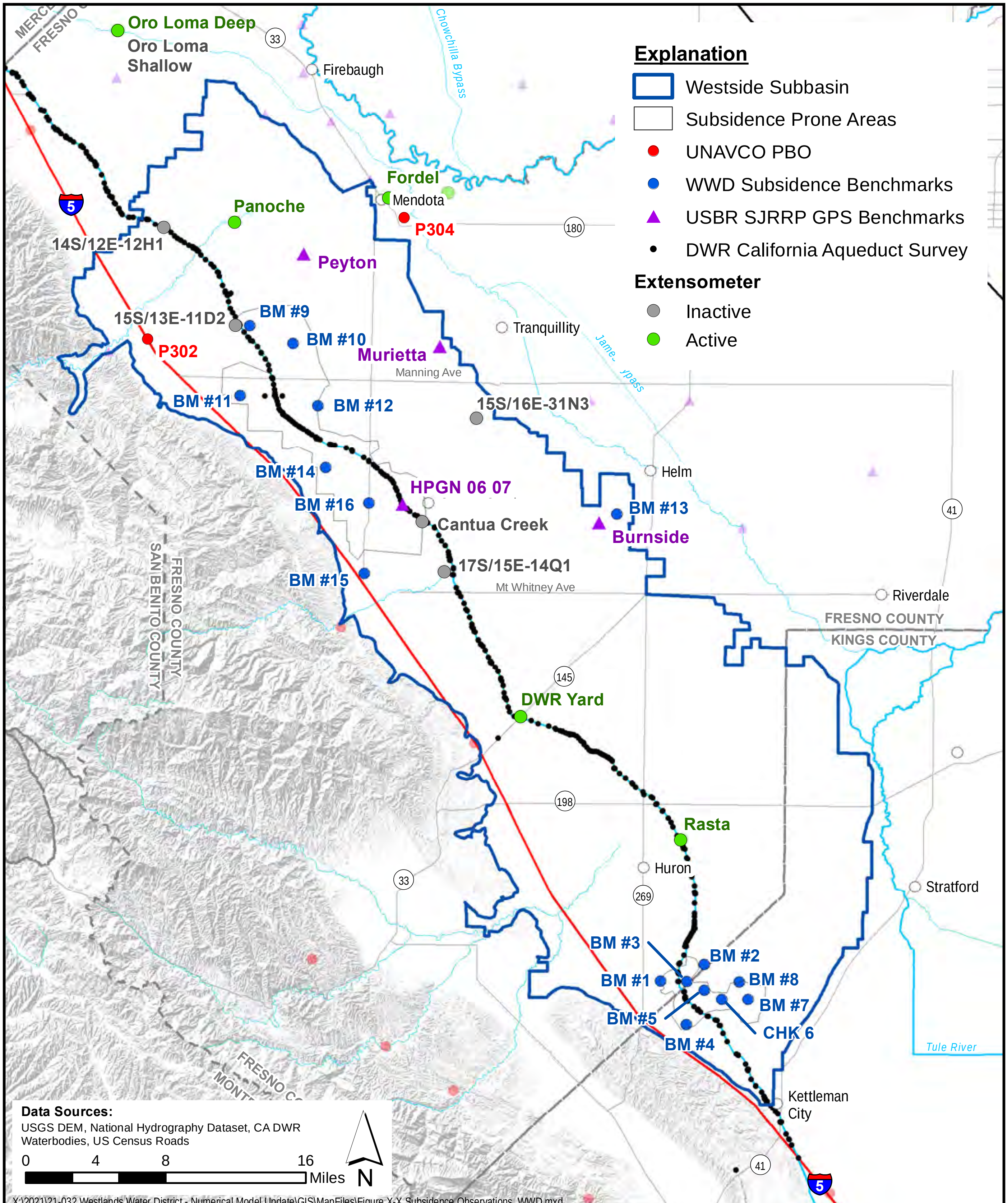

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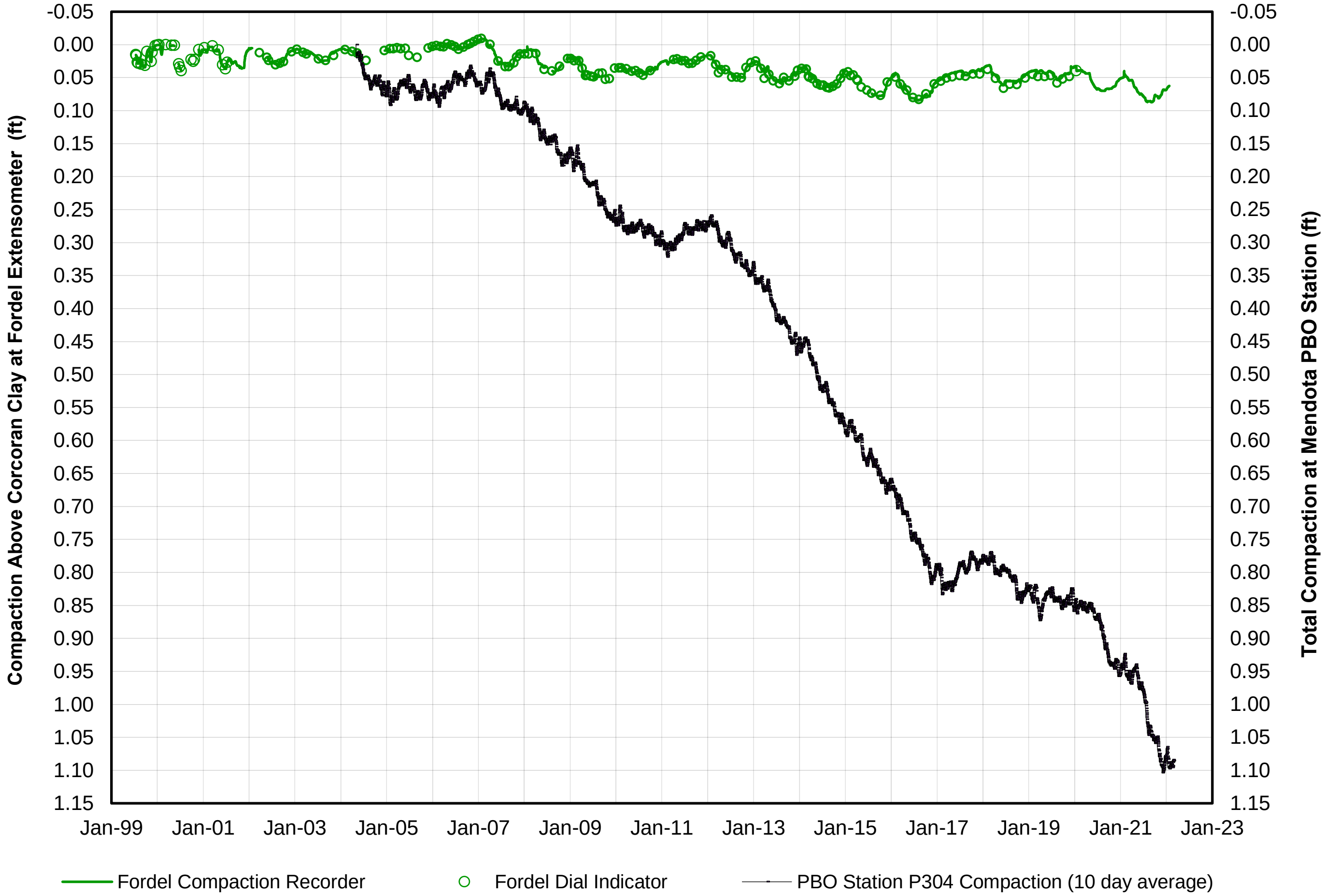
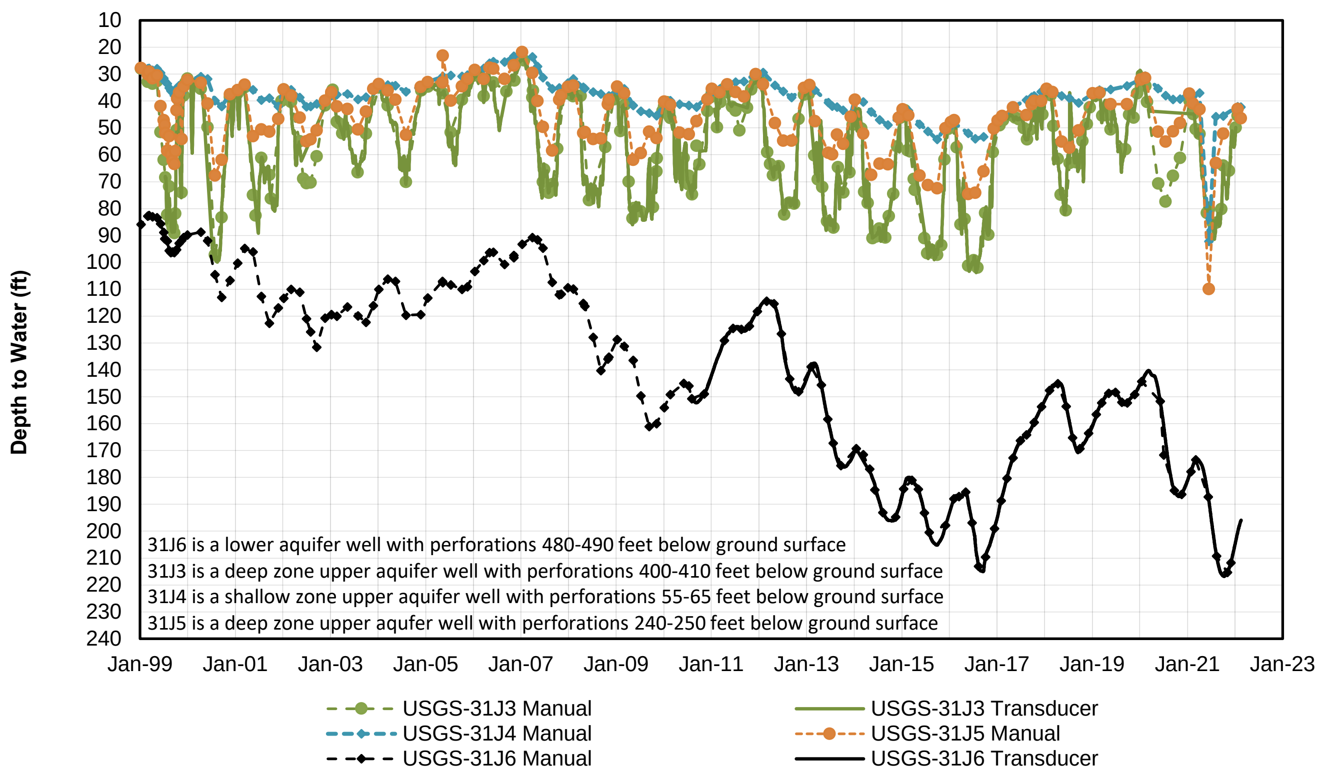
Subsidence Observations in and Adjacent to the Westside Subbasin

SGMA Sustainability Analyses
Westside Subbasin

Figure 2-59





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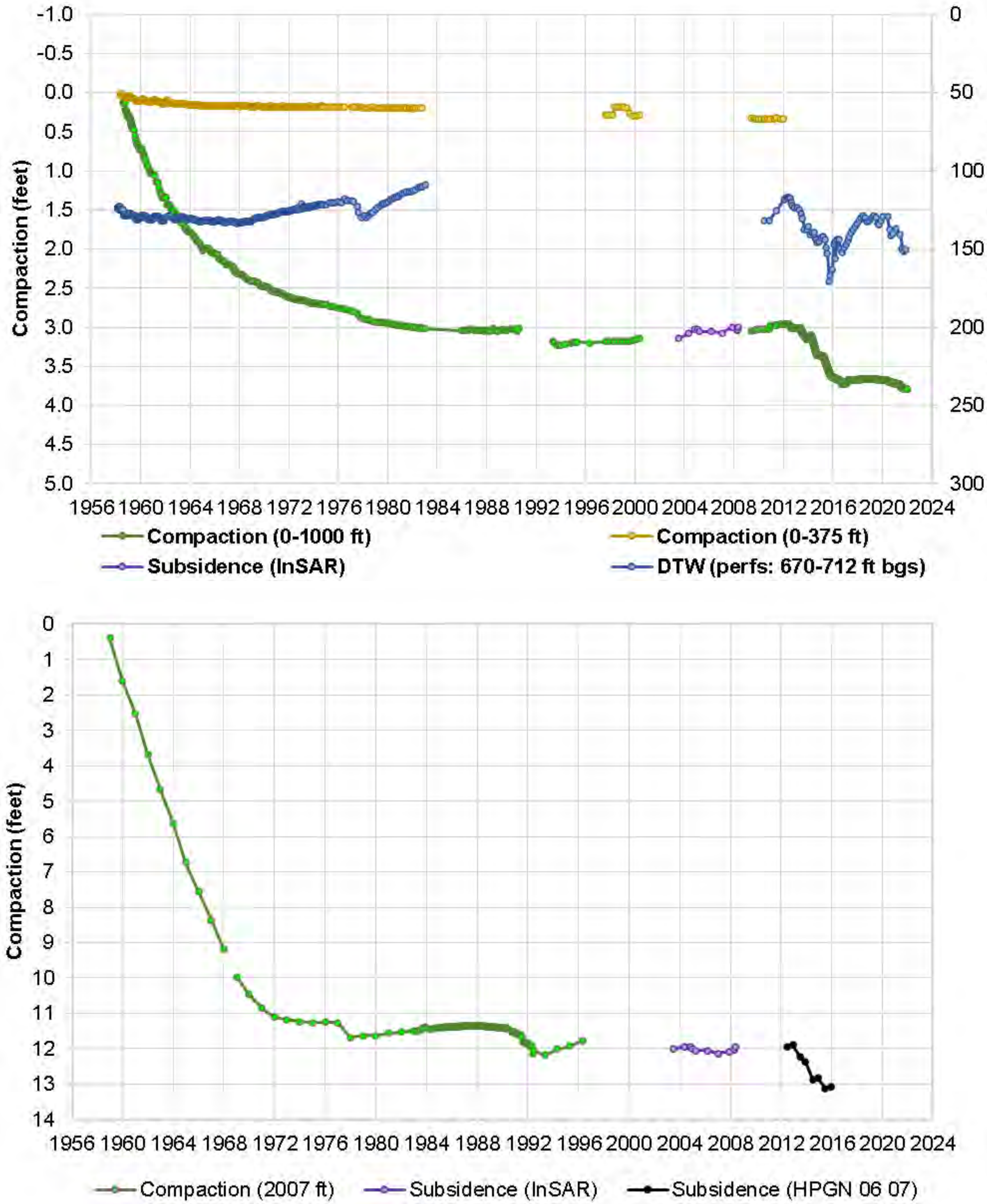
Total Compaction West of Mendota Pool and Depth to Water Below Corcoran Clay USGS Well T13S/R15E-31J6 (Outside of WWD)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-60



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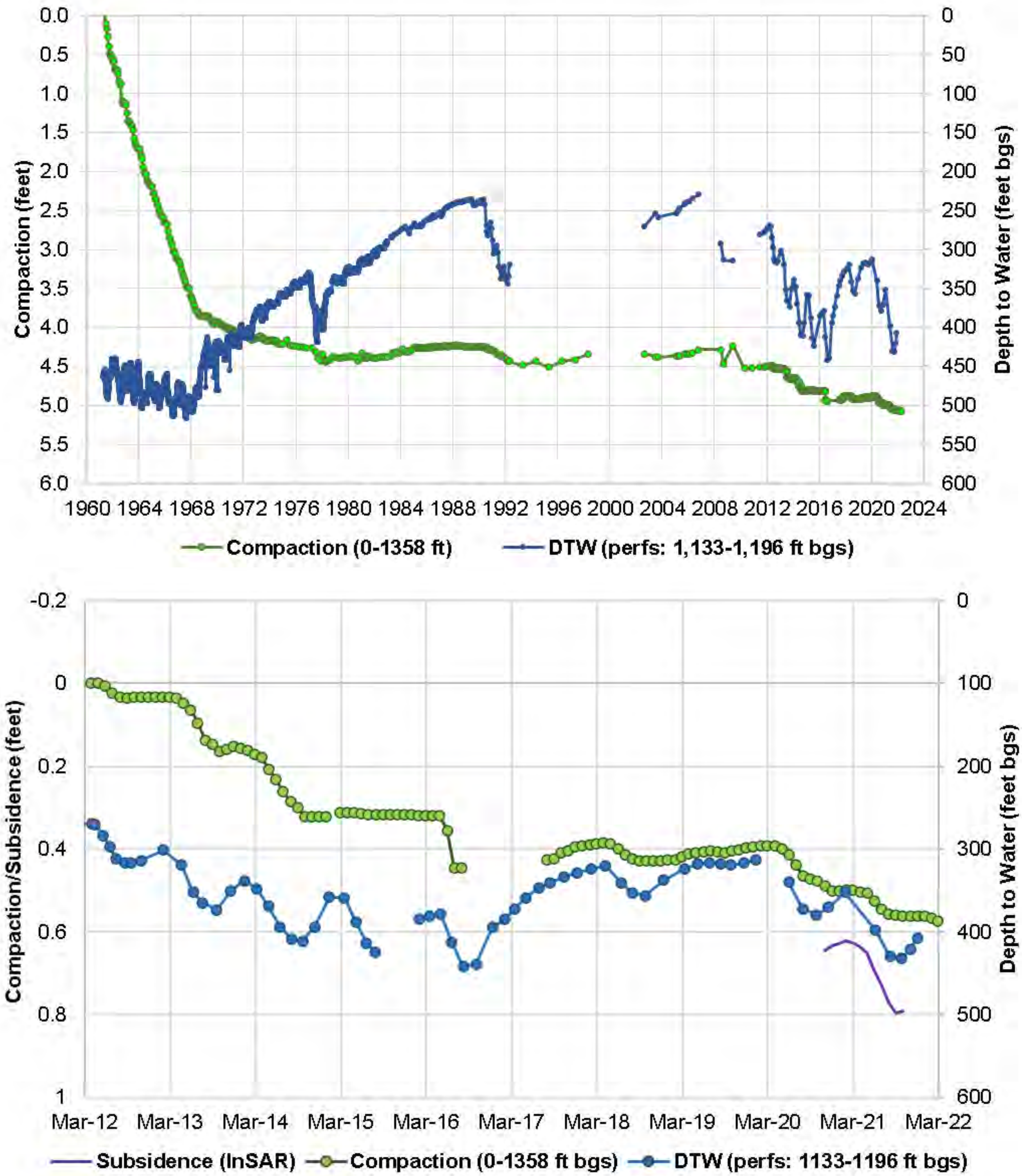
Compaction, Subsidence and Depth to Water
Oro Loma (12S/12E-16H - Outside of WWD) and Cantua Creek (16S/15E/34N) Extensometers

