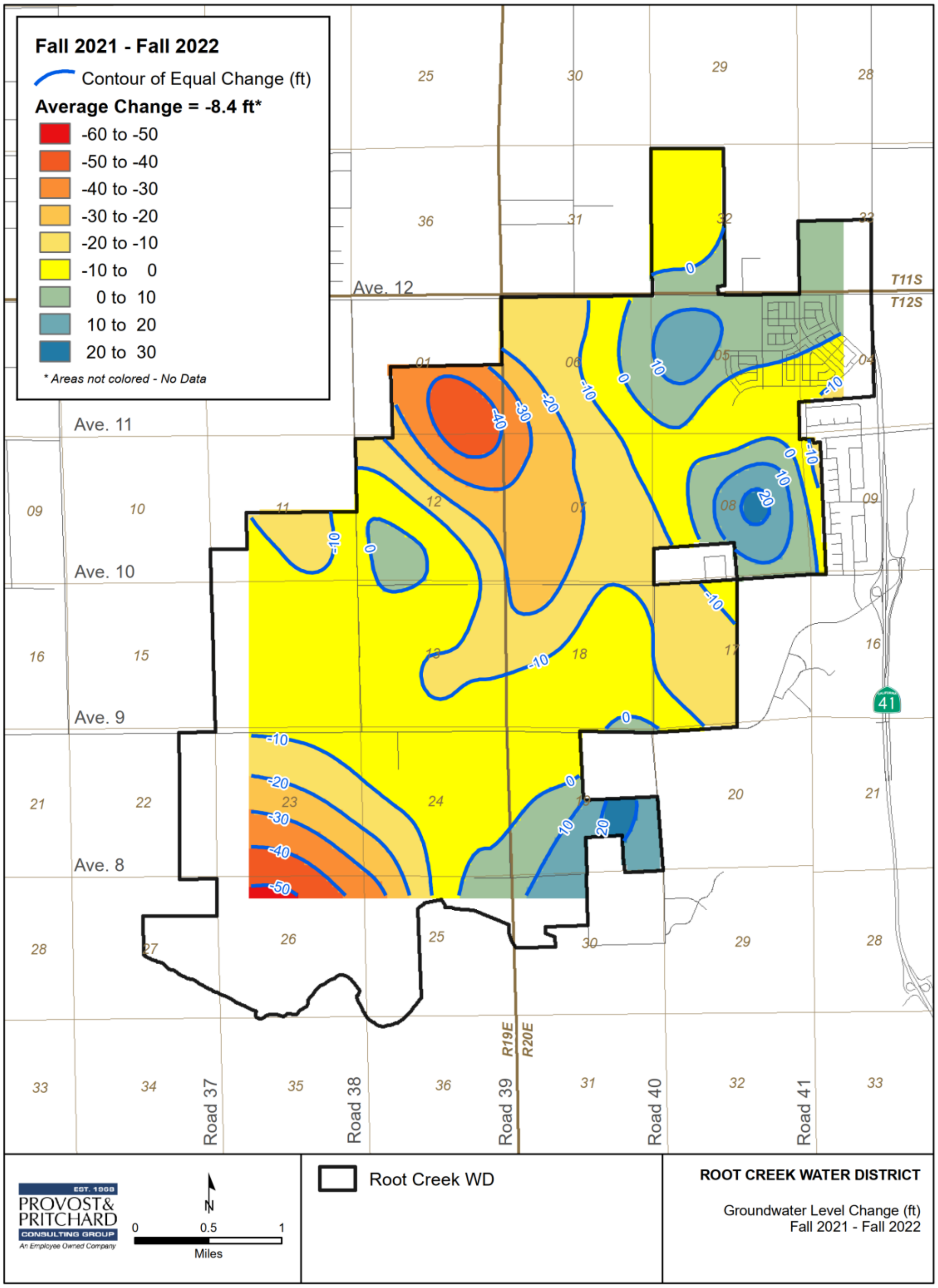



*Figure 18. Change in Groundwater Storage in RCWDGSA - Fall 2021 to Fall 2022*

### Groundwater Quality

It is planned that groundwater quality will be monitored at the wells shown in **Figure 19**. As of now, the municipal wells (designated with an “M”) and the monitor wells (designated with an “MW”) for the wastewater treatment plant have been monitored. Water quality data from 2017 - 2022 for all monitor wells is presented in **Table 15** through **Table 21.** Since RCWDGSA created a goal to maintain water quality levels, the first few years of monitoring is setting a baseline for comparison. The first year of data shows relatively consistent values for constituents in the water. The Minimum Thresholds for agricultural irrigation water and municipal groundwater quality wells will be further defined in the first GSP 5-year update. The Minimum Threshold for municipal groundwater quality wells are currently based on the Title 22 MCLs.

Data gaps identified in the GSP include inconsistent frequency of monitoring water quality. It has also been noted that existing water quality data is minimal in rural areas. The monitoring network presented will fill the spatial data gap. The frequency at which the municipal and monitoring network wells will be monitored is at least annually which will provide for consistent data.

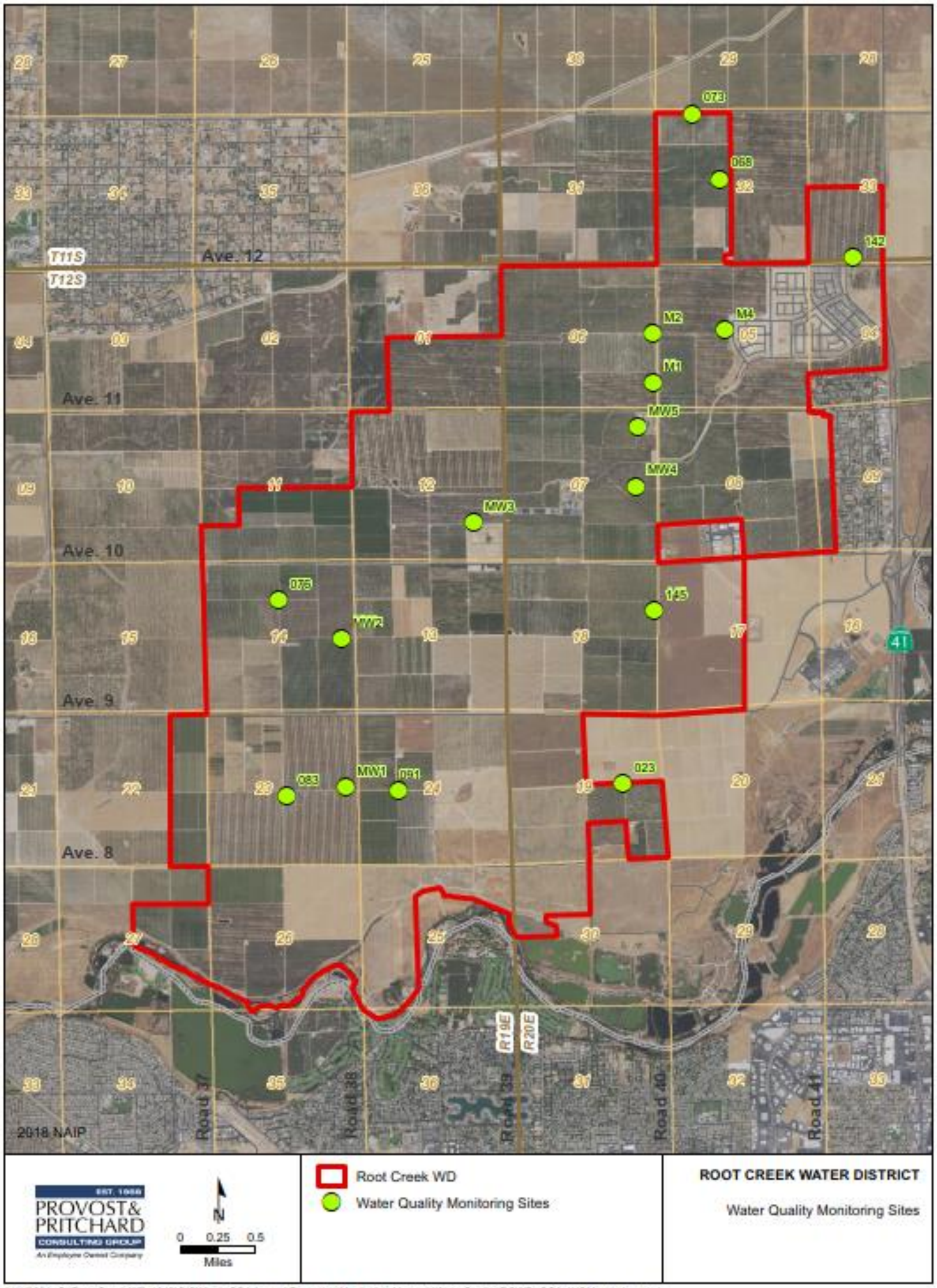



*Figure 19. Water Quality Monitoring Wells in RCWDGSA*

*Table 15. Water Quality – Total Dissolved Solids (TDS)*

| Total Dissolved Solids (TDS) (mg/L) | | | | | | |
|---|---|---|---|---|---|---|
| **Well** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| Well 73 | - | - | - | - | - | - |
| Well 68 | - | - | - | - | - | - |
| Well 142 | 135 | 137 | - | - | - | 128 |
| Well M4 | 280 | - | - | 200 | 844 | - |
| Well M2 | 370 | - | - | 260 | 790 | - |
| Well M1 | 260 | - | - | 330 | 227 | - |
| MW5 | 210 | 180 | 190 | 230 | 230 | 200 |
| MW4 | 280 | 290 | 330 | 200 | 200 | 200 |
| MW3 | 330 | 290 | 330 | 360 | 310 | 350 |
| Well 145 | 201 | 194 | - | - | - | - |
| Well 76 | 232 | 254 | - | - | - | 484 |
| MW2 | 210 | 260 | 280 | 250 | 260 | 290 |
| MW1 | 220 | 210 | 200 | 200 | 220 | 180 |
| Well 83 | - | 166 | - | - | - | 167 |
| Well 91 | 178 | 169 | - | - | - | 165 |
| Well 23 | 169 | 158 | - | - | - | 177 |