SGMA Sustainability Anlalysis
Westside Subbasin

Figure 2-61



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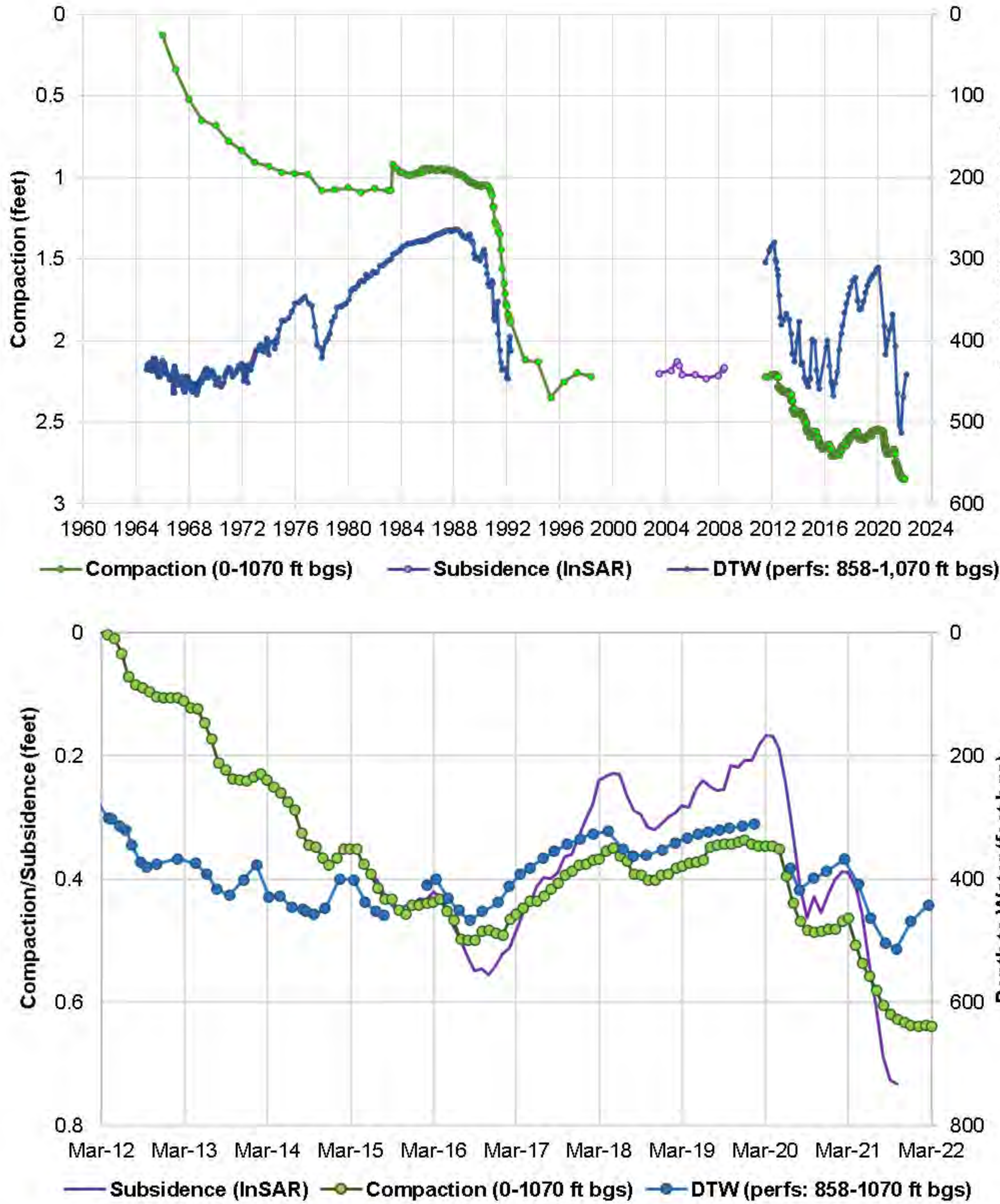
Compaction, Subsidence and Depth to Water
Panoche Extensometer (14S/13E-11D6)

SGMA Sustainability Anlalysis
Westside Subbasin

Figure 2-62



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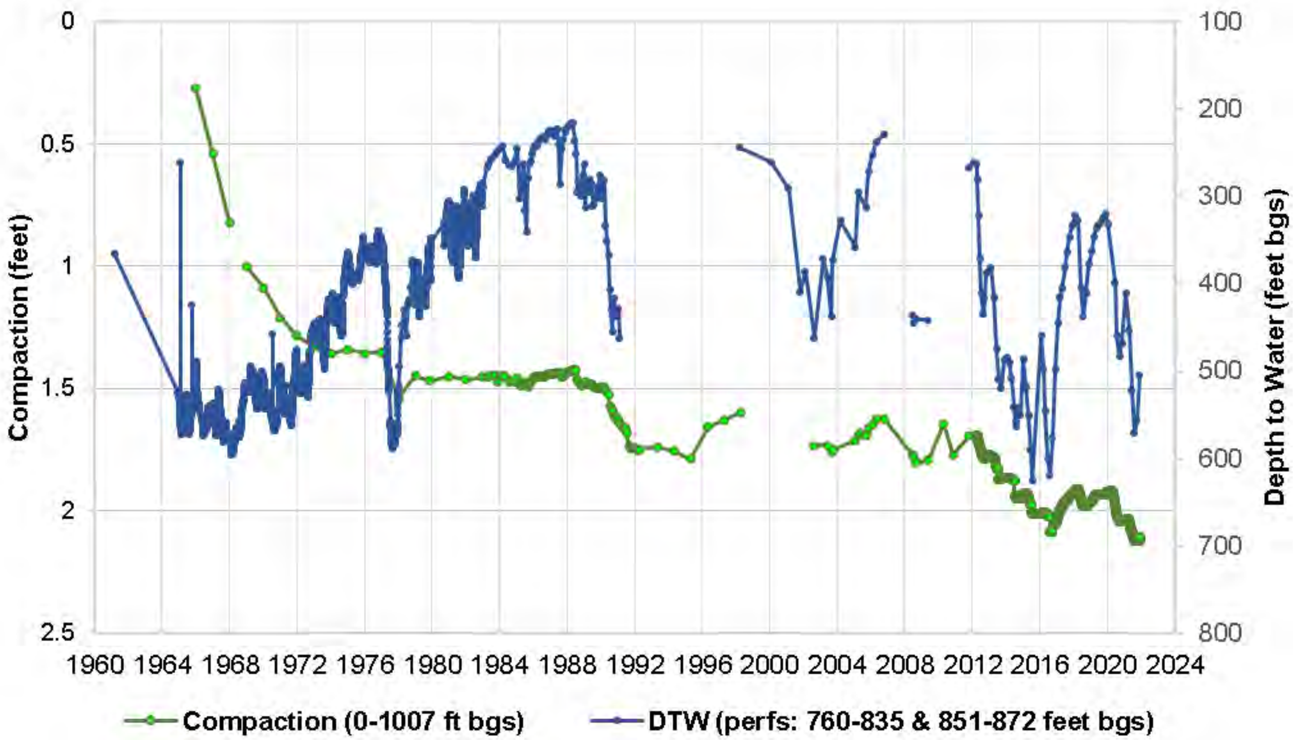
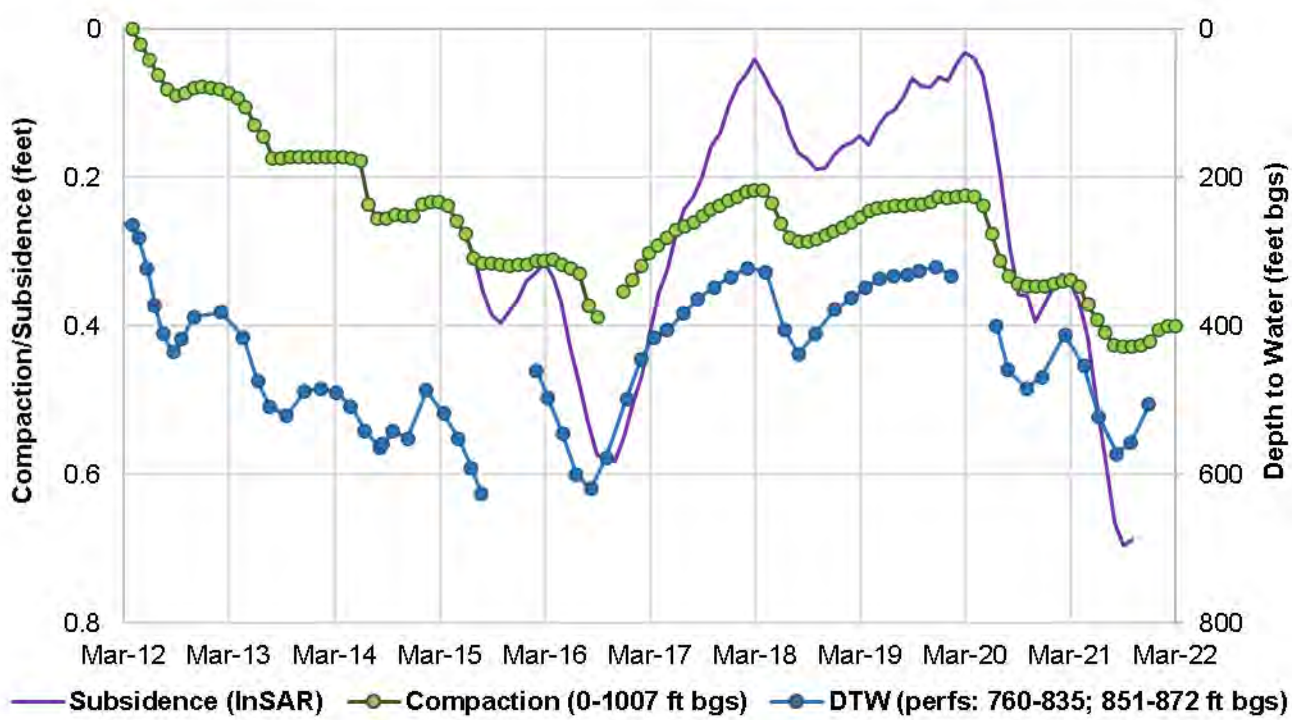
Compaction, Subsidence and Depth to Water
DWR-Yard Extensometer (18S/16E-33A1)

SGMA Sustainability Anlalysis
Westside Subbasin

Figure 2-63





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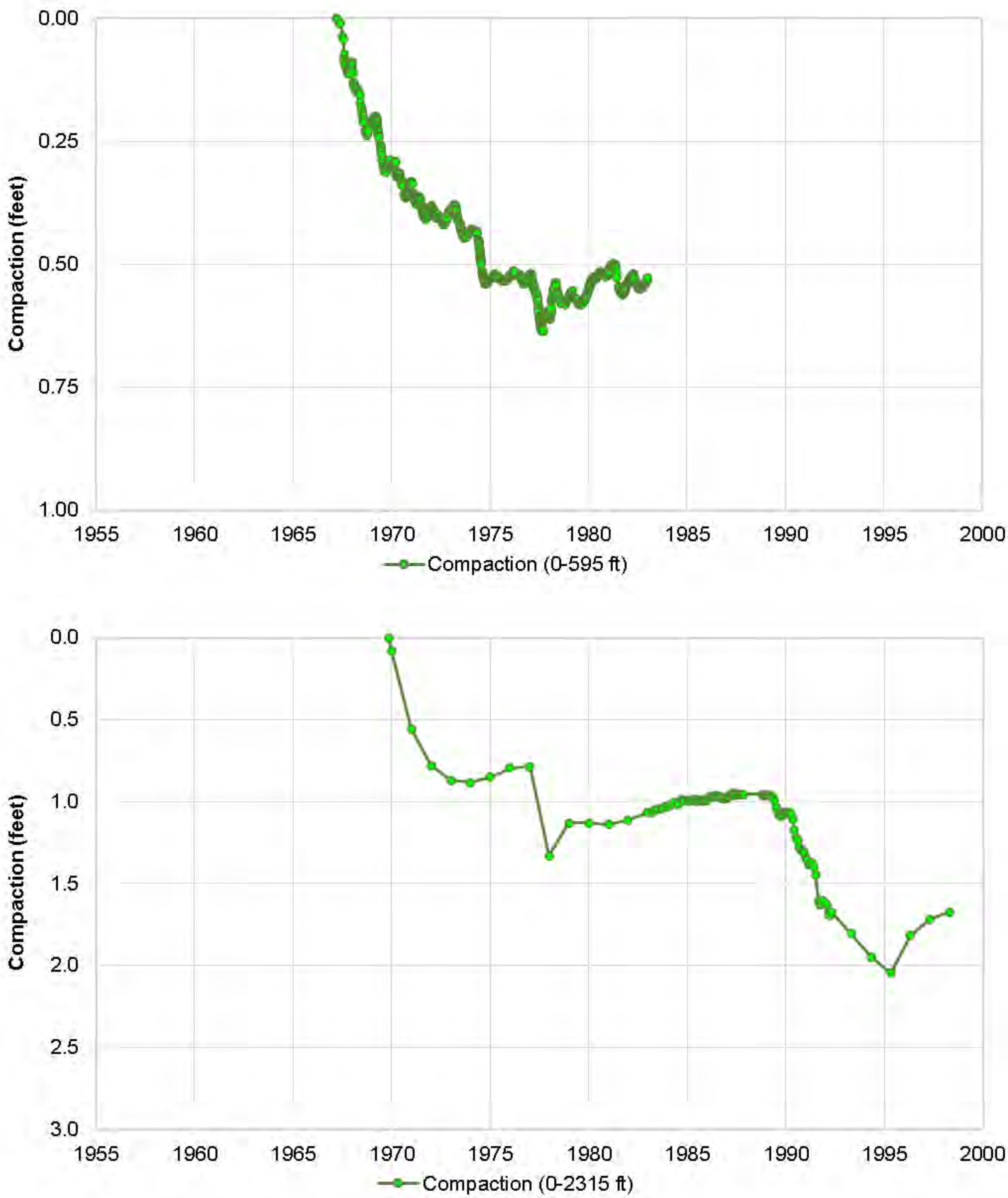
Compaction, Subsidence and Depth to Water
Rasta Extensometer (20S/18E-06D)

SGMA Sustainability Anlalysis
Westside Subbasin

Figure 2-64



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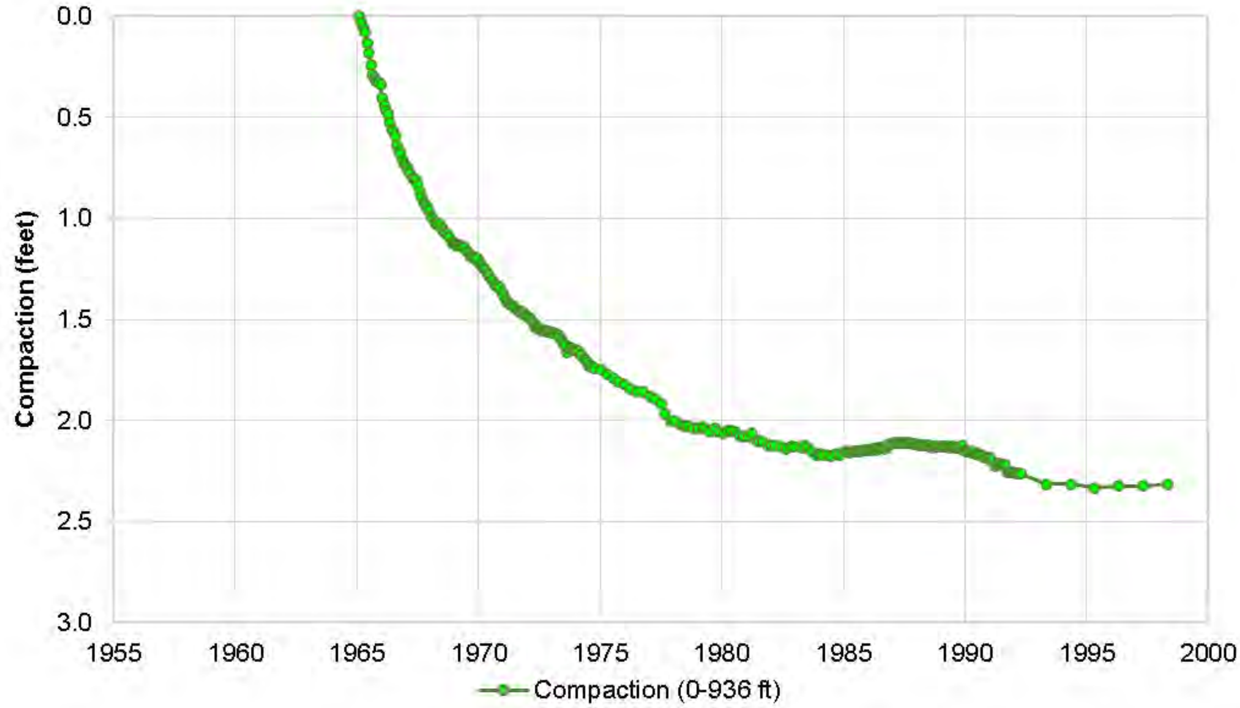
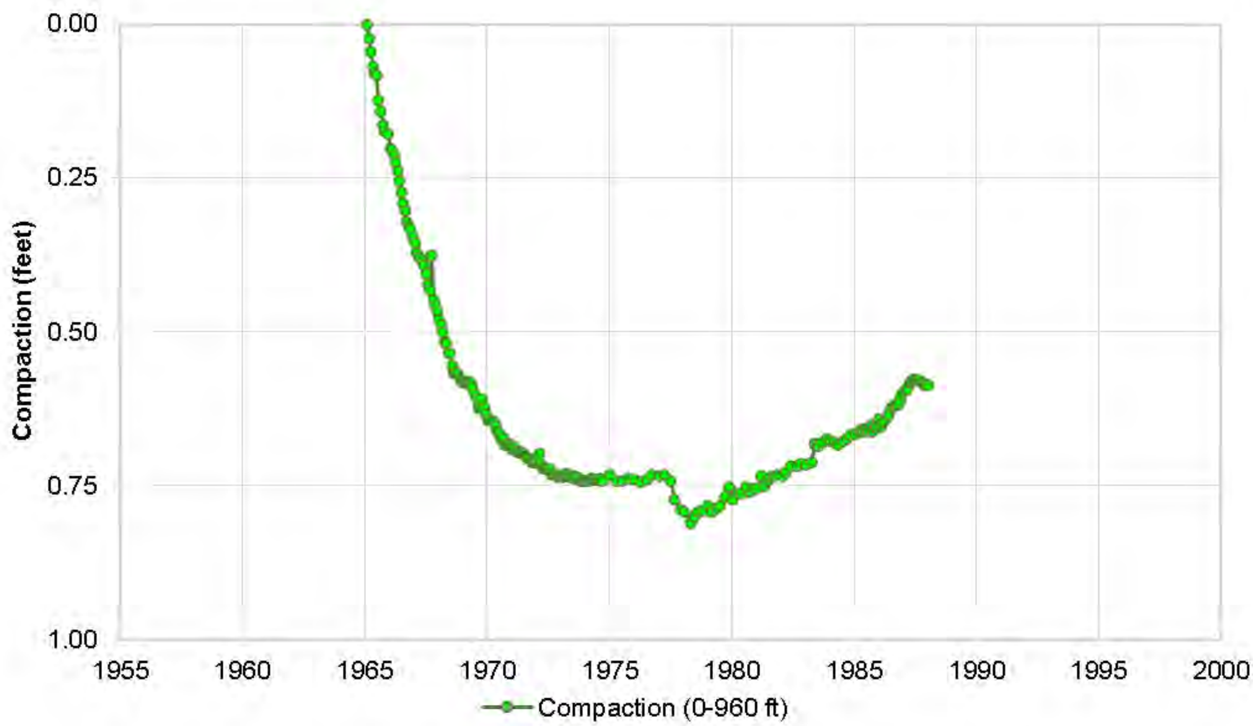
Compaction at 15S/16E-31N3 (Top) and 17S/15E-14Q1 (Bottom) Extensometers

SGMA Sustainability Anlalysis
Westside Subbasin

Figure 2-65





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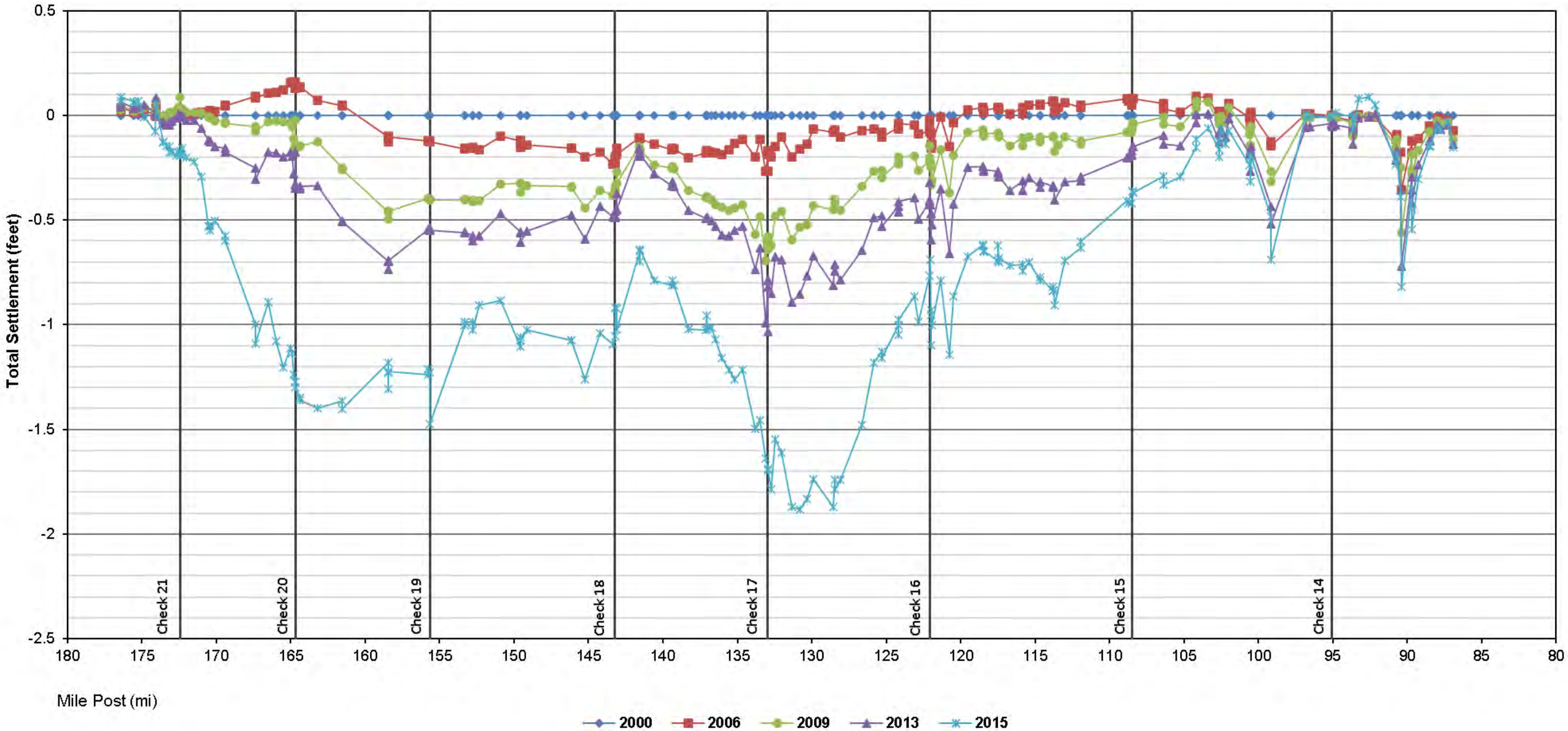
Compaction at 14S/12E-12H1 (Top) and 15S/13E-11D2 (Bottom) Extensometers

SGMA Sustainability Anlalysis
Westside Subbasin

Figure 2-66



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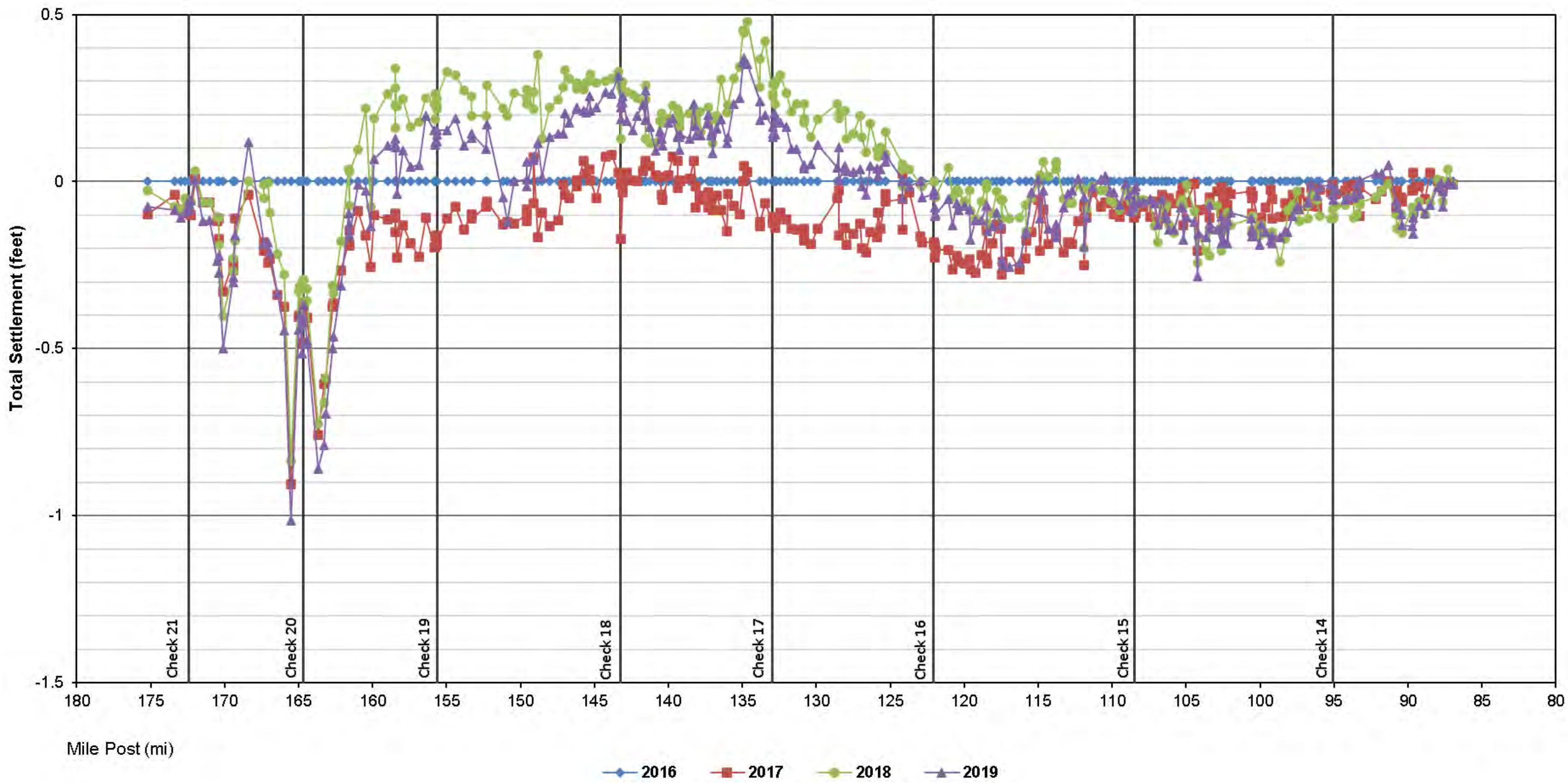
Subsidence Along the California Aqueduct from 2000 to 2015 San Luis Reservoir to Kettleman City

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-67



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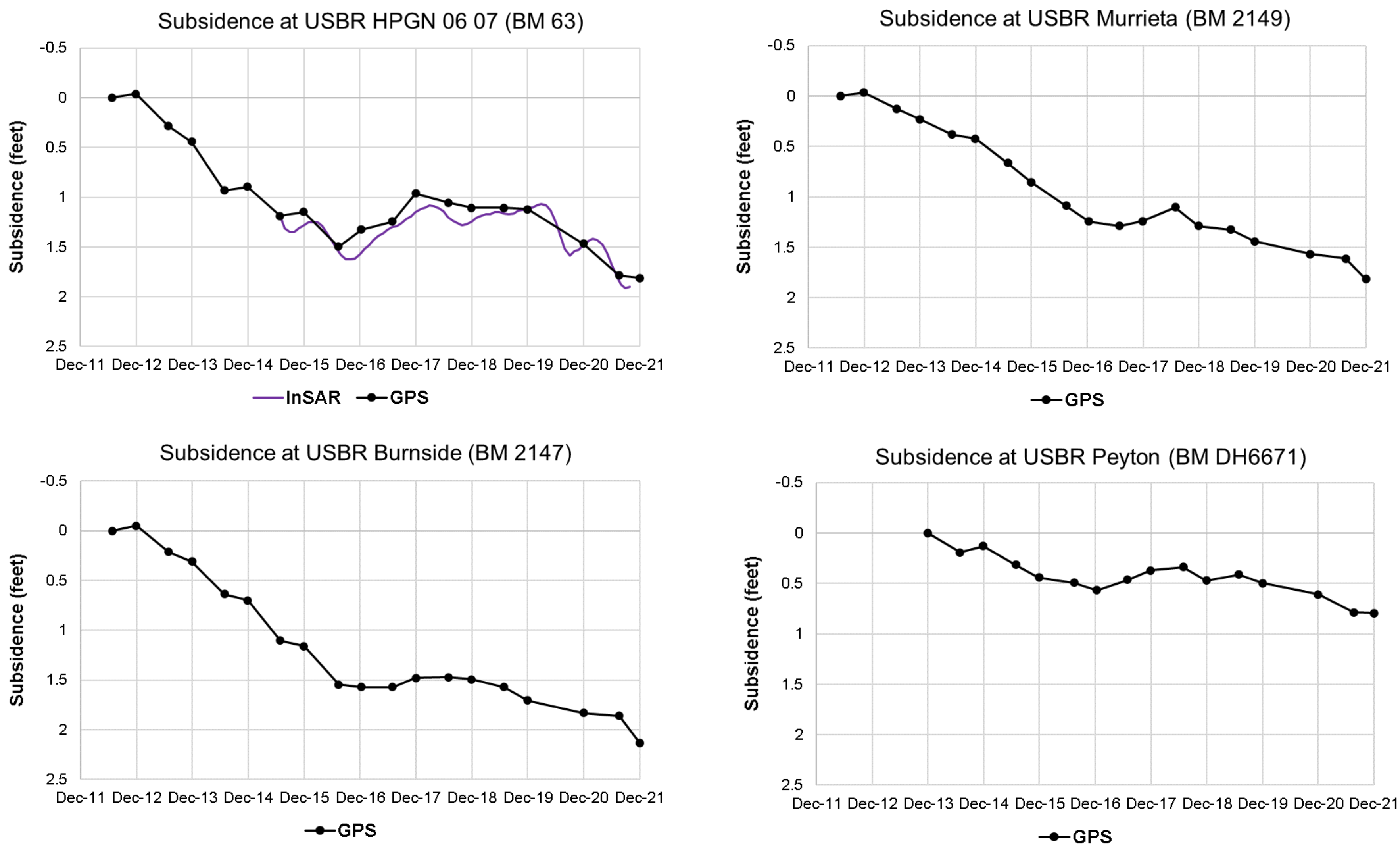
Subsidence Along the California Aqueduct from 2016 to 2019 San Luis Reservoir to Kettleman City

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-68



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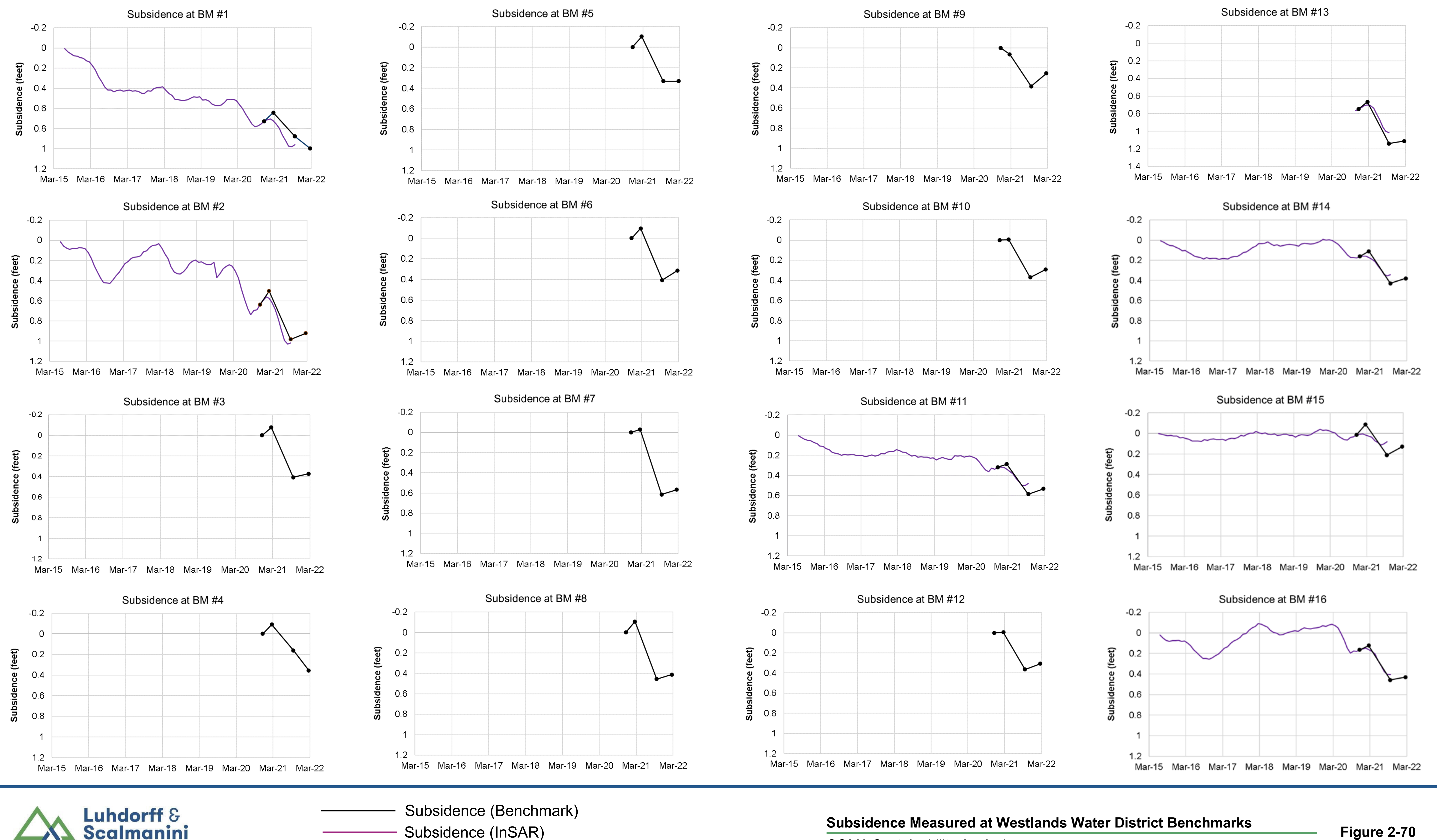
Subsidence at USBR SJRRP GPS Benchmarks