*Table 16. Water Quality – Boron*

| Boron (mg/L) | | | | | | |
|---|---|---|---|---|---|---|
| **Well** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| Well 73 | - | - | - | - | - | - |
| Well 68 | - | - | - | - | - | - |
| Well 142 | - | 0.02 | - | - | - | ND |
| Well M4 | ND | - | - | ND | - | - |
| Well M2 | ND | - | - | ND | - | - |
| Well M1 | ND | - | - | ND | - | - |
| MW5 | ND | ND | - | ND | ND | ND |
| MW4 | ND | ND | - | ND | ND | ND |
| MW3 | ND | ND | - | ND | ND | ND |
| Well 145 | - | 0.01 | - | - | - | - |
| Well 76 | - | 0.01 | - | - | - | 0.10 |
| MW2 | ND | ND | - | ND | ND | ND |
| MW1 | ND | ND | - | ND | ND | ND |
| Well 83 | - | 0.02 | - | - | - | 0.02 |
| Well 91 | - | 0.02 | - | - | - | ND |
| Well 23 | - | 0.02 | - | - | - | 0.02 |

*Table 17. Water Quality – Iron*

| | Iron (mg/L) | | | | | |
|---|---|---|---|---|---|---|
| **Well** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| Well 73 | - | - | - | - | - | - |
| Well 68 | - | - | - | - | - | - |
| Well 142 | - | - | - | - | - | - |
| Well M4 | ND | - | - | ND | 0.478 | - |
| Well M2 | ND | - | - | ND | 0.603 | - |
| Well M1 | ND | - | - | ND | 0.078 | - |
| MW5 | 8 | ND | 0.2 | 0.14 | 0.18 | 0.3 |
| MW4 | 20 | 0.3 | 0.8 | ND | 0.25 | 1.10 |
| MW3 | 0.6 | ND | 0.3 | ND | 0.28 | 0.4 |
| Well 145 | - | - | - | - | - | - |
| Well 76 | - | - | - | - | - | - |
| MW2 | 0.2 | ND | 4.4 | 1.1 | ND | 0.2 |
| MW1 | ND | ND | ND | ND | ND | ND |
| Well 83 | - | - | - | - | - | - |
| Well 91 | - | - | - | - | - | - |
| Well 23 | - | - | - | - | - | - |

*Table 18. Water Quality – Nitrate as N*

| | Nitrate as N (mg/L) | | | | | |
|---|---|---|---|---|---|---|
| **Well** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| Well 73 | - | - | - | - | - | - |
| Well 68 | - | - | - | - | - | - |
| Well 142 | - | 7.1 | - | - | - | 9.0 |
| Well M4 | 1.0 | - | - | 6.5 | 3.5 | - |
| Well M2 | 2.8 | - | - | 5.3 | ND | - |
| Well M1 | 3.0 | - | - | 2.9 | 3.8 | - |
| MW5 | 8.5 | 8.2 | 8.5 | 11.0 | 9.9 | 12.0 |
| MW4 | 11.0 | 12.0 | 12.0 | 8.6 | 8.4 | 9.3 |
| MW3 | 19.0 | 18.0 | 15.0 | 20.0 | 15.0 | 14.0 |
| Well 145 | - | 7.1 | - | - | - | - |
| Well 76 | - | 4.7 | - | - | - | 2.3 |
| MW2 | 4.9 | 7.1 | 7.0 | 8.9 | 8.7 | 11.0 |
| MW1 | 3.7 | 3.6 | 2.8 | 2.6 | 3.5 | 2.6 |
| Well 83 | - | 4.7 | - | - | - | 3.4 |
| Well 91 | - | 1.9 | - | - | - | 1.3 |
| Well 23 | - | 0.4 | - | - | - | 1.9 |

*Table 19. Water Quality – Manganese*

| | Manganese (mg/L) | | | | | |
|---|---|---|---|---|---|---|
| **Well** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| Well 73 | - | - | - | - | - | - |
| Well 68 | - | - | - | - | - | - |
| Well 142 | - | - | - | - | - | - |
| Well M4 | 0.018 | - | - | 0.0055 | 0.077 | - |
| Well M2 | 0.011 | - | - | 0.025 | 0.150 | - |
| Well M1 | 0.018 | - | - | 0.055 | 0.204 | - |
| MW5 | 0.3 | ND | ND | ND | 0.0069 | 0.012 |
| MW4 | 0.9 | 0.01 | 0.1 | ND | 0.011 | 0.061 |
| MW3 | ND | ND | ND | ND | 0.0068 | 0.0120 |
| Well 145 | - | - | - | - | - | - |
| Well 76 | - | - | - | - | - | - |
| MW2 | ND | ND | ND | 0.0055 | ND | ND |
| MW1 | ND | ND | ND | ND | ND | ND |
| Well 83 | - | - | - | - | - | - |
| Well 91 | - | - | - | - | - | - |
| Well 23 | - | - | - | - | - | - |

*Table 20. Water Quality – Sodium*

| | Sodium (mg/L) | | | | | |
|---|---|---|---|---|---|---|
| **Well** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| Well 73 | - | - | - | - | - | - |
| Well 68 | - | - | - | - | - | - |
| Well 142 | - | 19.3 | - | - | - | 18.2 |
| Well M4 | 36.0 | - | - | 18.0 | - | - |
| Well M2 | 46.0 | - | - | 25.0 | - | - |
| Well M1 | 29.0 | - | - | 33.0 | - | - |
| MW5 | 15.0 | 14.0 | 14.0 | 16.0 | 14.0 | 16.0 |
| MW4 | 17.0 | 19.0 | 18.0 | 14.0 | 14.0 | 14.0 |
| MW3 | 23.0 | 22.0 | 21.0 | 22.0 | 23.0 | 22.0 |
| Well 145 | - | 21.3 | - | - | - | - |
| Well 76 | - | 26.9 | - | - | - | 75.4 |
| MW2 | 16.0 | 18.0 | 17.0 | 18.0 | 19.0 | 19.0 |
| MW1 | 20.0 | 20.0 | 18.0 | 17.0 | 18.0 | 16.0 |
| Well 83 | - | 19.1 | - | - | - | 19.0 |
| Well 91 | - | 19.1 | - | - | - | 26.2 |
| Well 23 | - | 15.1 | - | - | - | 16.5 |

*Table 21. Water Quality – Chloride*

| Well | Chloride (mg/L) | | | | | |
|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| Well 73 | - | - | - | - | - | - |
| Well 68 | - | - | - | - | - | - |
| Well 142 | - | 19.3 | - | - | - | - |
| Well M4 | 36 | - | - | 18 | - | - |
| Well M2 | 46 | - | - | 25 | - | - |
| Well M1 | 29 | - | - | 33 | - | - |
| MW5 | 15 | 14 | 14 | 16 | 15 | 18 |
| MW4 | 17 | 19 | 18 | 14 | 11 | 13 |
| MW3 | 23 | 22 | 21 | 22 | 24 | 26 |
| Well 145 | - | 21.3 | - | - | - | - |
| Well 76 | - | 26.9 | - | - | - | 14 |
| MW2 | 16 | 18 | 17 | 18 | 20 | 28 |
| MW1 | 20 | 20 | 18 | 17 | 10 | 8.8 |
| Well 83 | - | 19.1 | - | - | - | 9.4 |
| Well 91 | - | 19.1 | - | - | - | 11.9 |
| Well 23 | - | 15.1 | - | - | - | 8.1 |

## Land Subsidence

Land subsidence is a concern in the Subbasin. Even though RCWDGSA has not historically experienced land subsidence as discussed in the GSP, sustainability management criteria have been established to reflect coordination within the Subbasin (**Table 22**). The Subbasin has identified two representative subsidence groups (Area of Subsidence Concern Group and Subsidence Monitoring Group) consisting of a total seven representative monitoring stations (**Figure 20**). Due to being located on the eastern portion of the Subbasin, isolated from the Corcoran Clay, RCWDGSA will be evaluating the Subsidence Monitoring Group stations. The USBR produces subsidence data through the San Joaquin River Restoration program and is shown on **Figure 20** and **Figure 21**. indicates no significant subsidence north, east, and south of RCWD. However, subsidence along Highway 99 northwest of the figure is significant. Annual changes in land surface elevation from December 2016 to December 2022 for the Subsidence Monitoring Group stations are summarized in **Table 23**. The month of December is used as a reference point to capture potential inelastic rebound. Between 2012 and 2022.