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-69



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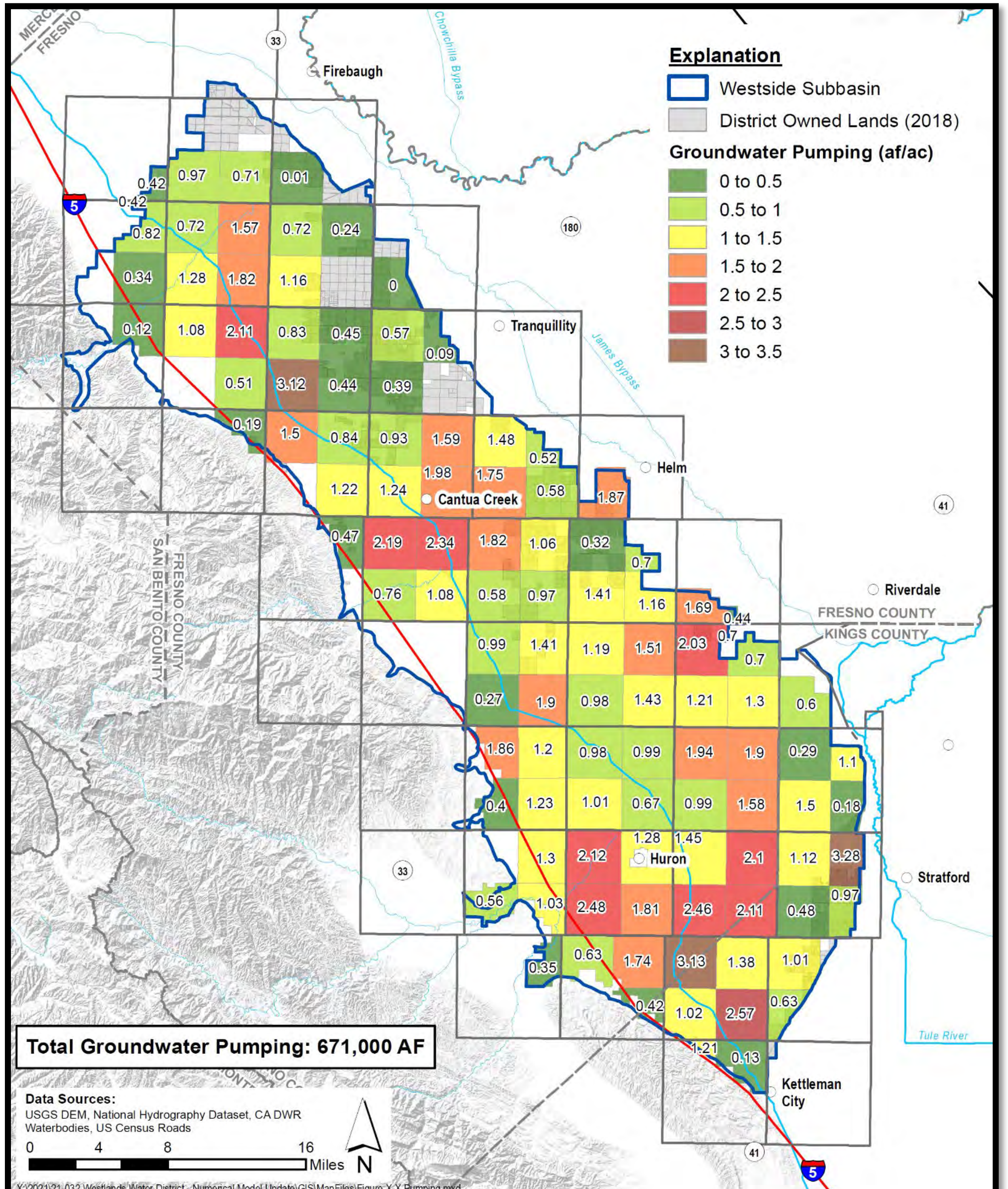
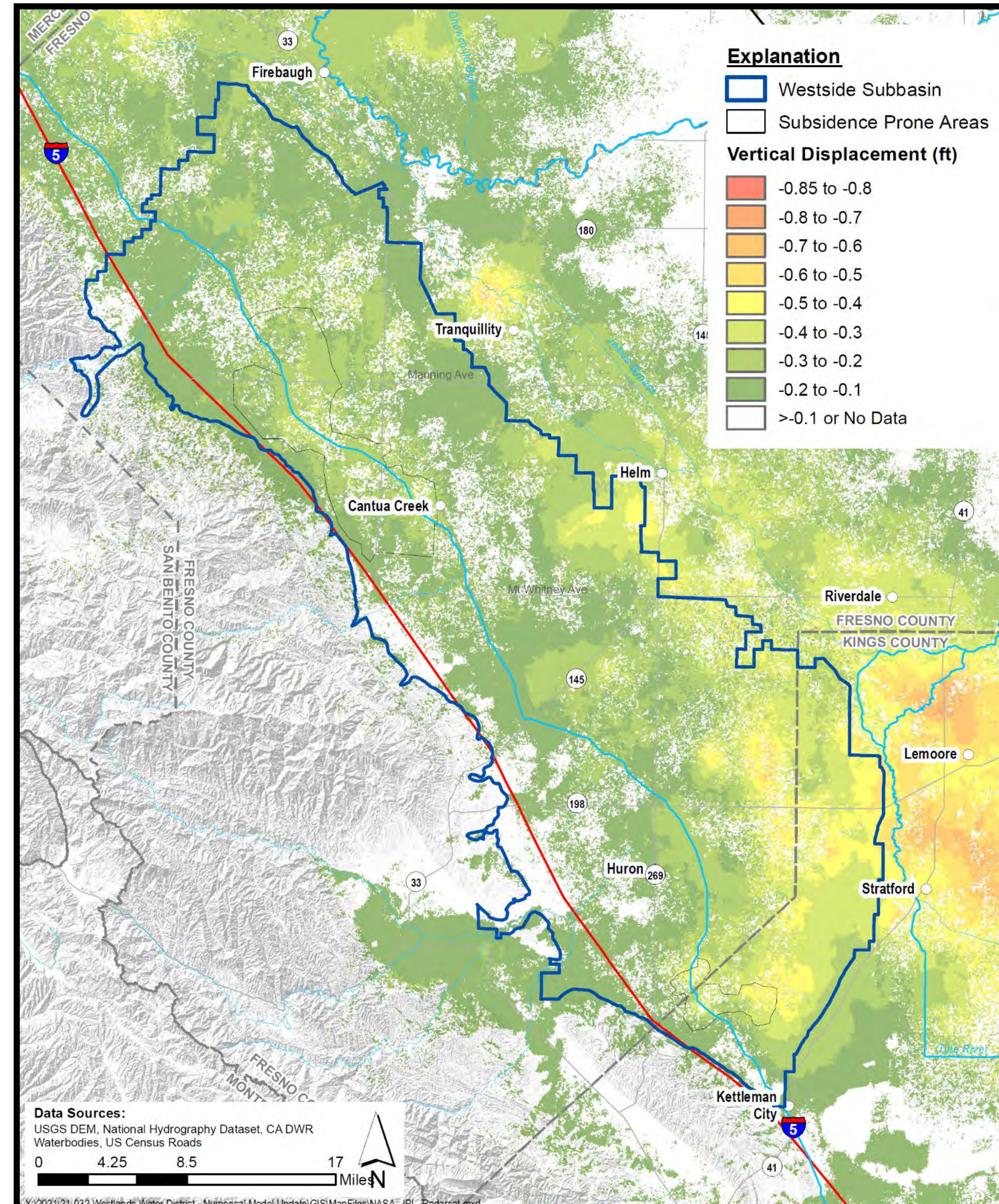
Subsidence Measured at Westlands Water District Benchmarks

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-70





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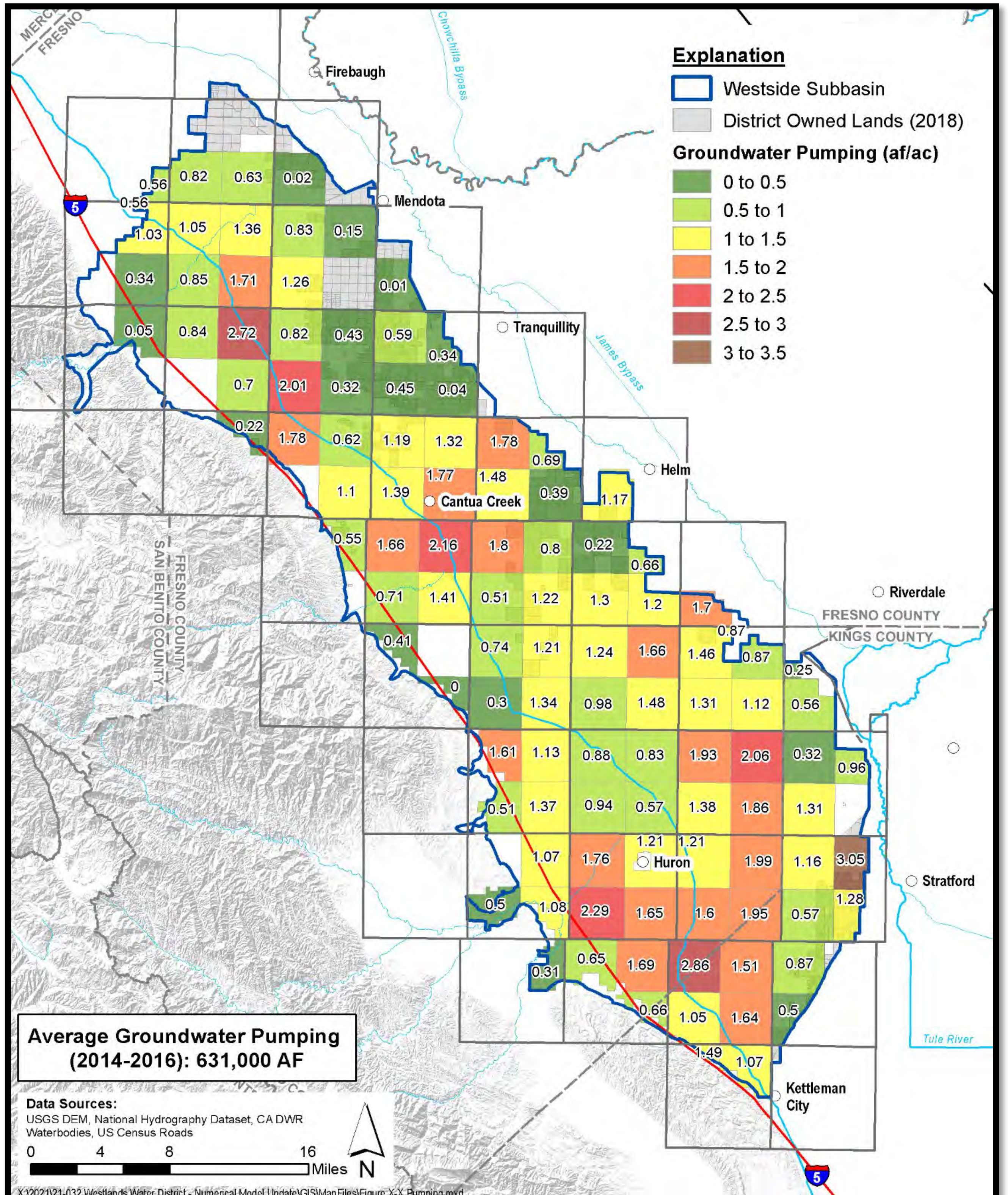
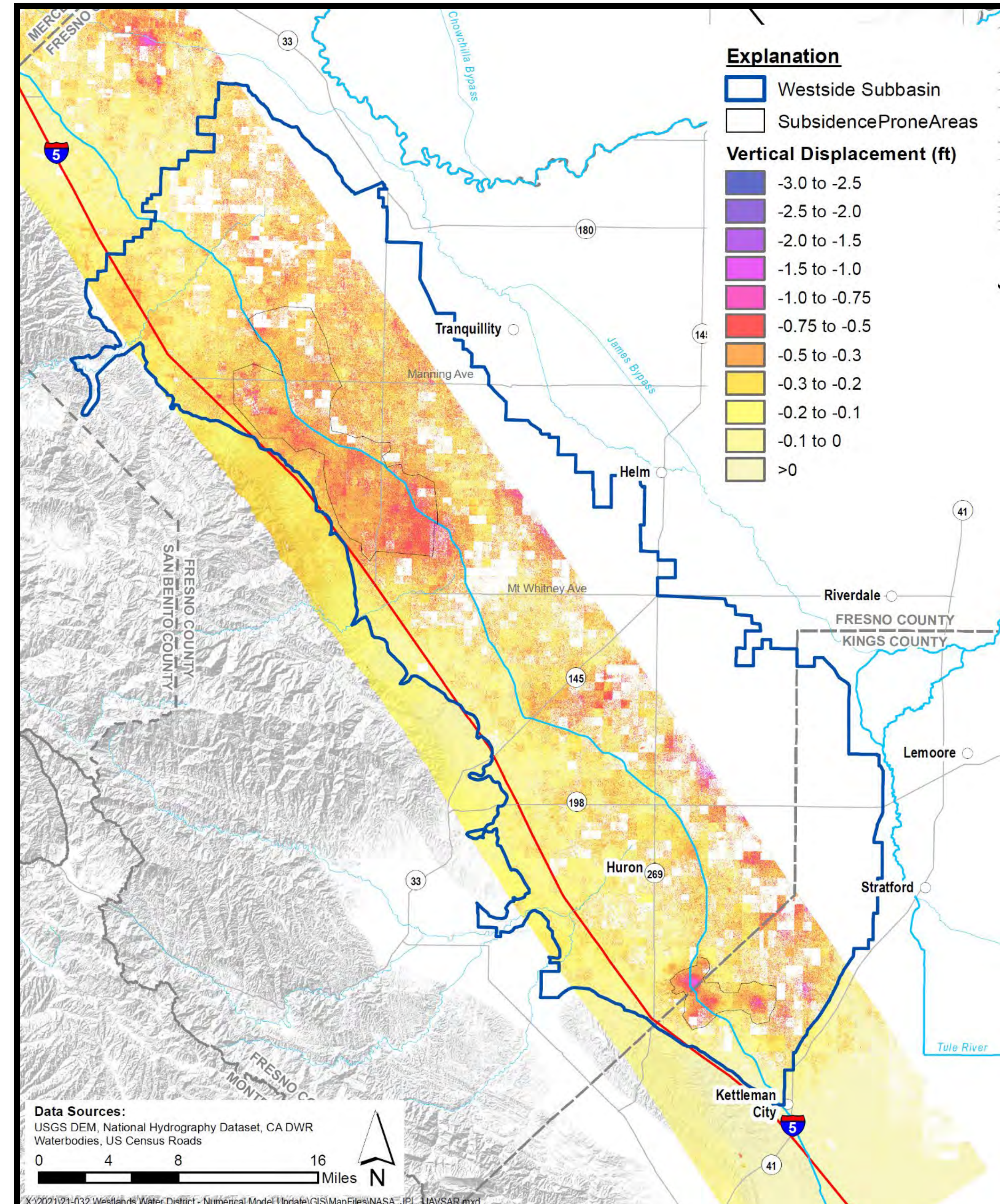
Groundwater Pumping (March 2014 through February 2015)
NASA JPL InSAR from Radarsat-2 (May 2014 to January 2015)
SGMA Sustainability Analysis
Westside Subbasin

Figure 2-71





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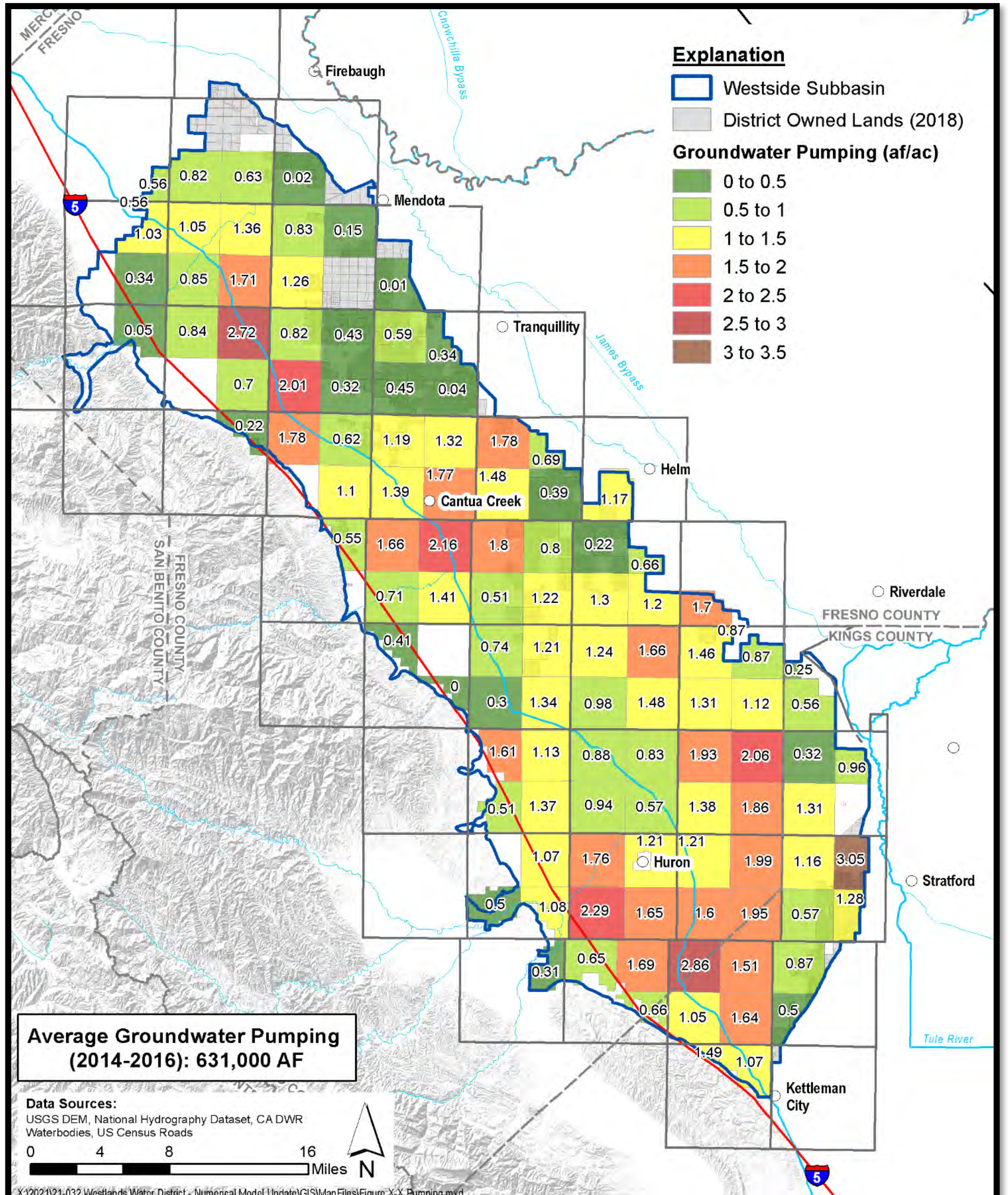
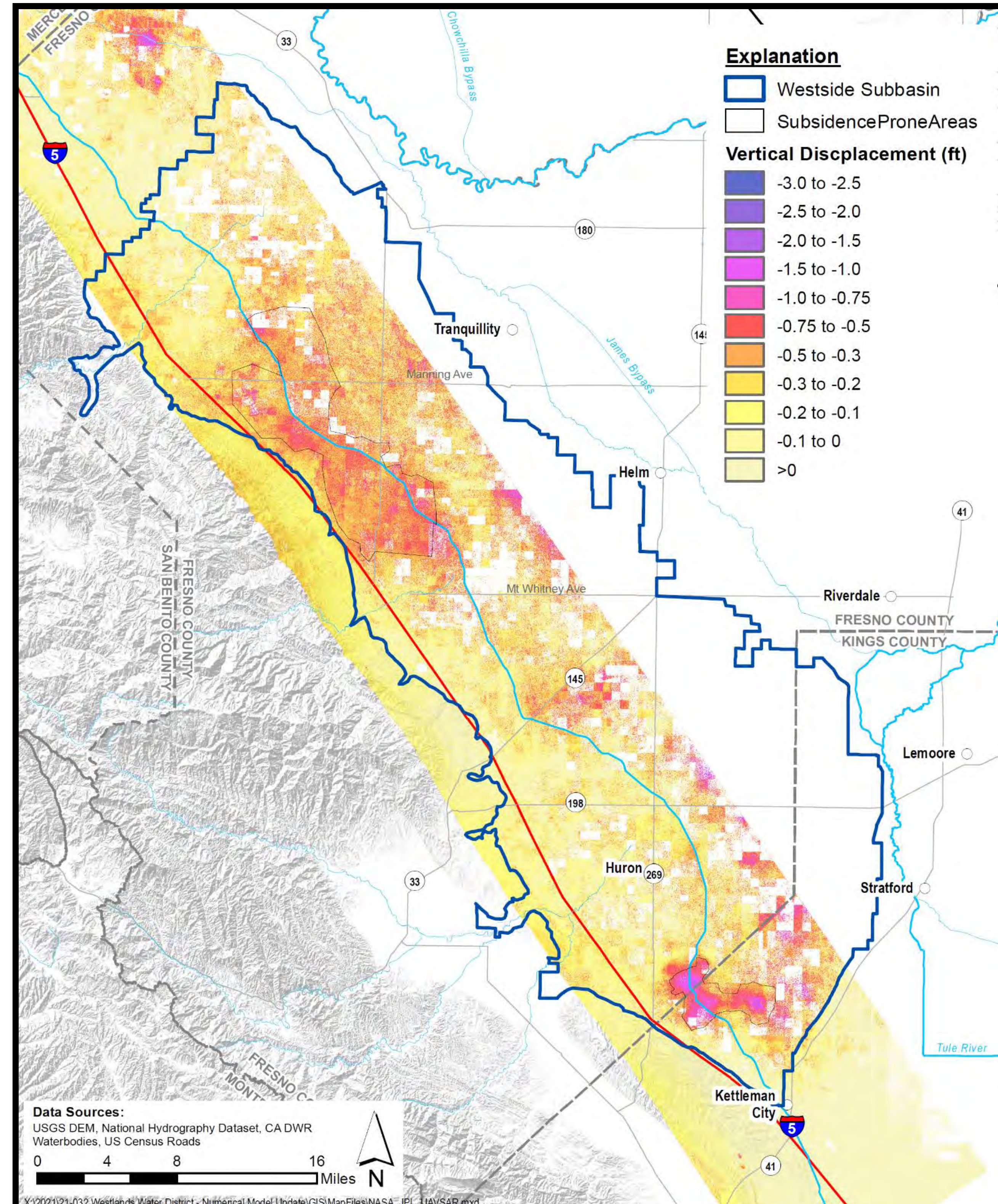
Groundwater Pumping (March 2014 through February 2017 Average)
NASA JPL InSAR from UAVSAR Imagery (May 2013 to March 2015)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-72





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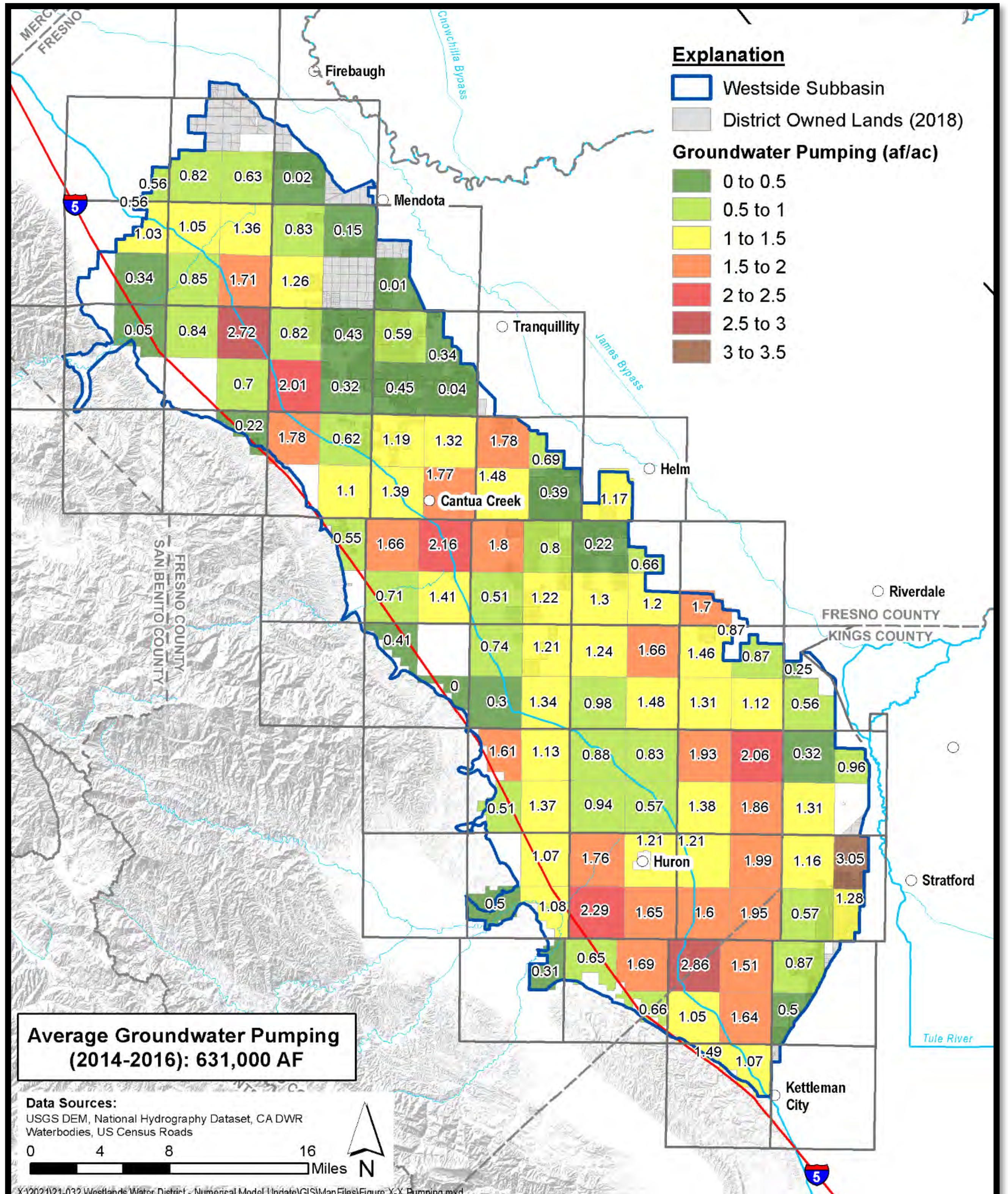
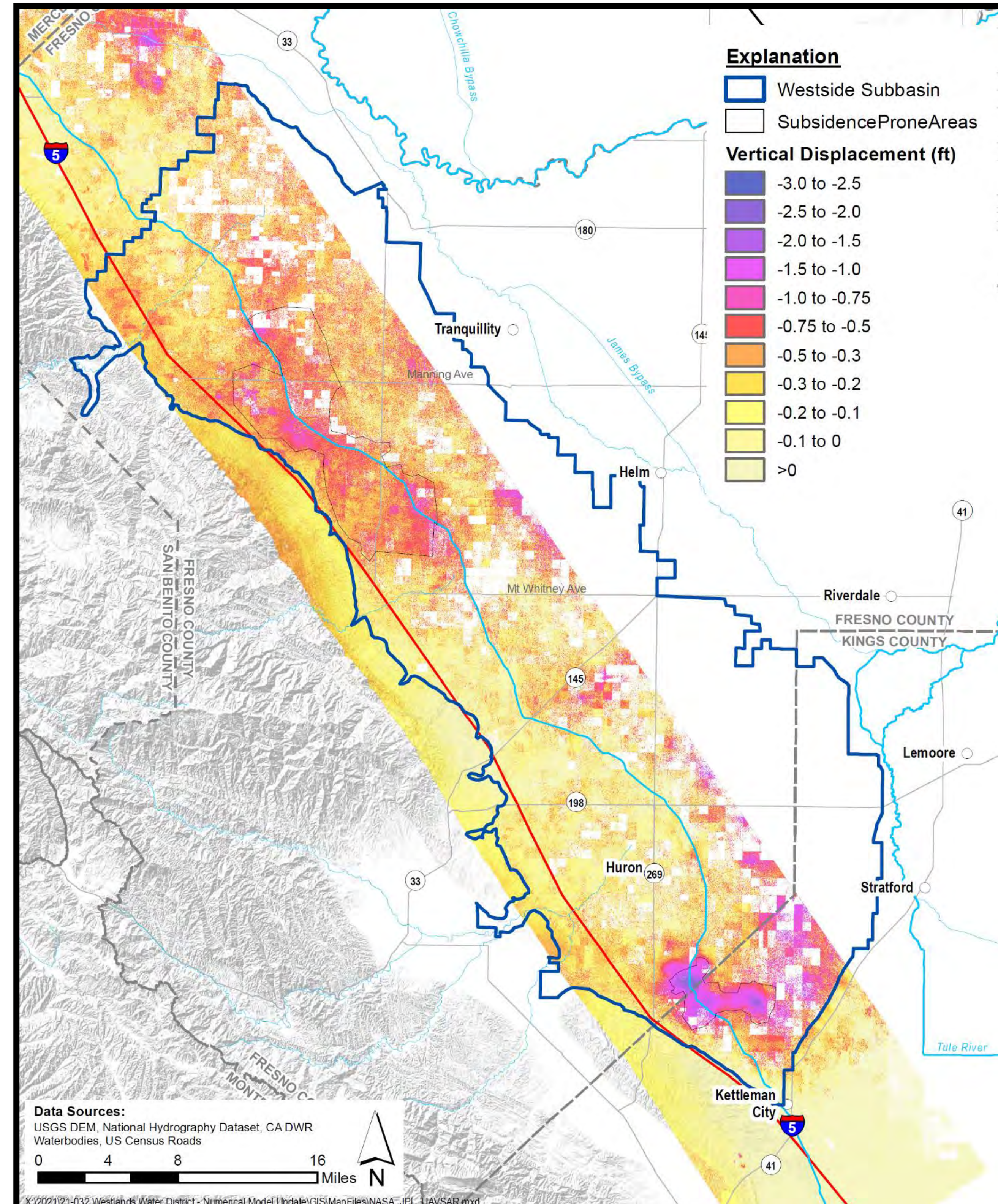
Groundwater Pumping (March 2014 through February 2017 Average)
NASA JPL InSAR from UAVSAR Imagery (May 2013 to February 2016)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-73





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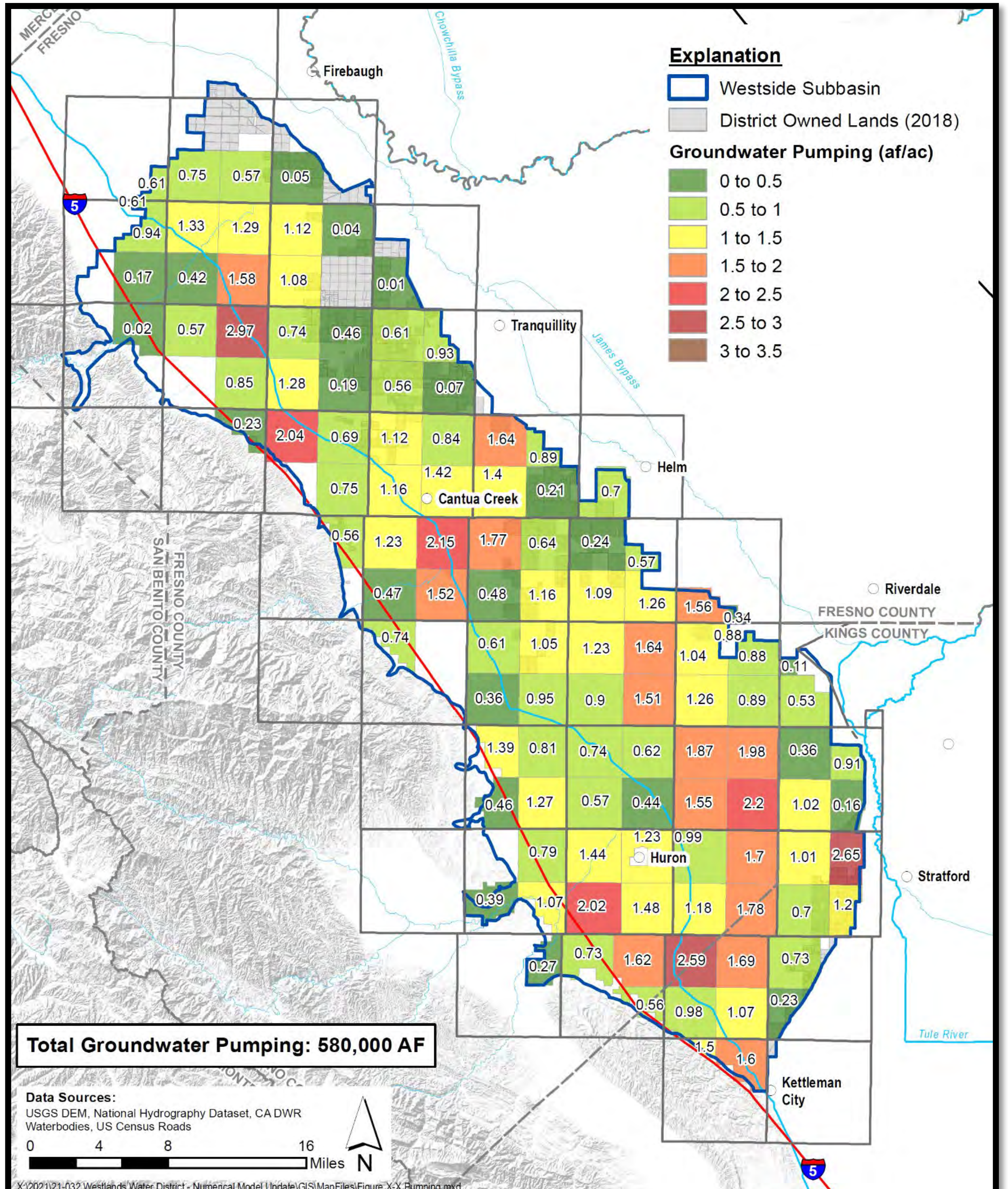
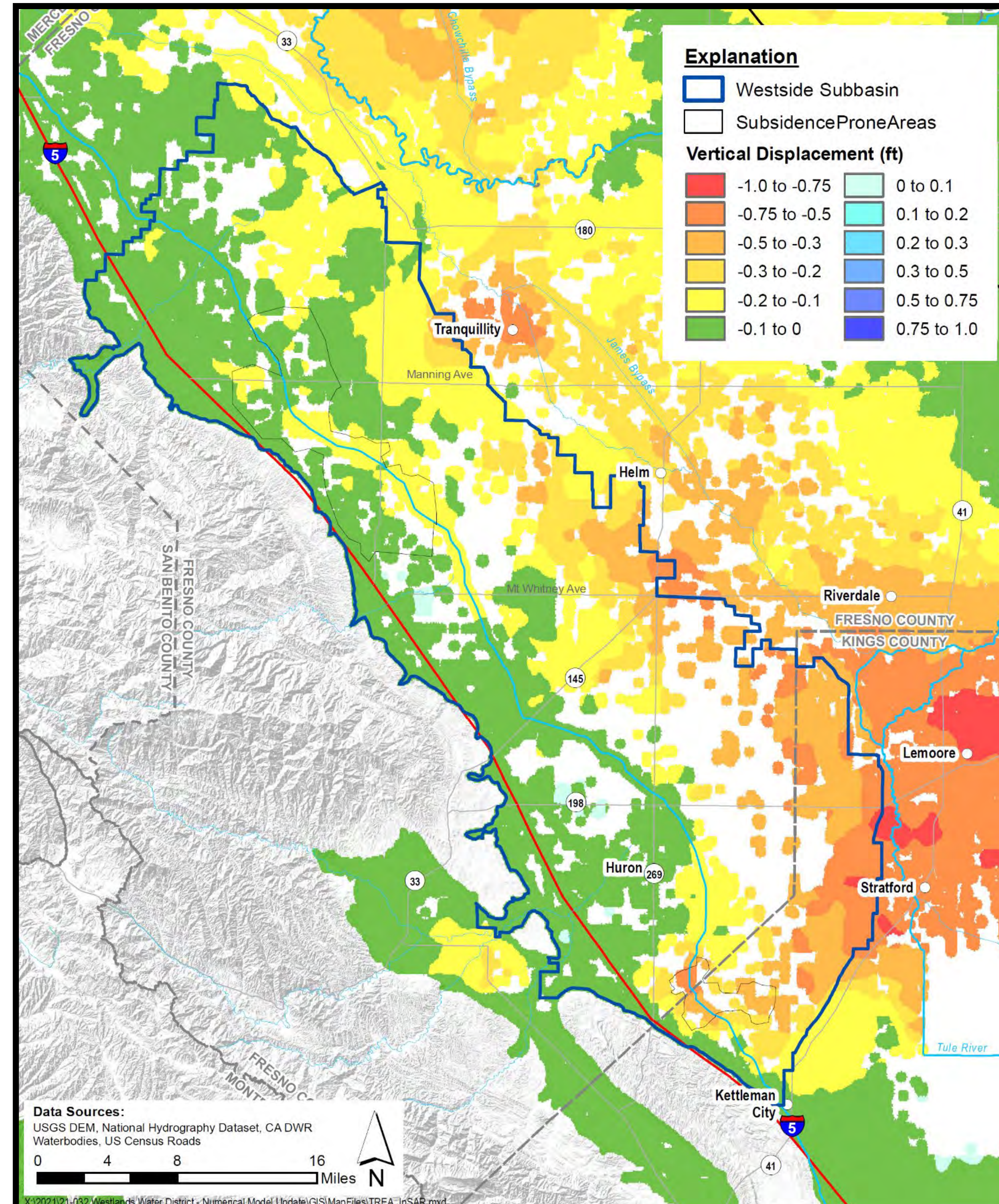
Groundwater Pumping (March 2014 through February 2017 Average)
NASA JPL InSAR from UAVSAR Imagery (May 2013 to April 2017)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-74