*Table 22 Summary of Madera Subbasin Land Subsidence SMCs*

| Subsidence Group | Interim Milestones (ft/yr) | | | Minimum Threshold (ft/yr)[1] |
|---|---|---|---|---|
| | 2025 | 2030 | 2035 | 2040 |
| Monitoring Group | -0.2 | -0.13 | -0.07 | 0.0 |
| Concern Group | -0.6 | -0.4 | -0.2 | 0.0 |

1. Due to uncertainty in land subsidence measurement accuracy, a rate of -0.16 feet/year is considered in compliance with the MT

## Interconnected Surface Water and Groundwater

As mentioned in the GSP, there have been no sustainability criteria set for interconnected surface water. It is inconclusive whether the groundwater and surface water system are interconnected along the portion of the San Joaquin River adjacent to the southern boundary of RCWD. The most recent available monitoring data from the San Joaquin River Restoration Program is inconclusive and will continue to be monitored. This is considered a data gap for the Madera Subbasin and the Subbasin continues to search for funding opportunities to improve interconnected groundwater monitoring.

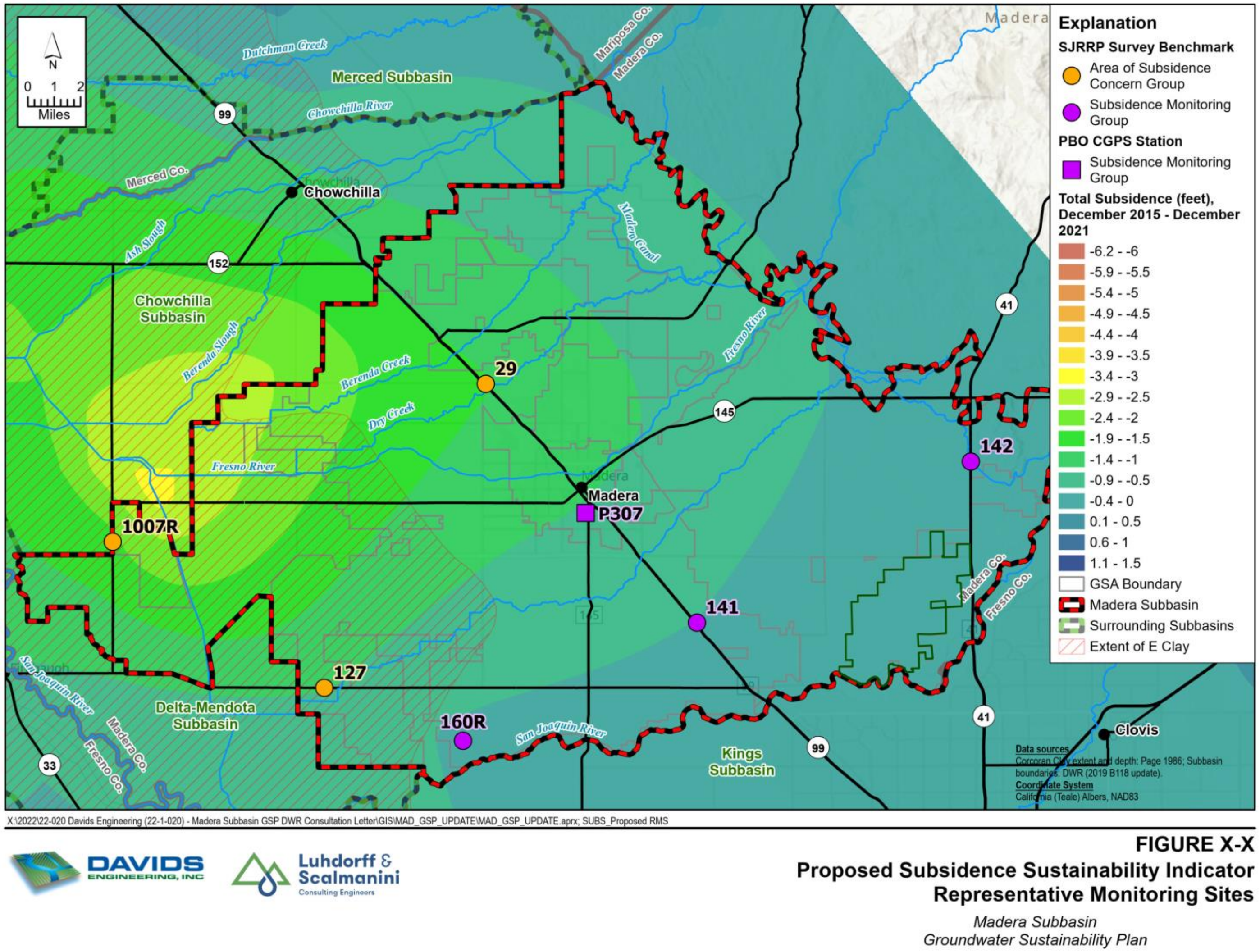



*Figure 20 Subbasin Land Subsidence Monitoring Stations*

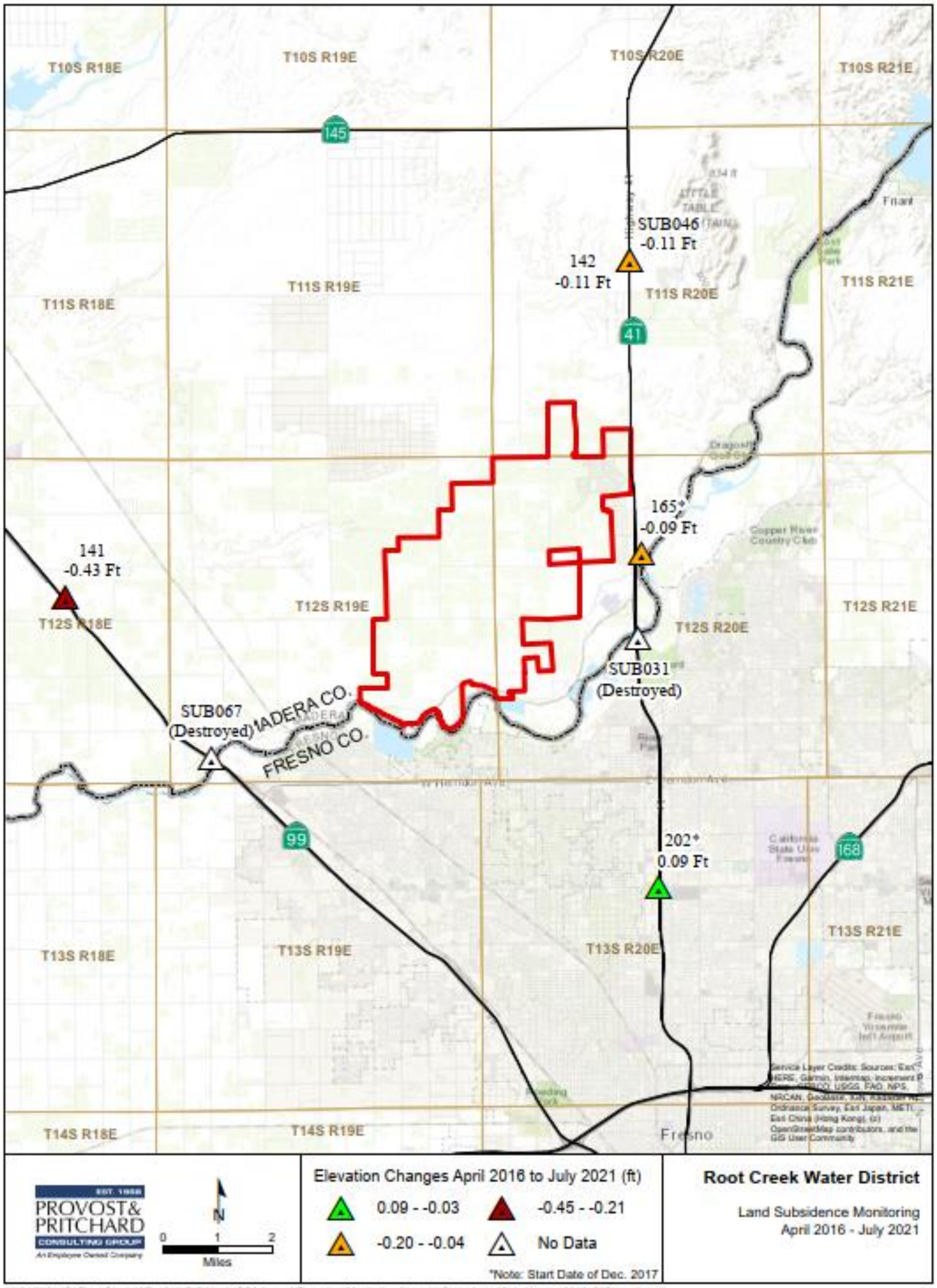


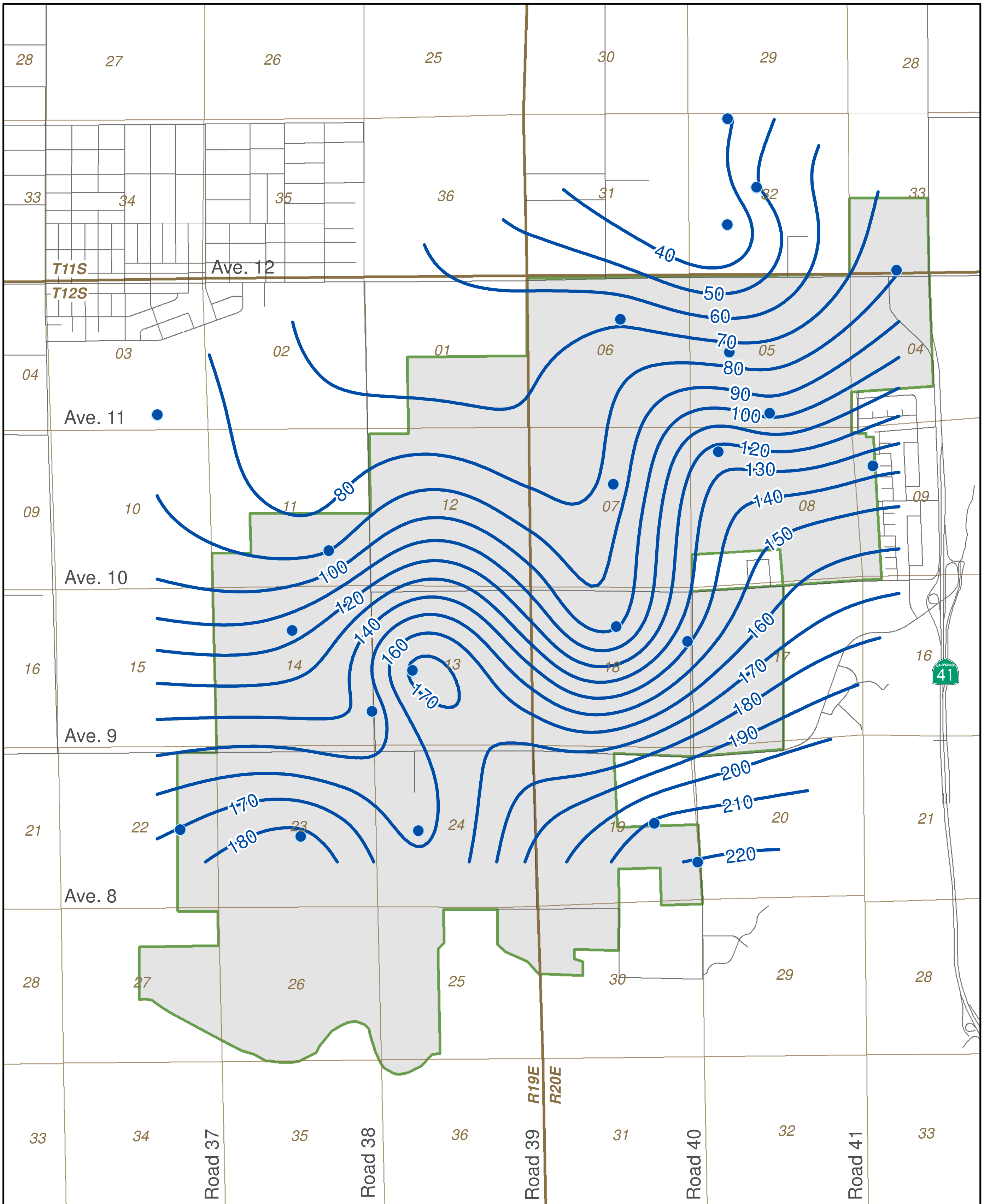

Figure 21. Land Subsidence 2016-*2022*

*Table 23. Annual Subsidence*