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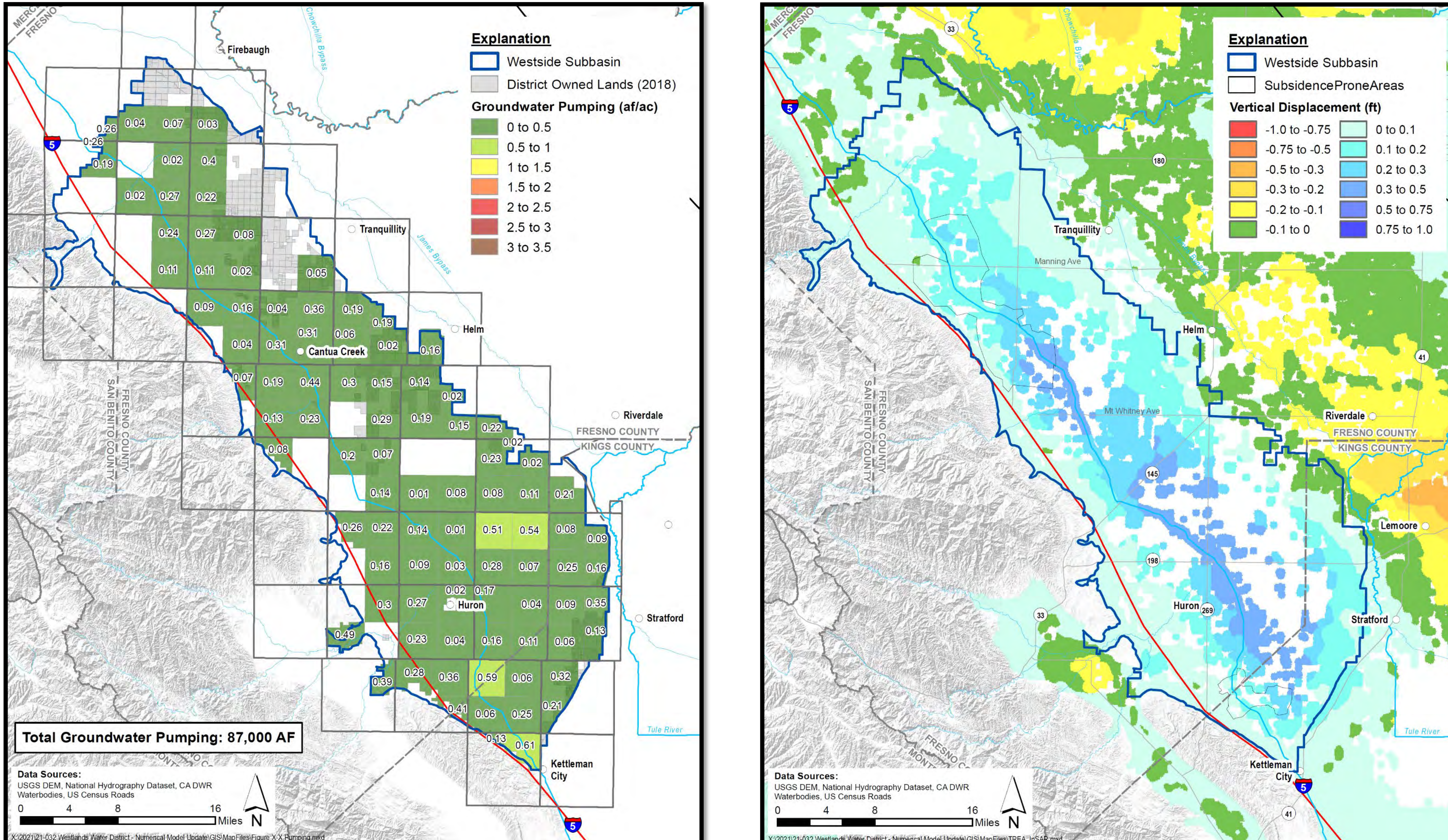
Groundwater Pumping (March 2016 through February 2017)
TRE Altamira InSAR from Sentinel-1 (March 2016 to March 2017)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-75



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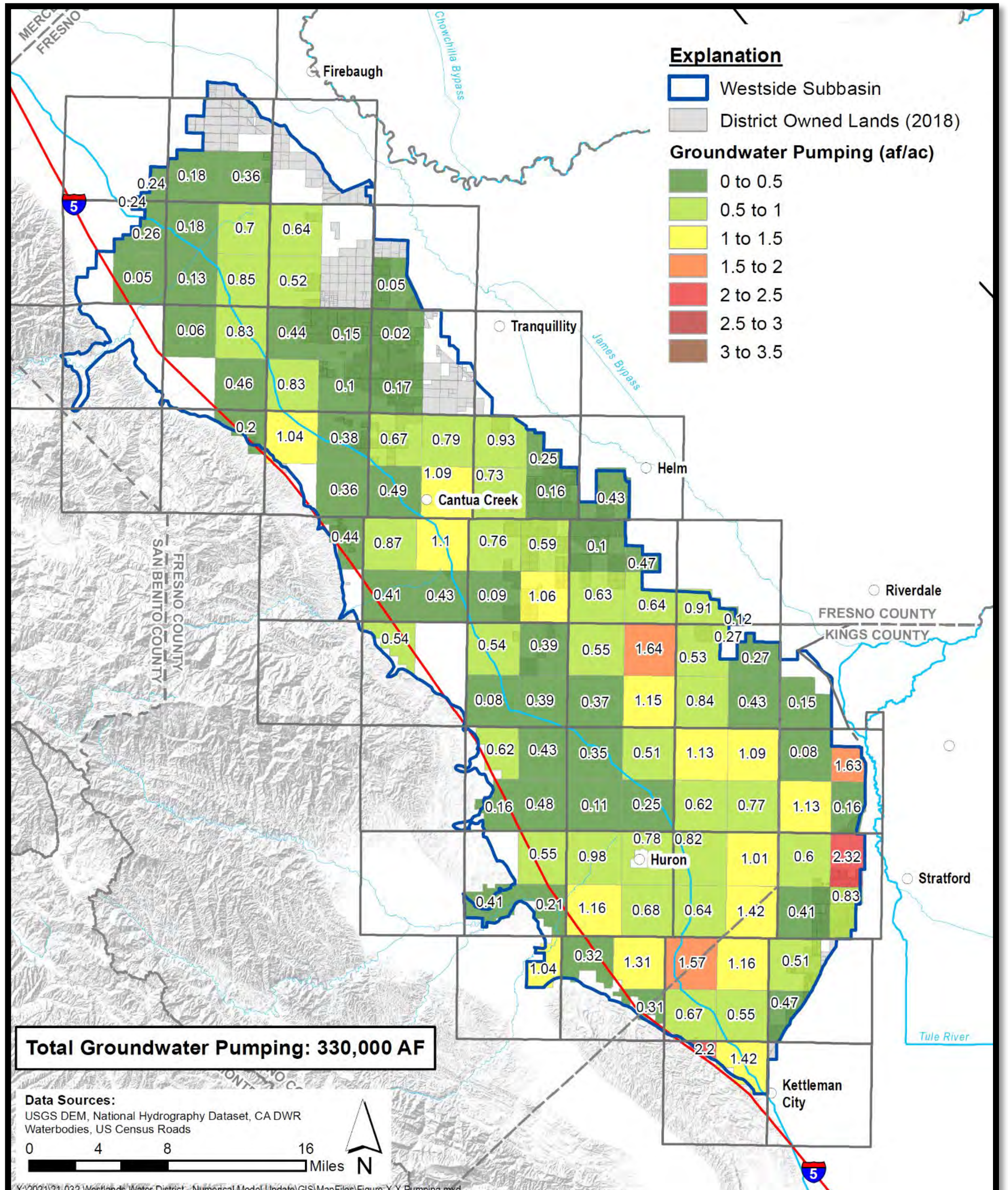
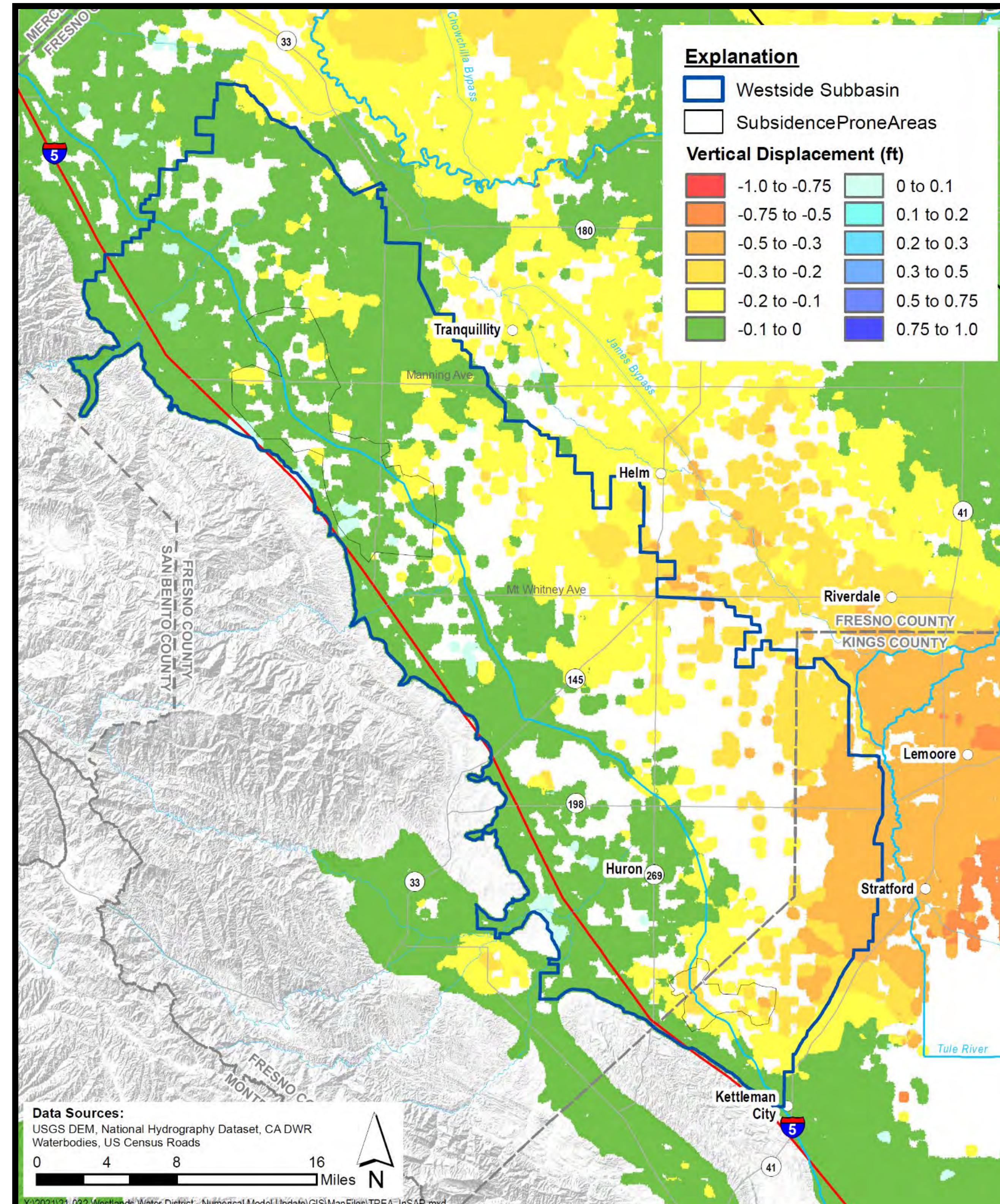
Groundwater Pumping (March 2017 through February 2018)
TRE Altamira InSAR from Sentinel-1 (March 2017 to March 2018)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-76





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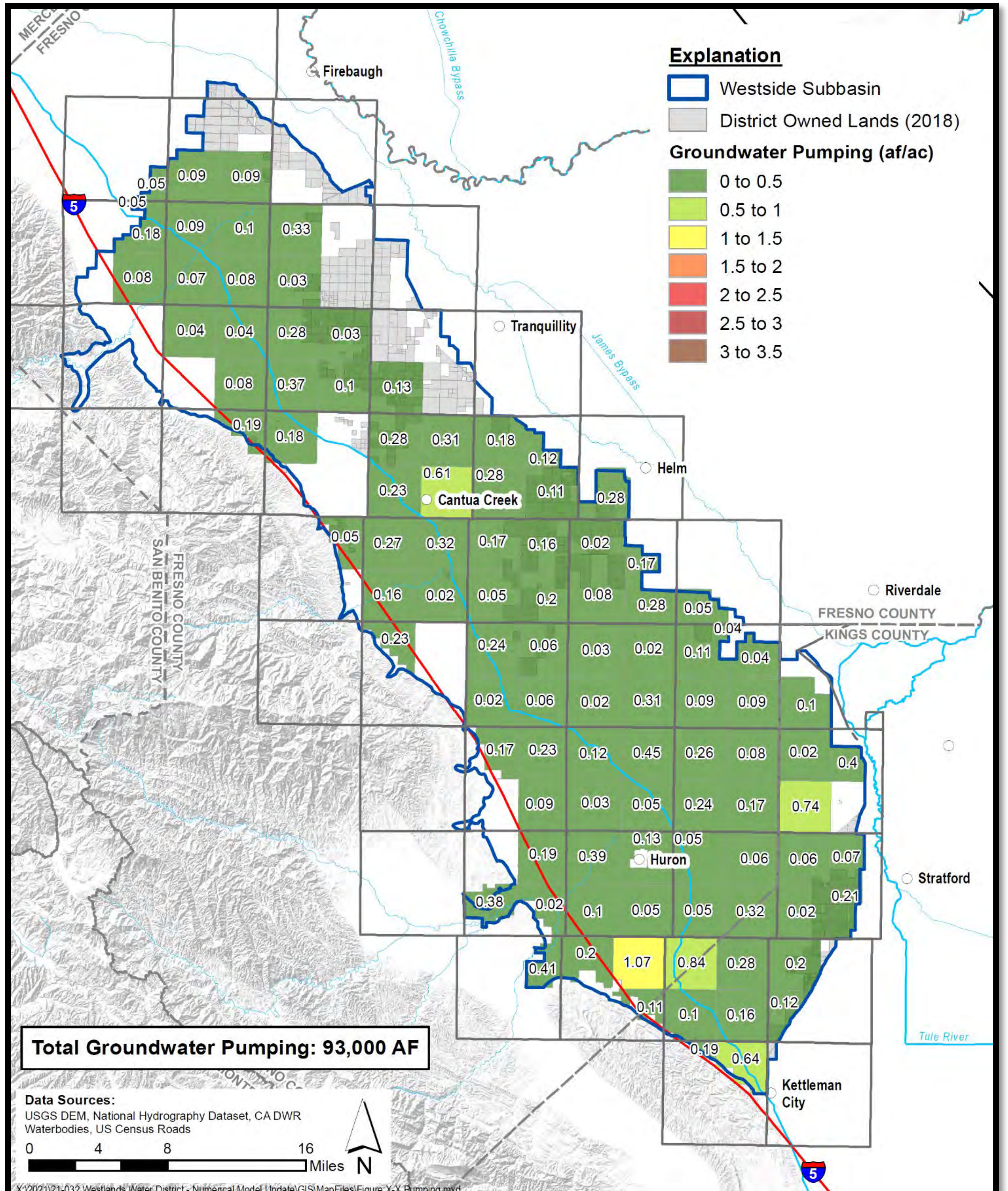
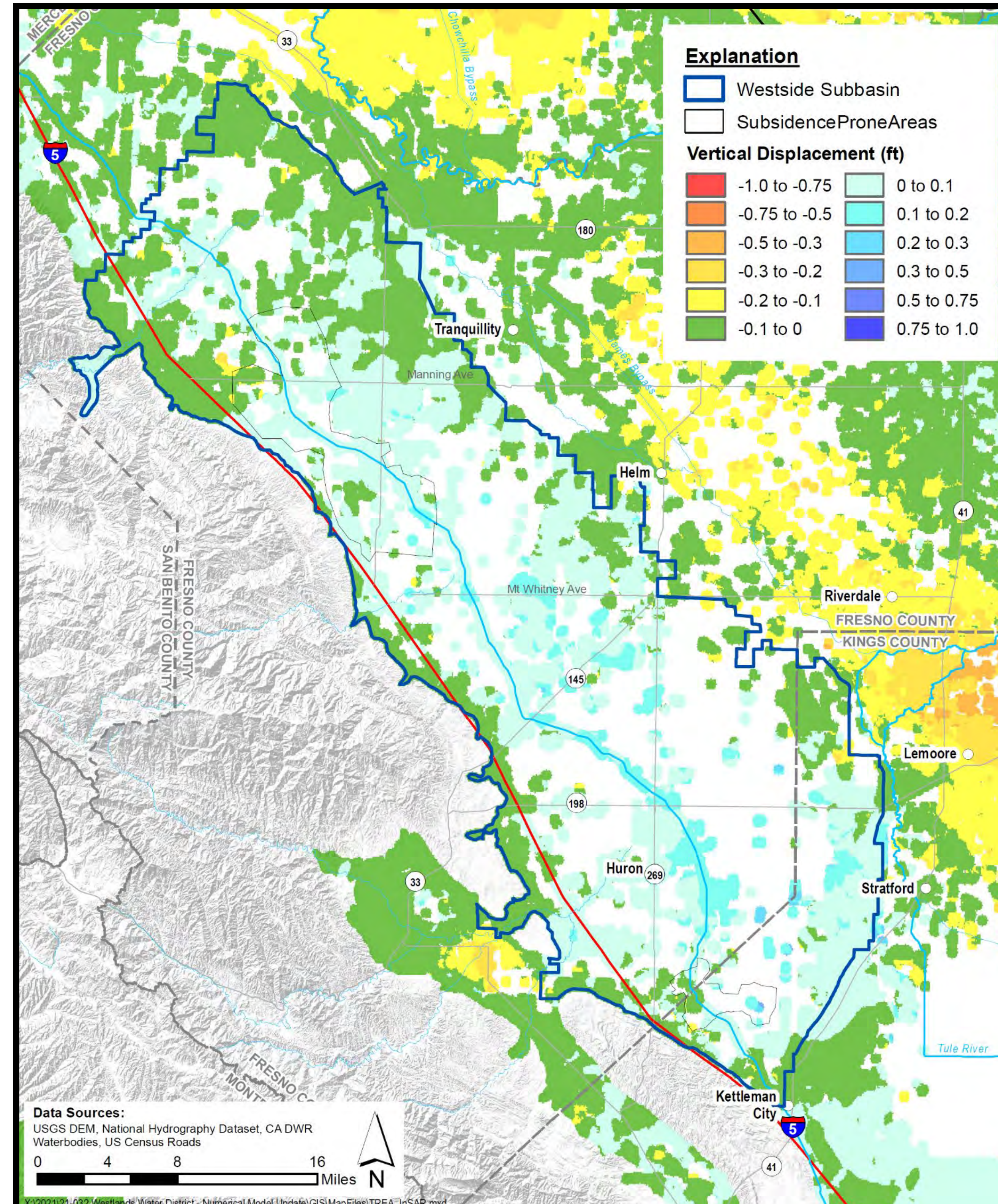
Groundwater Pumping (March 2018 through February 2019)
TRE Altamira InSAR from Sentinel-1 (March 2018 to March 2019)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-77