| Dec – Dec Annual Subsidence (ft) | | | | |
|---|---|---|---|---|
| Monitoring Point | | | | |
| Years | **160R** | **P307*** | **141** | **142** |
| Dec-16 – Dec-17 | -0.04 | — | -0.07 | -0.02 |
| Dec-17 – Dec-18 | -0.06 | — | -0.12 | -0.05 |
| Dec-18 – Dec-19 | -0.07 | — | -0.10 | -0.01 |
| Dec-19 – Dec-20 | 0.04 | — | -0.04 | 0.03 |
| Dec-20 – Dec-21 | -0.15 | — | -0.09 | 0.00 |
| Dec-21 – Dec-22 | -0.05 | — | -0.19 | -0.14 |
| **Dec-16 – Dec-22** | -0.48 | — | -0.61 | -0.19 |

*Data to be obtained in WY2023 Annual Report

*Appendix A - Groundwater Elevation Contours Spring 2015 – Spring 2021*




0 0.5 1 Miles

EST. 1968
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company

286 W. Cromwell Ave.
Fresno, CA 93711-6162
(559) 449-2700

**Legend**

Well Used In Analysis

**Elevation of Water in Wells (feet above sea level)**

Line of Equal Elevation (10 ft interval)

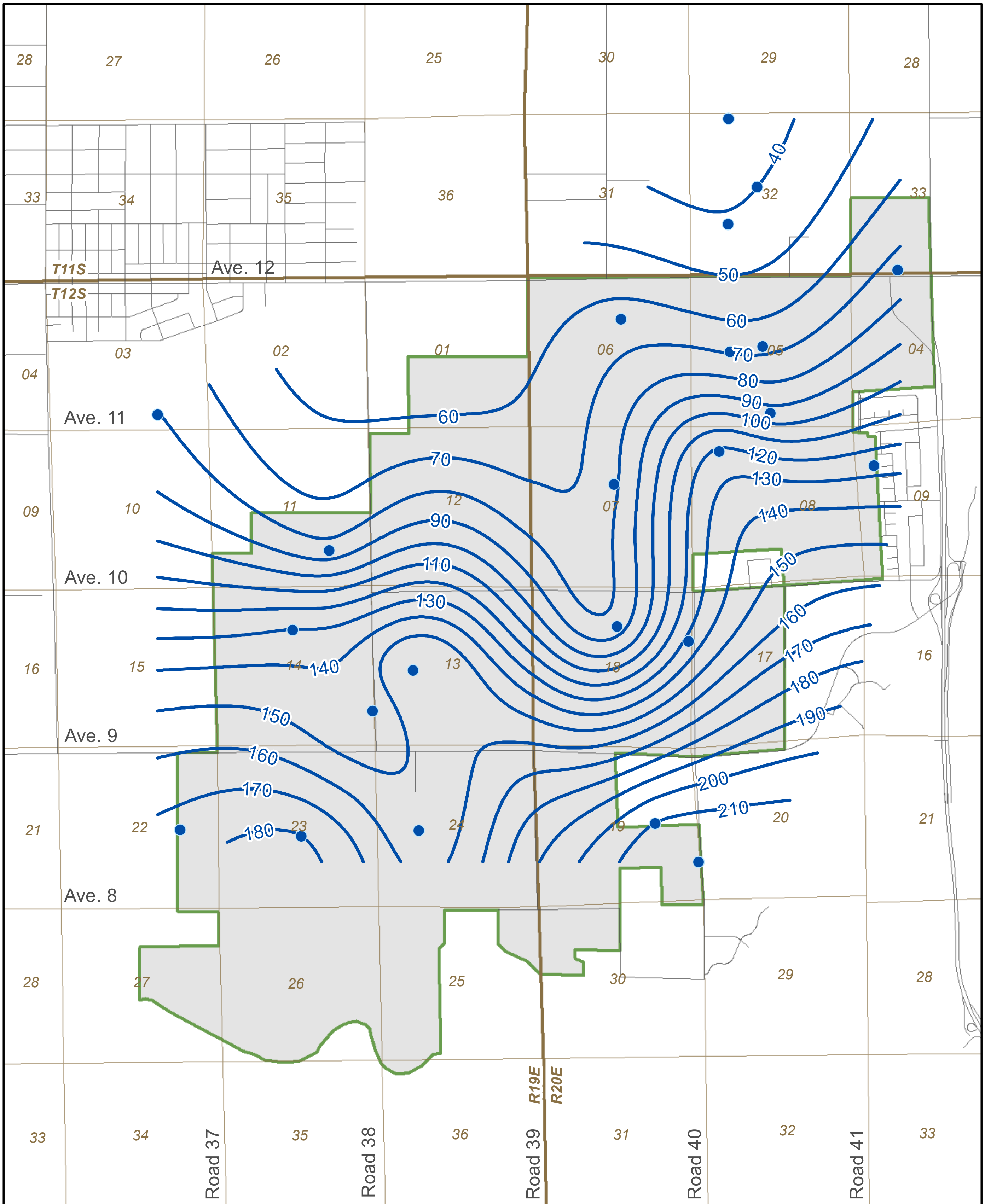
Root Creek WD

ROOT CREEK WATER DISTRICT

Elevation of Water in Wells

Spring 2015

9/9/2015: G:\Root Creek WD-1249\GIS\12491001-E\Groundwater Analysis\Map\Spring15_WSE.mxd




Provost & Pritchard Consulting Group
EST. 1968
An Employee Owned Company

0 0.5 1
Miles

**Legend**

Well Used In Analysis

**Elevation of Water in Wells (feet above sea level)**

Line of Equal Elevation (10 ft interval)

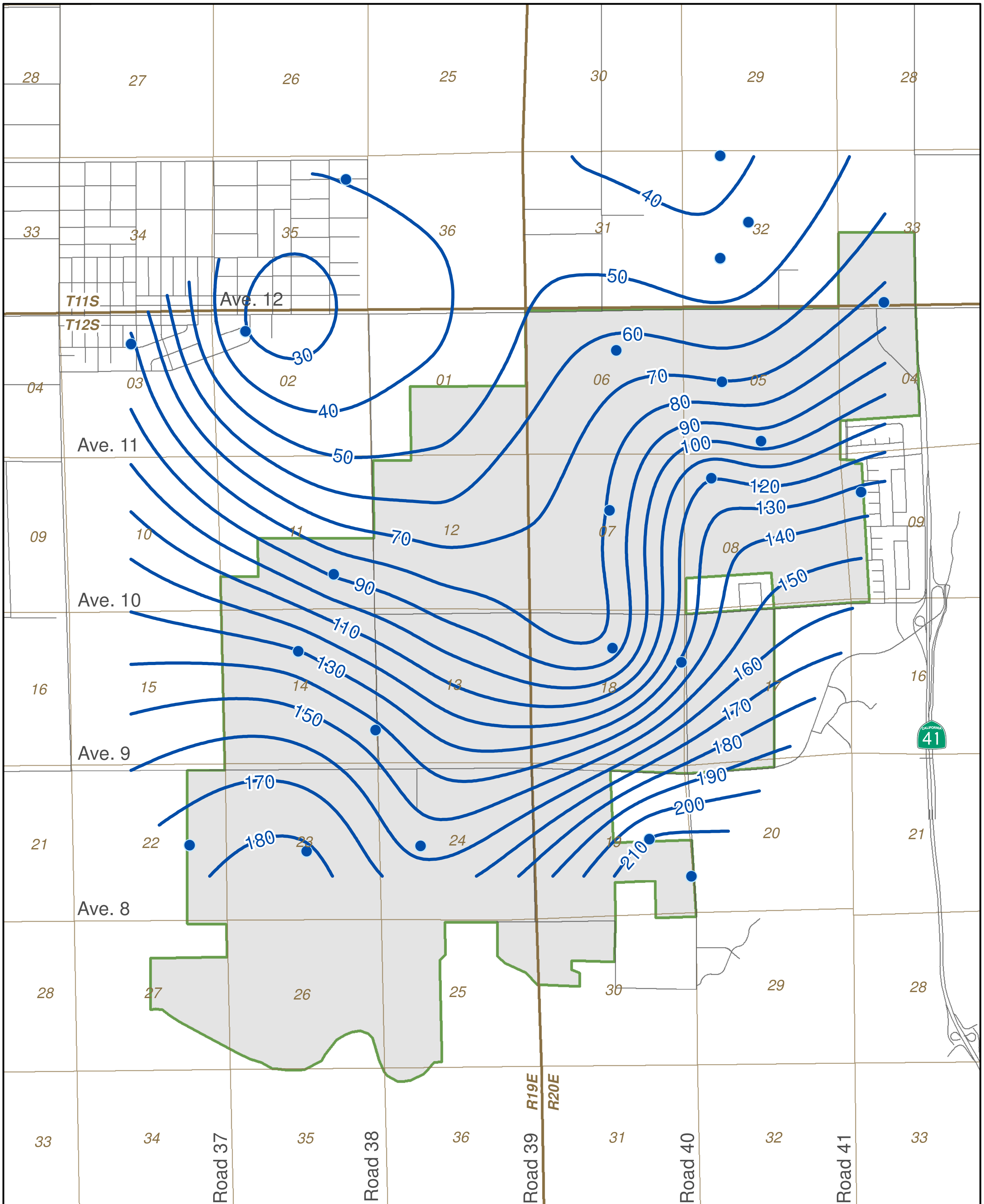
Root Creek WD

ROOT CREEK WATER DISTRICT

Elevation of Water in Wells

Spring 2016

7/20/2016: G:\Root Creek WD-1249\GIS\12491001-E\Groundwater Analysis\Map\Spring16_WSE.mxd




0 0.5 1
Miles

**Legend**

Well Used In Analysis

**Elevation of Water in Wells (feet above sea level)**

Line of Equal Elevation (10 ft interval)

Root Creek WD

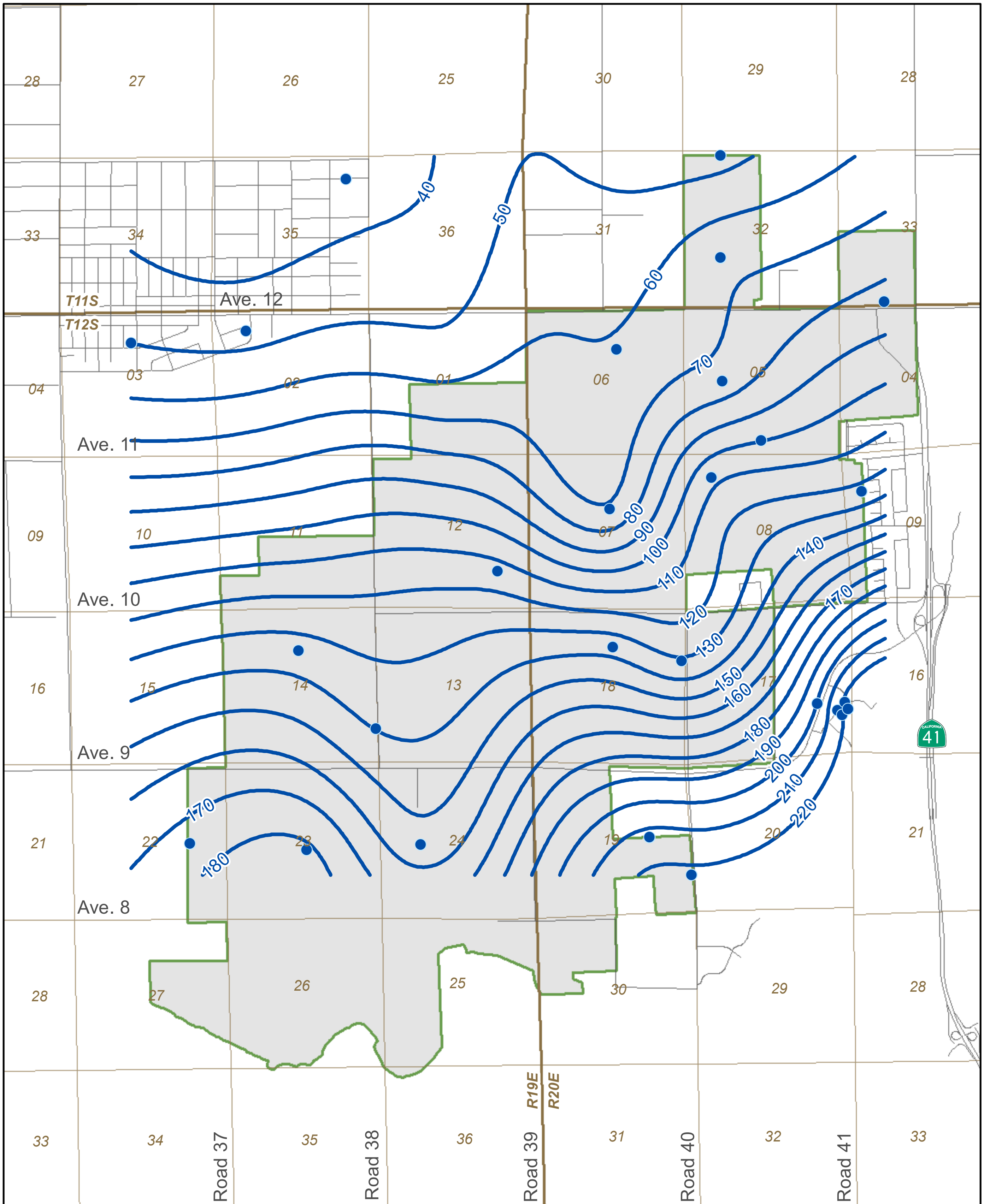
EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

ROOT CREEK WATER DISTRICT

Elevation of Water in Wells

Spring 2017

6/28/2017: G:\Root Creek WD-1249\GIS\12491001-E\Groundwater Analysis\Map\Spring17_WSE.mxd




EST. 1968
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company

N

0 0.5 1
Miles

**Legend**

Root Creek WD

Well Used In Analysis

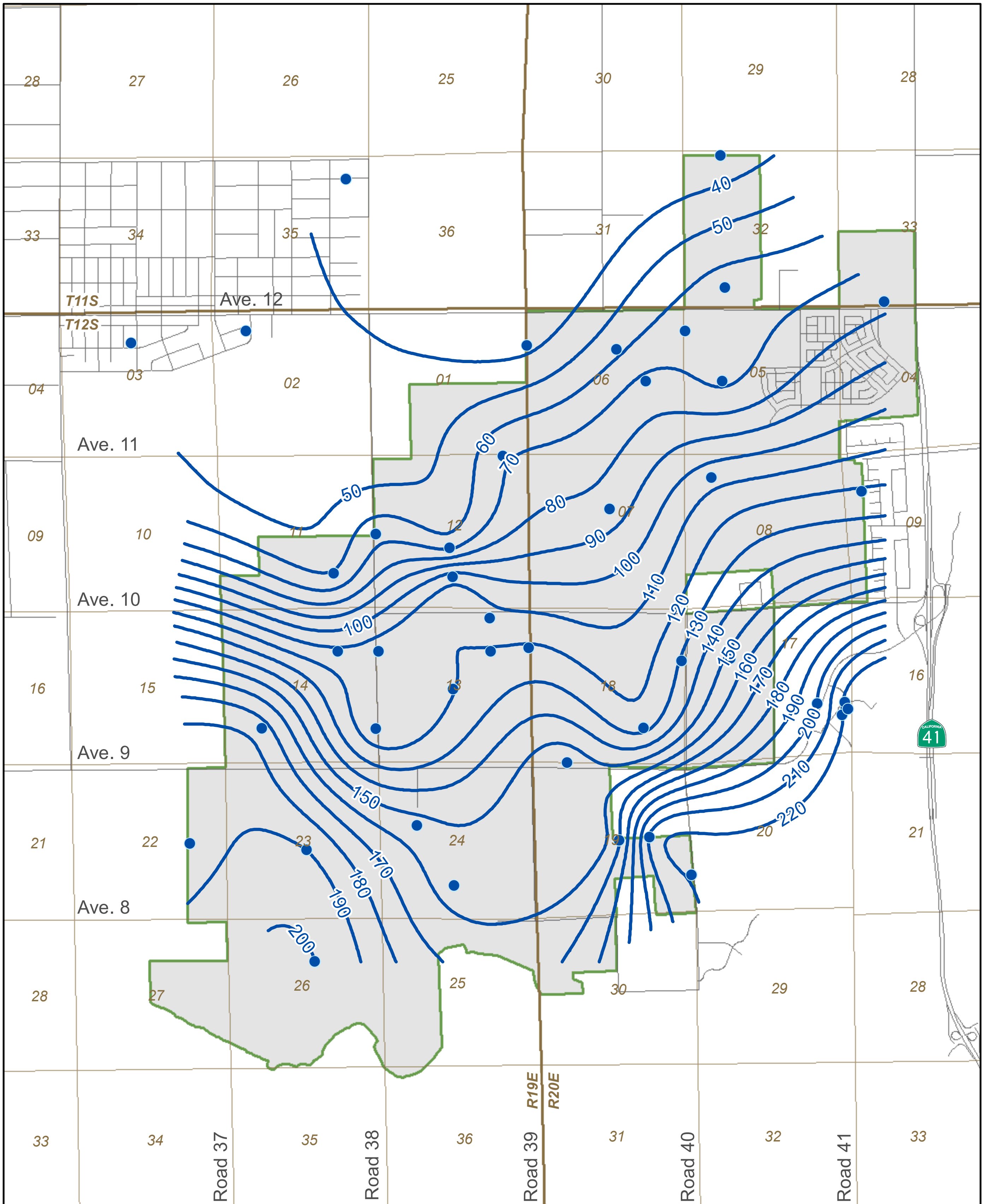
**Elevation of Water in Wells (feet above sea level)**