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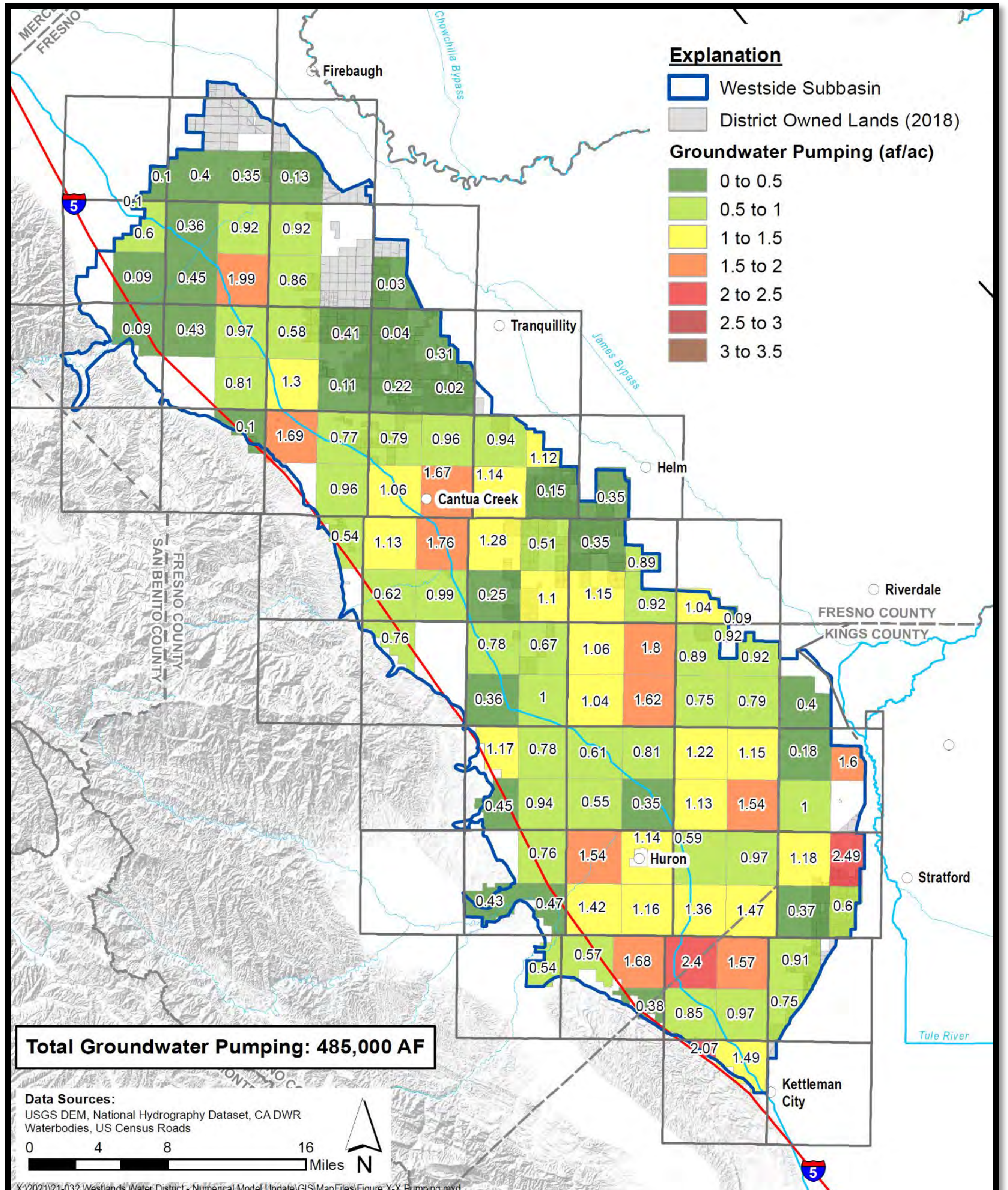
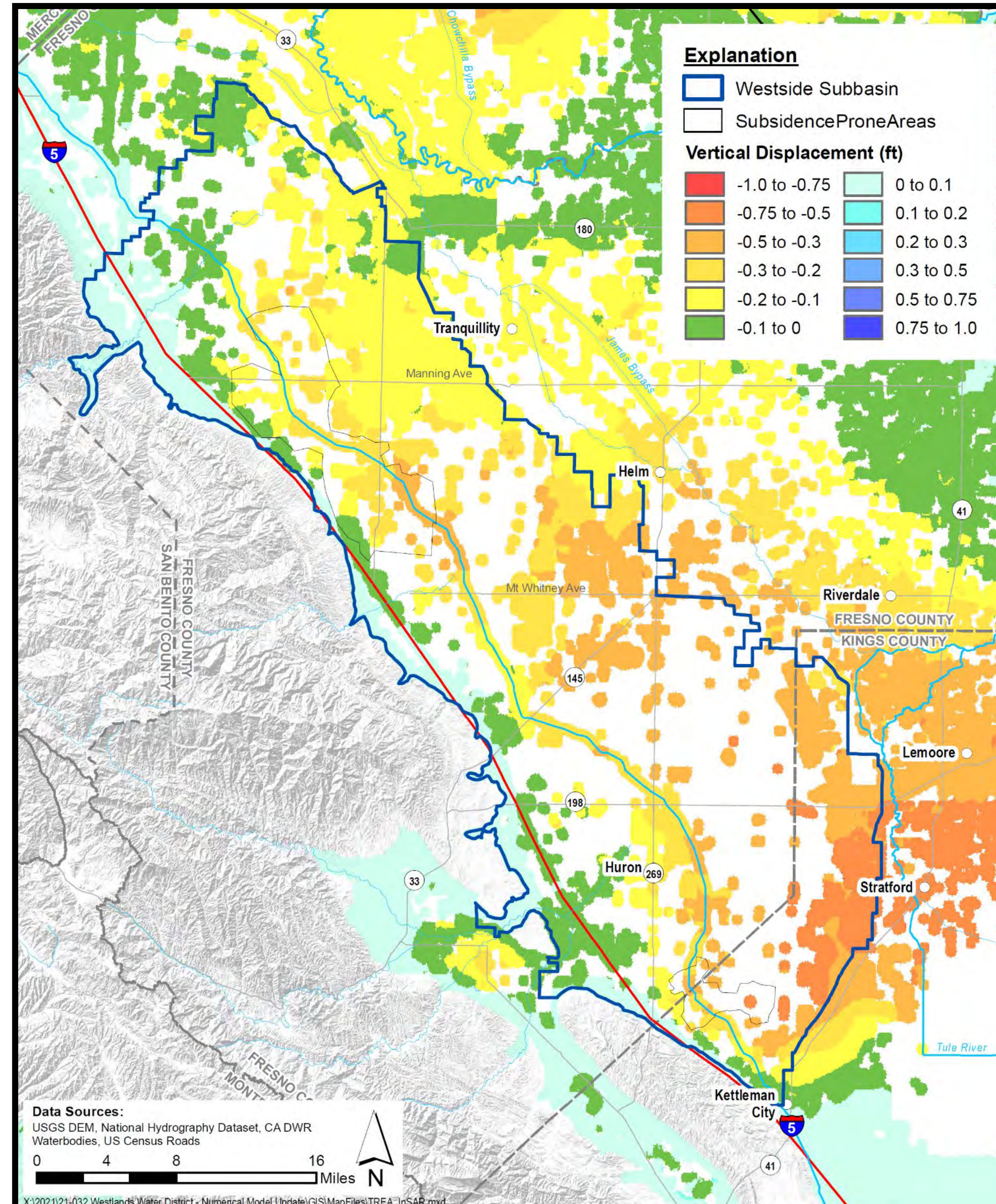
Groundwater Pumping (March 2019 through February 2020)
TRE Altamira InSAR from Sentinel-1 (March 2019 to March 2020)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-78





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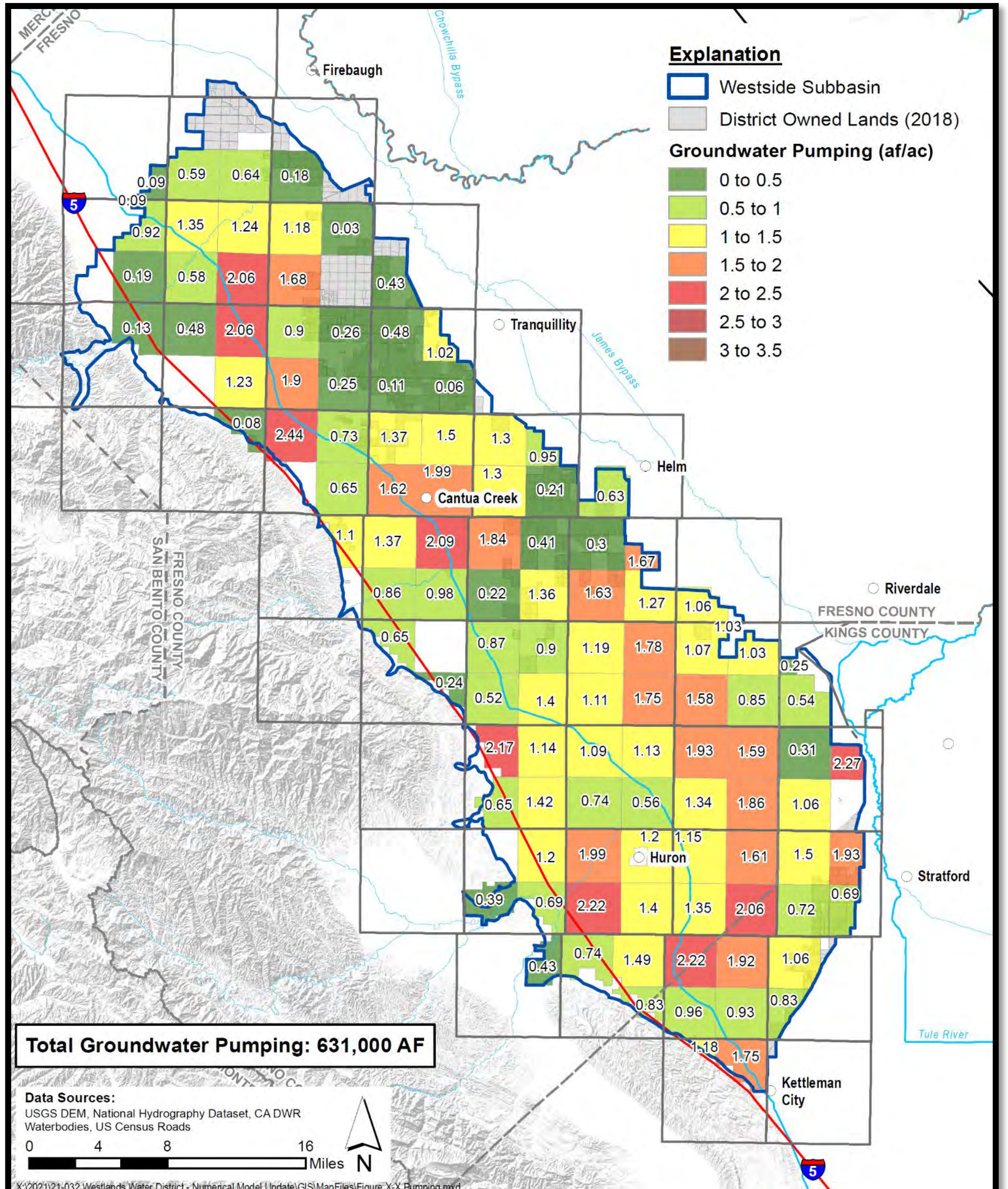
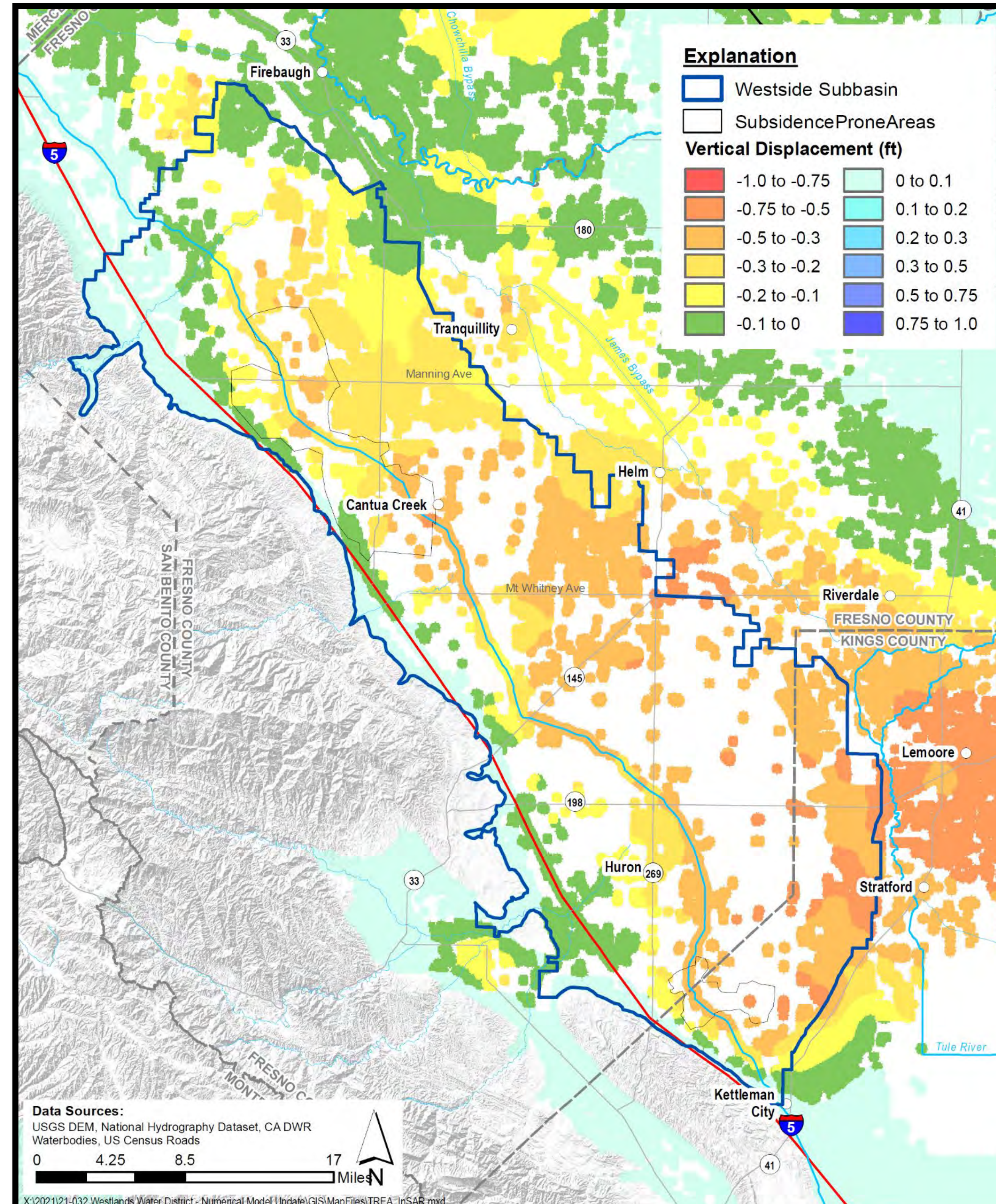
Groundwater Pumping (March 2020 through February 2021)
TRE Altamira InSAR from Sentinel-1 (March 2020 to March 2021)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-79





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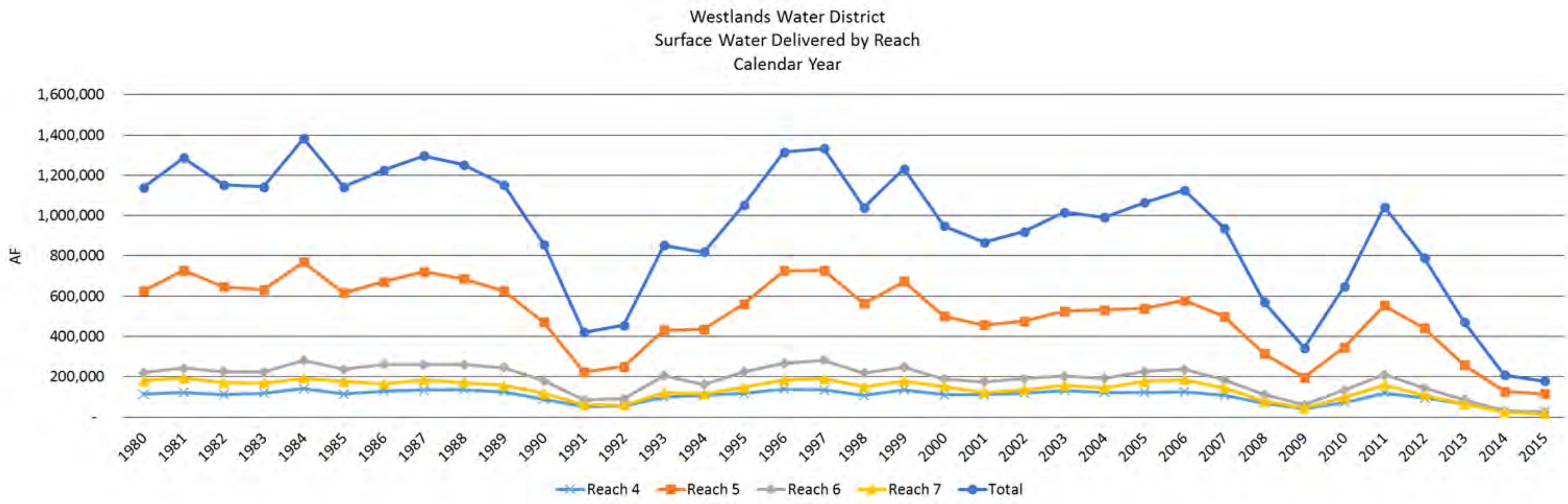
Groundwater Pumping (March 2021 through February 2022)
TRE Altamira InSAR from Sentinel-1 (March 2021 to October 2021)