Line of Equal Elevation (10 ft interval)

ROOT CREEK WATER DISTRICT

Elevation of Water in Wells

Spring 2018




**Provost & Pritchard Consulting Group** EST. 1968, An Employee Owned Company

N

0 0.5 1
Miles

**Legend**

Root Creek WD

Well Used In Analysis

**Elevation of Water in Wells (feet above sea level)**

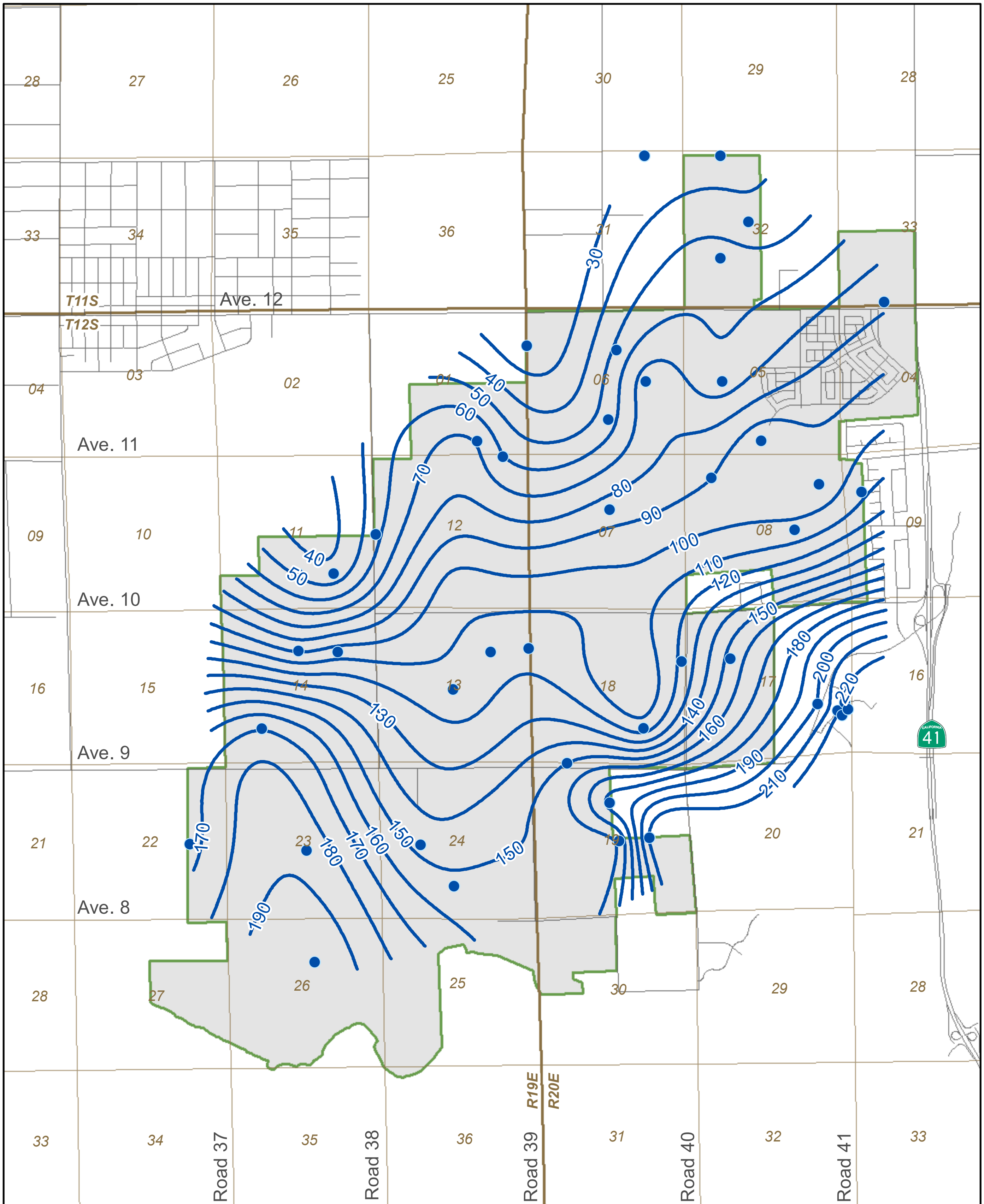
Line of Equal Elevation (10 ft interval)

ROOT CREEK WATER DISTRICT

Elevation of Water in Wells

Spring 2019

2/12/2020: \\ppeng.com\pzdata\clients\Root Creek WD-1249\GIS\12491001-E\Groundwater Analysis\Map\Spring19_WSE.mxd

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PRITCHARD
CONSULTING GROUP
An Employee Owned Company

N

0 0.5 1
Miles

**Legend**

Root Creek WD

Well Used In Analysis

**Elevation of Water in Wells (feet above sea level)**

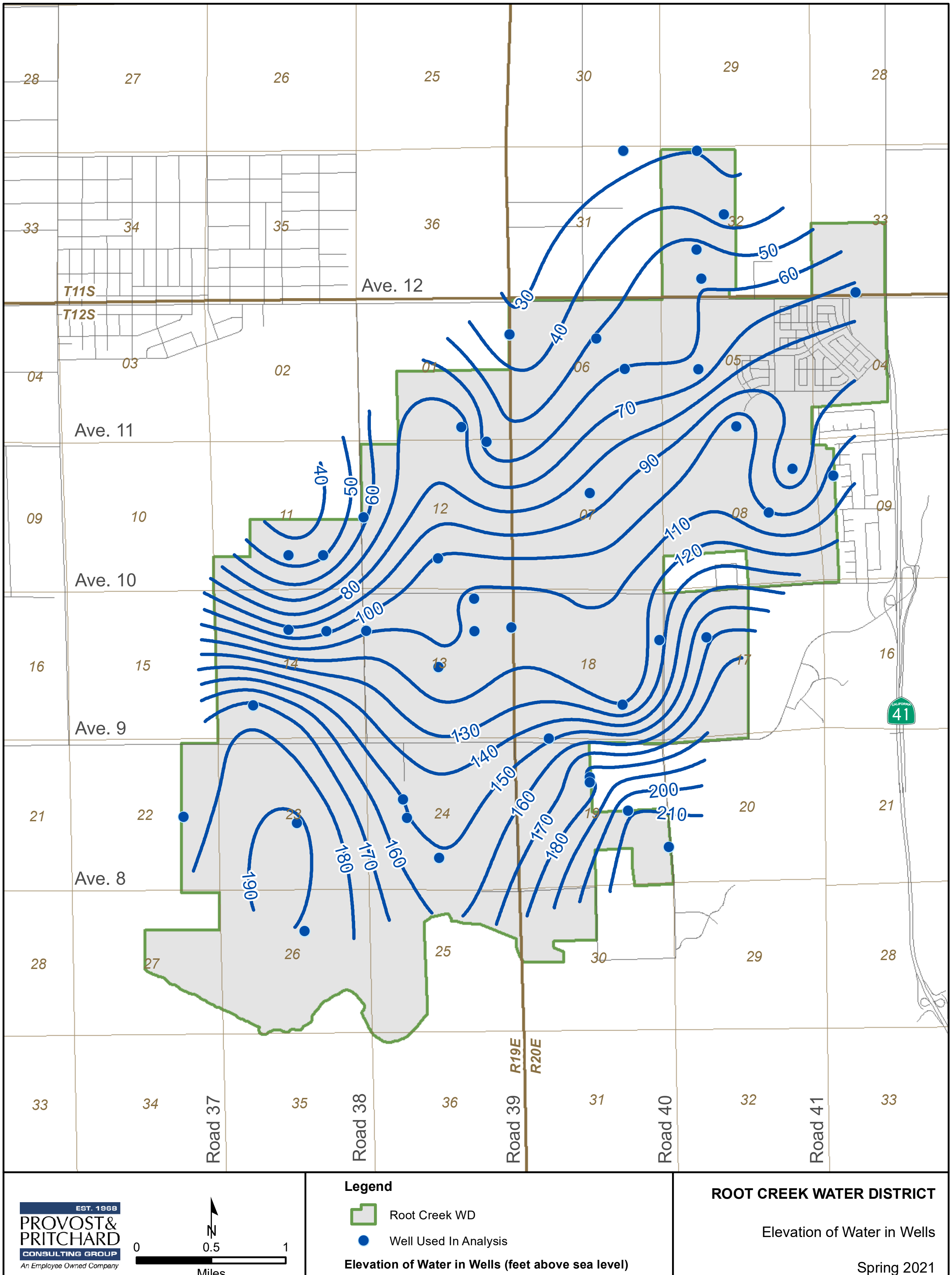
Line of Equal Elevation (10 ft interval)

ROOT CREEK WATER DISTRICT

Elevation of Water in Wells

Spring 2020

12/7/2020: G:\Root Creek WD-1249\GIS\12491001-E\Groundwater Analysis\Map\Spring20_WSE.mxd




**Legend**

Root Creek WD

Well Used In Analysis

**Elevation of Water in Wells (feet above sea level)**

Line of Equal Elevation (10 ft interval)

**ROOT CREEK WATER DISTRICT**

Elevation of Water in Wells

Spring 2021

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10/25/2021: G:\Root Creek WD-1249\GIS\12491001-E\Groundwater Analysis\Map\Spring21_WSE.mxd

*Appendix B - DWR AEM Maps – Excerpt from DWR's Draft Data Reports and RCWD AEM Results*

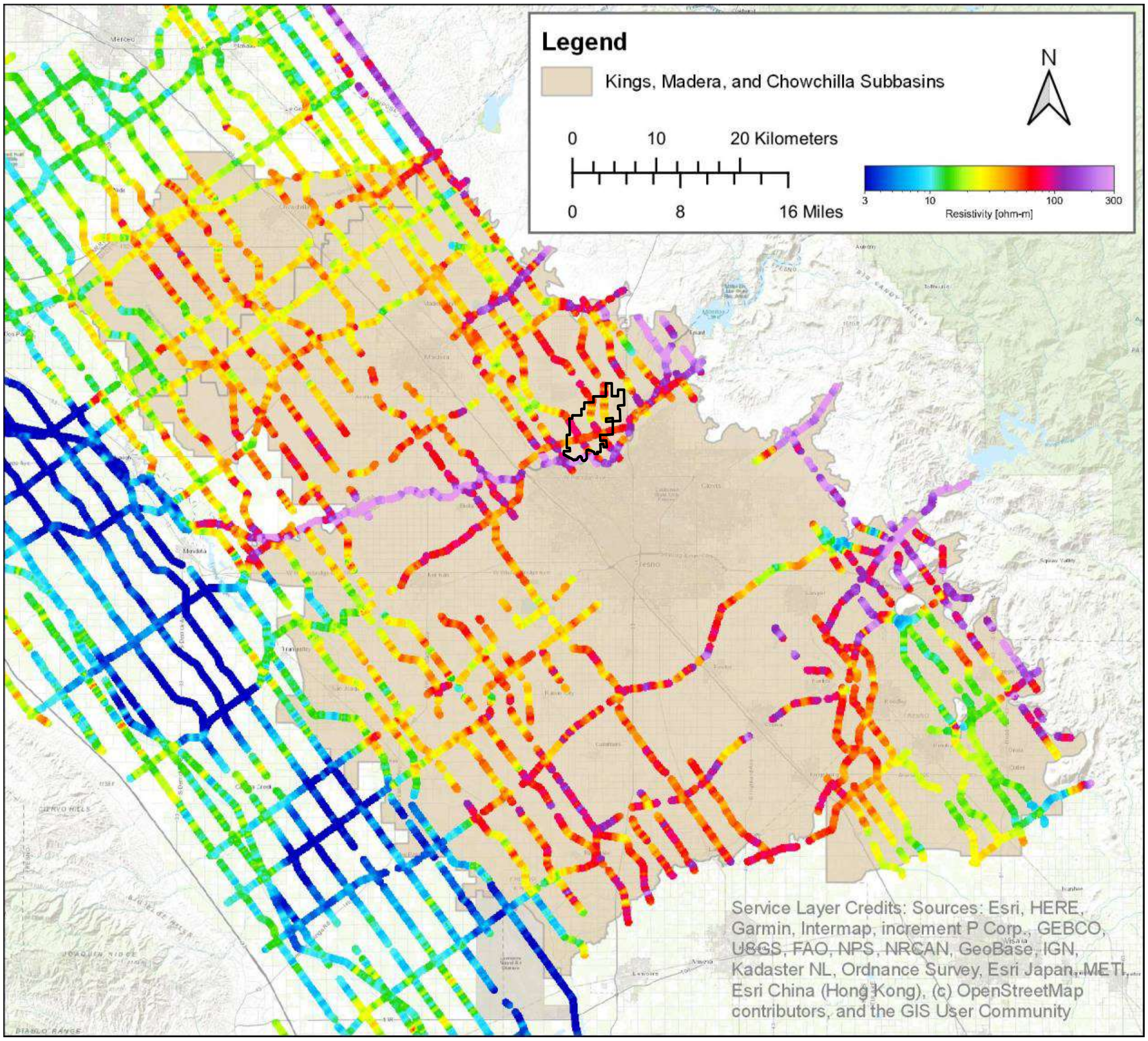


**Figure 4-7 Mean resistivity plan-view map in the depth interval 0-5 m (0-16 ft) bgs. The colors represent the resistivity, with blue colors representing the lower resistivities, below 10 ohm-m, the yellow and green colors representing the moderate resistivities, between 10 and 50 ohm-m, and the orange and red colors representing the higher resistivities, over 50 ohm-m.**

*Modified to show the Root Creek Water District boundary

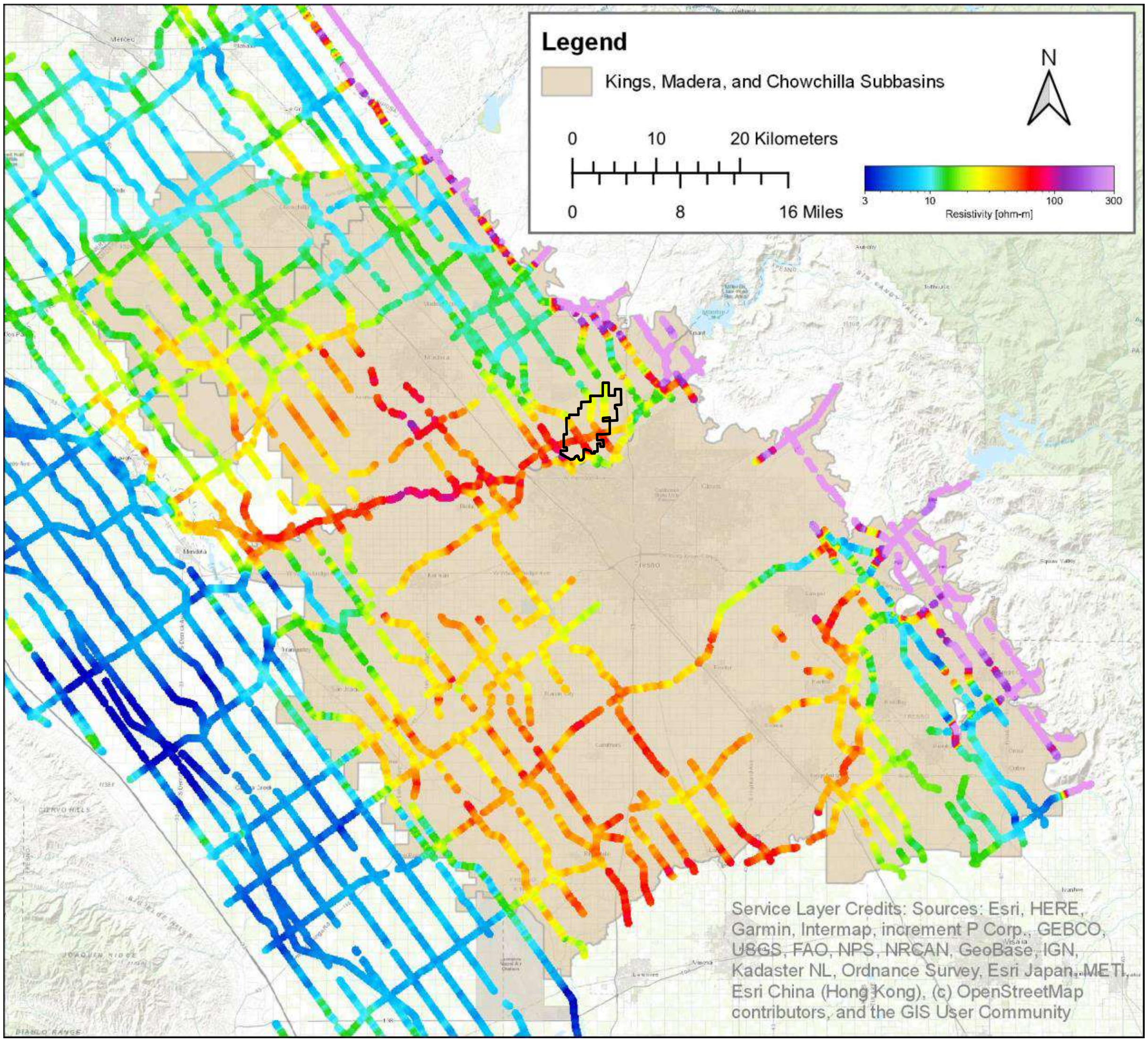


**Figure 4-8 Mean resistivity plan-view map in the depth interval 30-60 m (100-200 ft) bgs. The colors represent the resistivity, with blue colors representing the lower resistivities, below 10 ohm-m, the yellow and green colors representing the moderate resistivities, between 10 and 50 ohm-m, and the orange and red colors representing the higher resistivities, over 50 ohm-m.**

*Modified to show the Root Creek Water District boundary

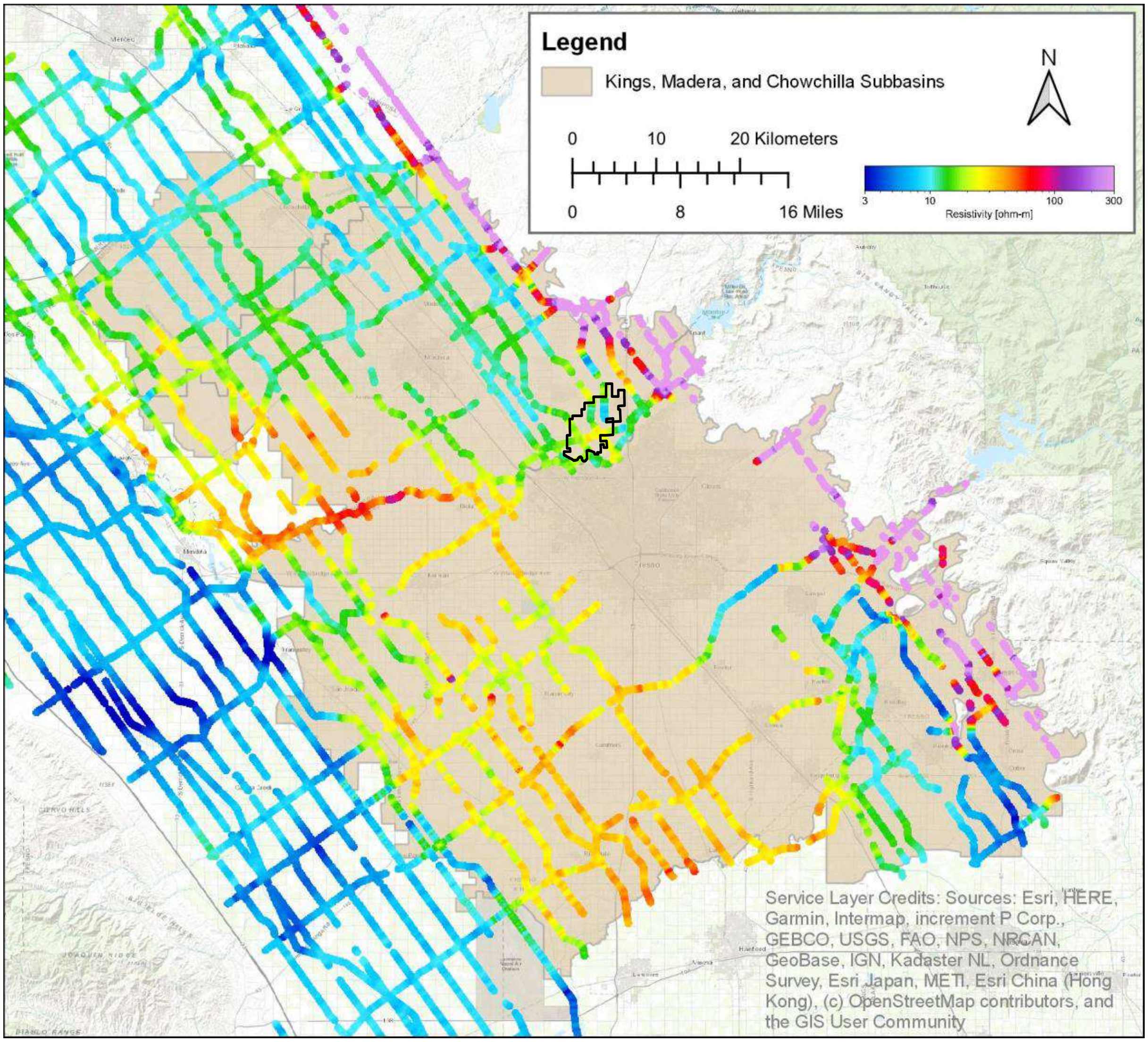


**Figure 4-9 Mean resistivity plan-view map in the elevation interval 0 to -20 m (0 to -65 ft) amsl. The colors represent the resistivity, with blue colors representing the lower resistivities, below 10 ohm-m, the yellow and green colors representing the moderate resistivities, between 10 and 50 ohm-m, and the orange and red colors representing the higher resistivities, over 50 ohm-m.**

*Modified to show the Root Creek Water District boundary

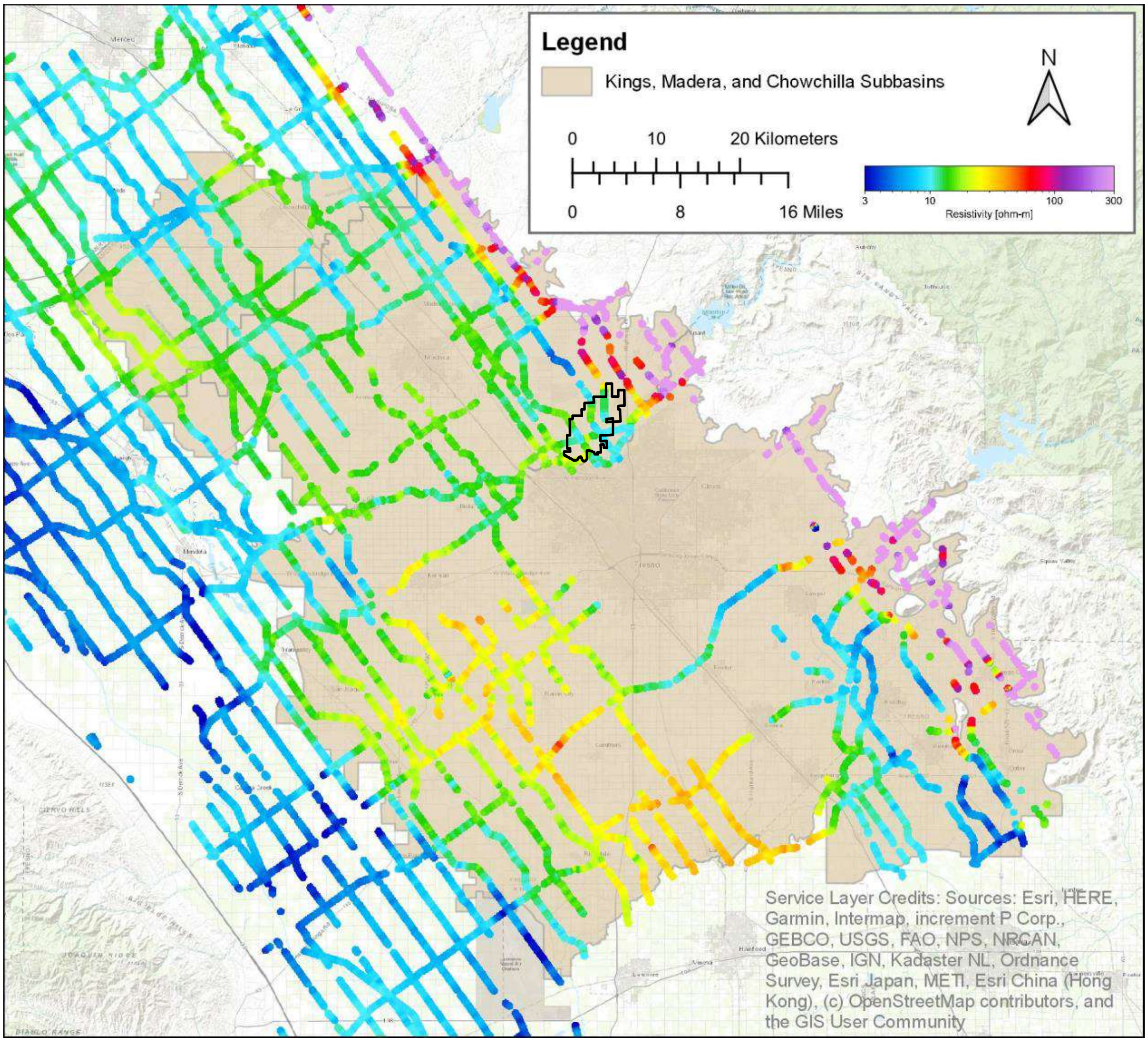


**Figure 4-10 Mean resistivity plan-view map in the elevation interval -80 m to -100 m ( -260 to -330 ft) amsl. The colors represent the resistivity, with blue colors representing the lower resistivities, below 10 ohm-m, the yellow and green colors representing the moderate resistivities, between 10 and 50 ohm-m, and the orange and red colors representing the higher resistivities, over 50 ohm-m.**

*Modified to show the Root Creek Water District boundary