SGMA Sustainability Analysis
Westside Subbasin

Figure 2-80



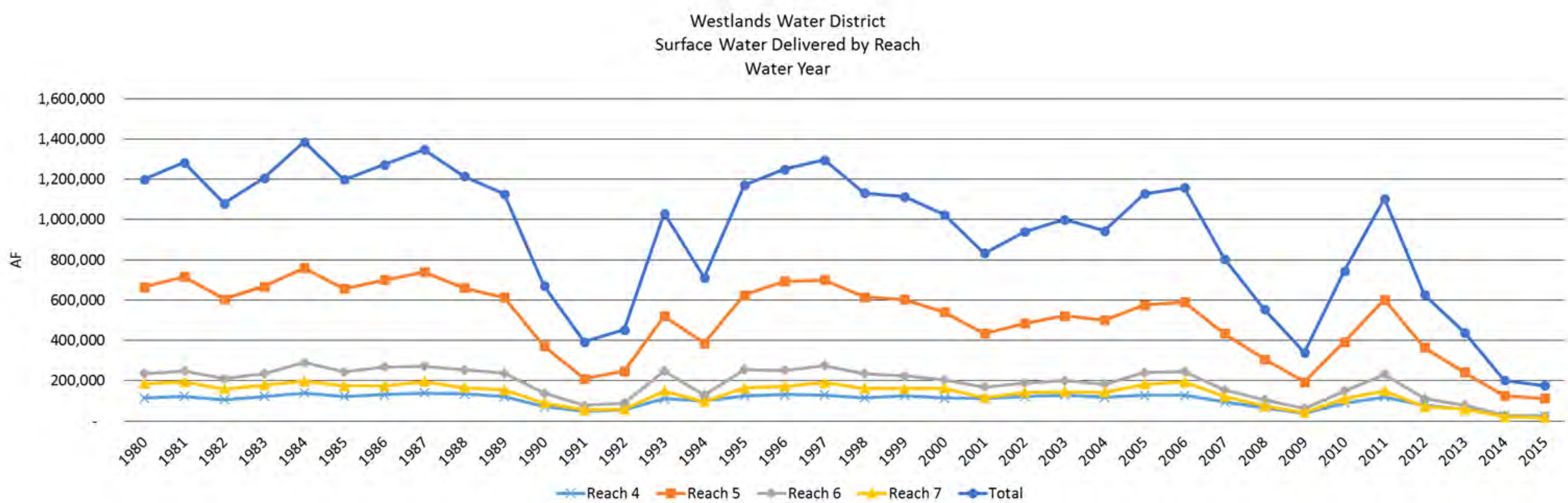


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FIGURE 2-82
Graph of Annual Imported Water

Groundwater Sustainability Plan
Westside Subbasin

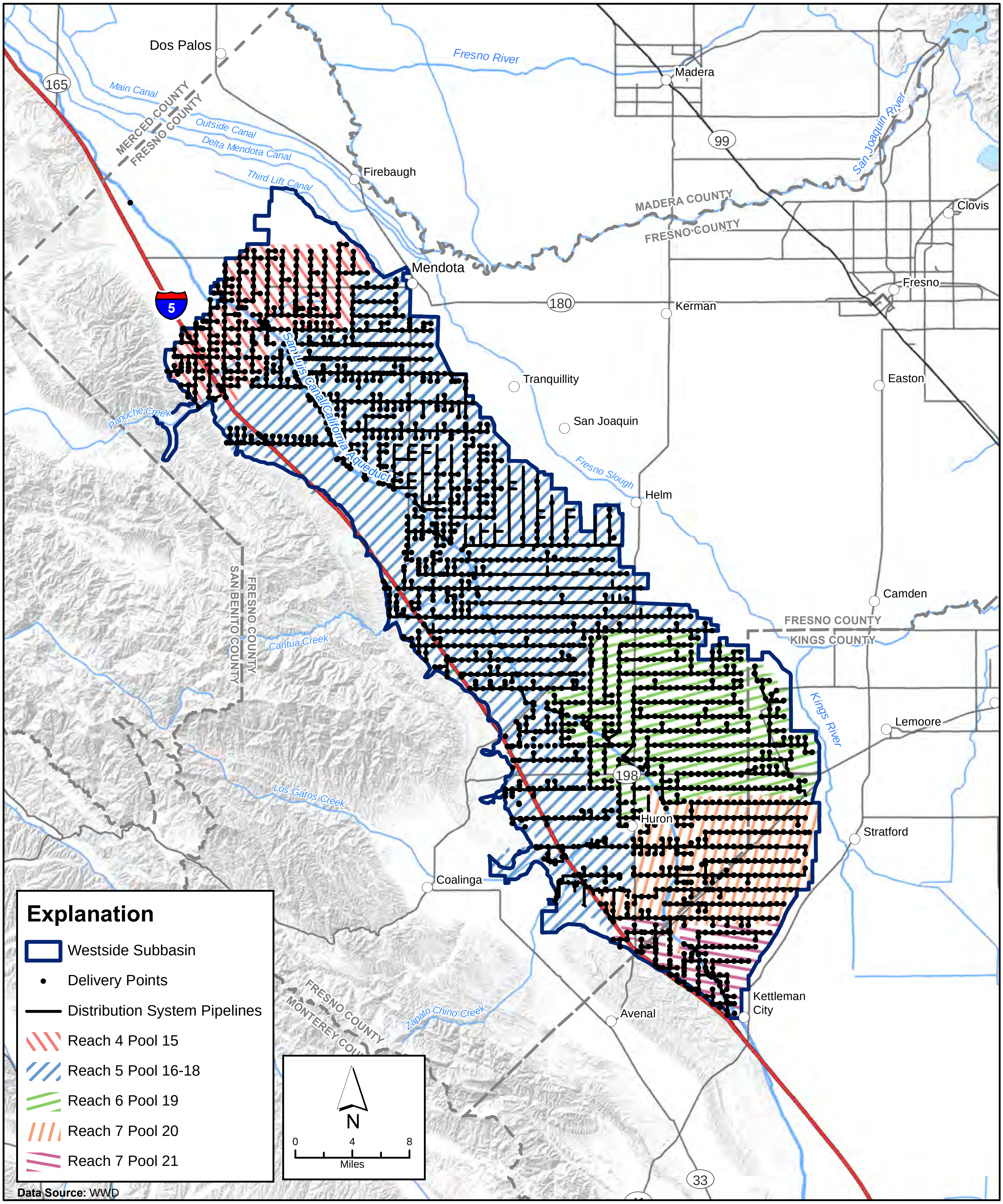

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FIGURE 2-83
Map of Imported Water Conveyance System and Delivery Points

Groundwater Sustainability Plan
Westside Subbasin

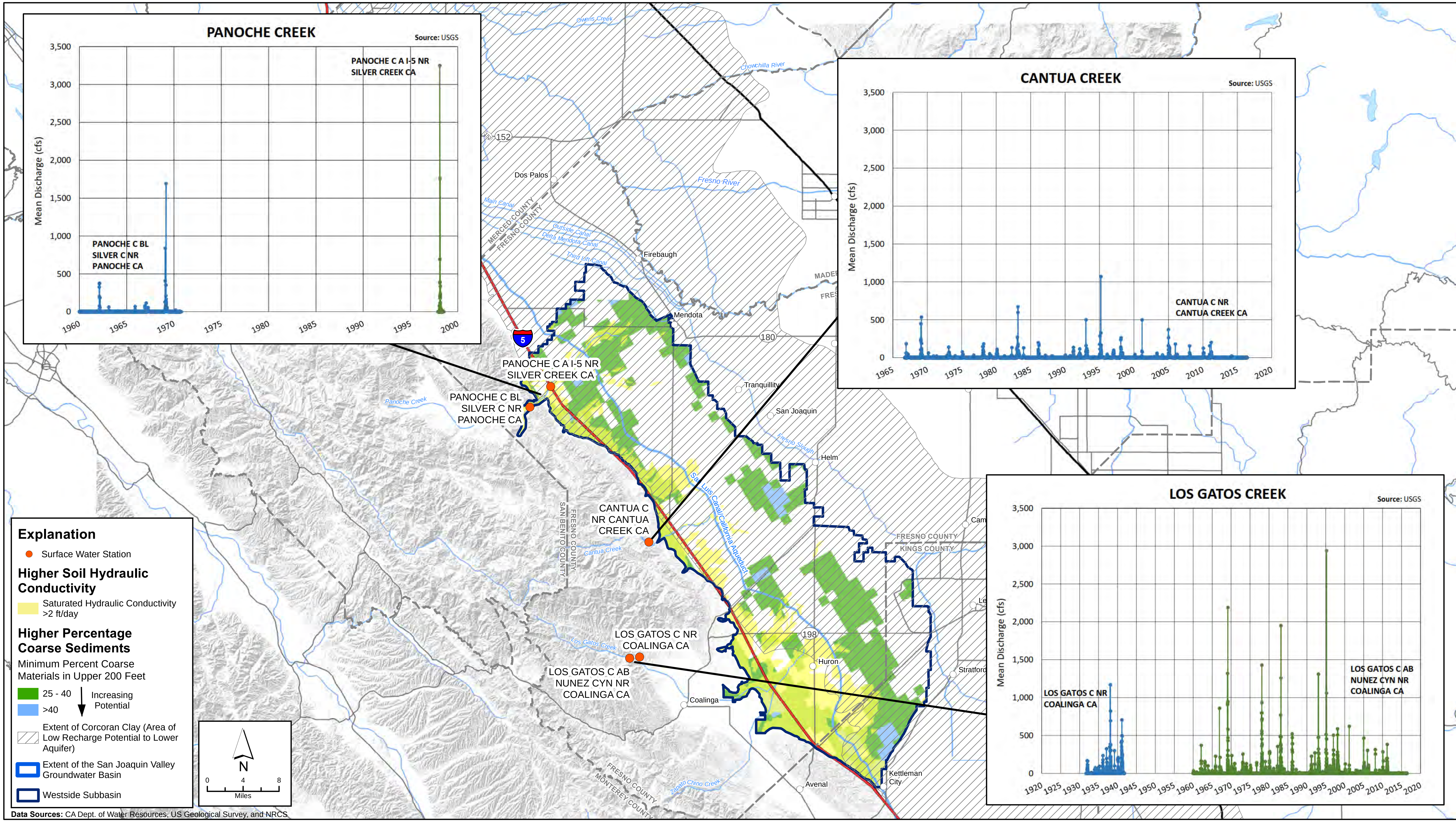

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FIGURE 2-84
Map of Surface Water Features and Areas with Higher Potential for Groundwater Recharge

Groundwater Sustainability Plan
Westside Subbasin

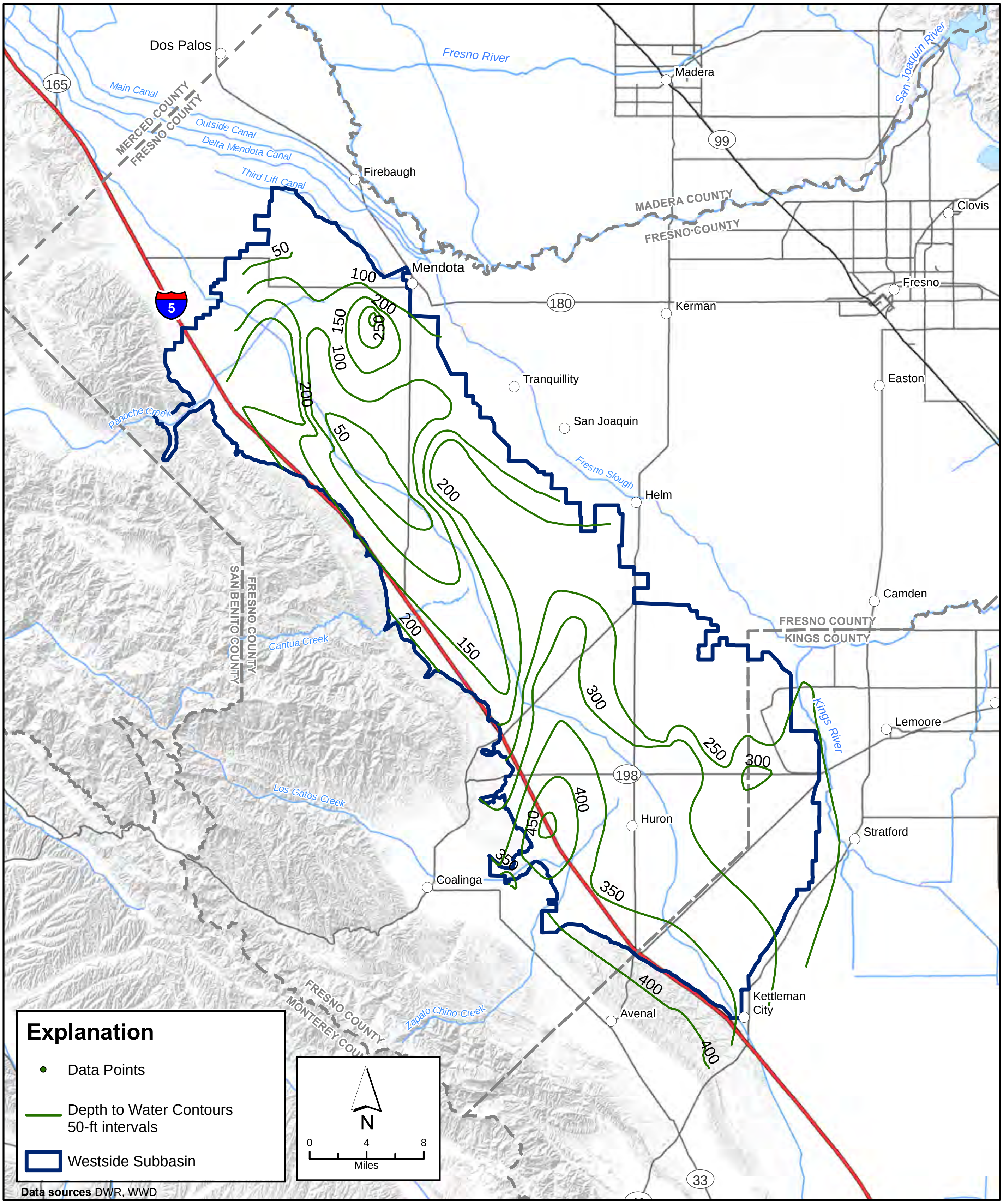

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FIGURE 2-85
Depth to Water Contours Upper Aquifer, Winter 2014/2015

Groundwater Sustainability Plan
Westside Subbasin

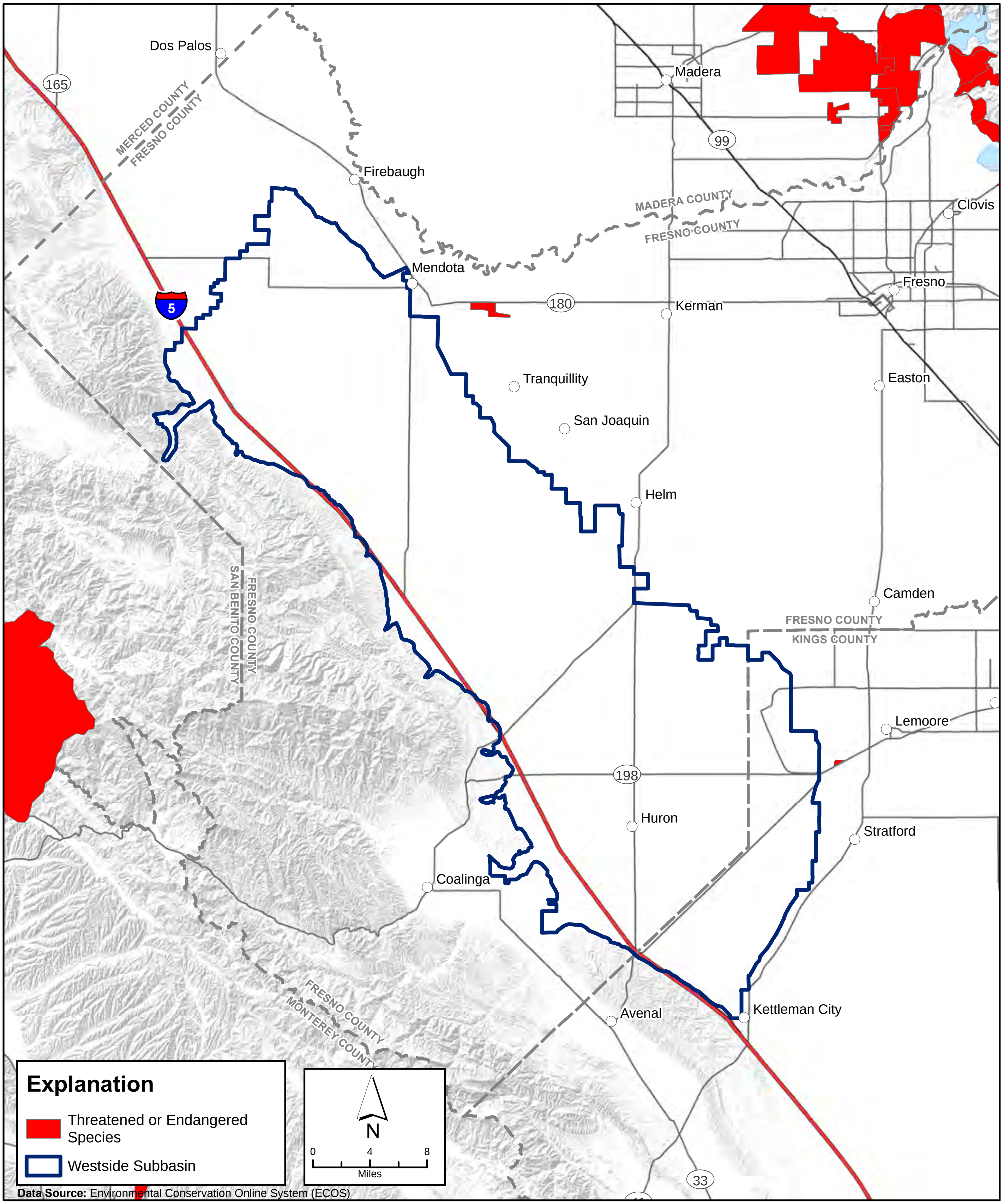

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FIGURE 2-86
Critical Habitats

Groundwater Sustainability Plan
Westside Subbasin

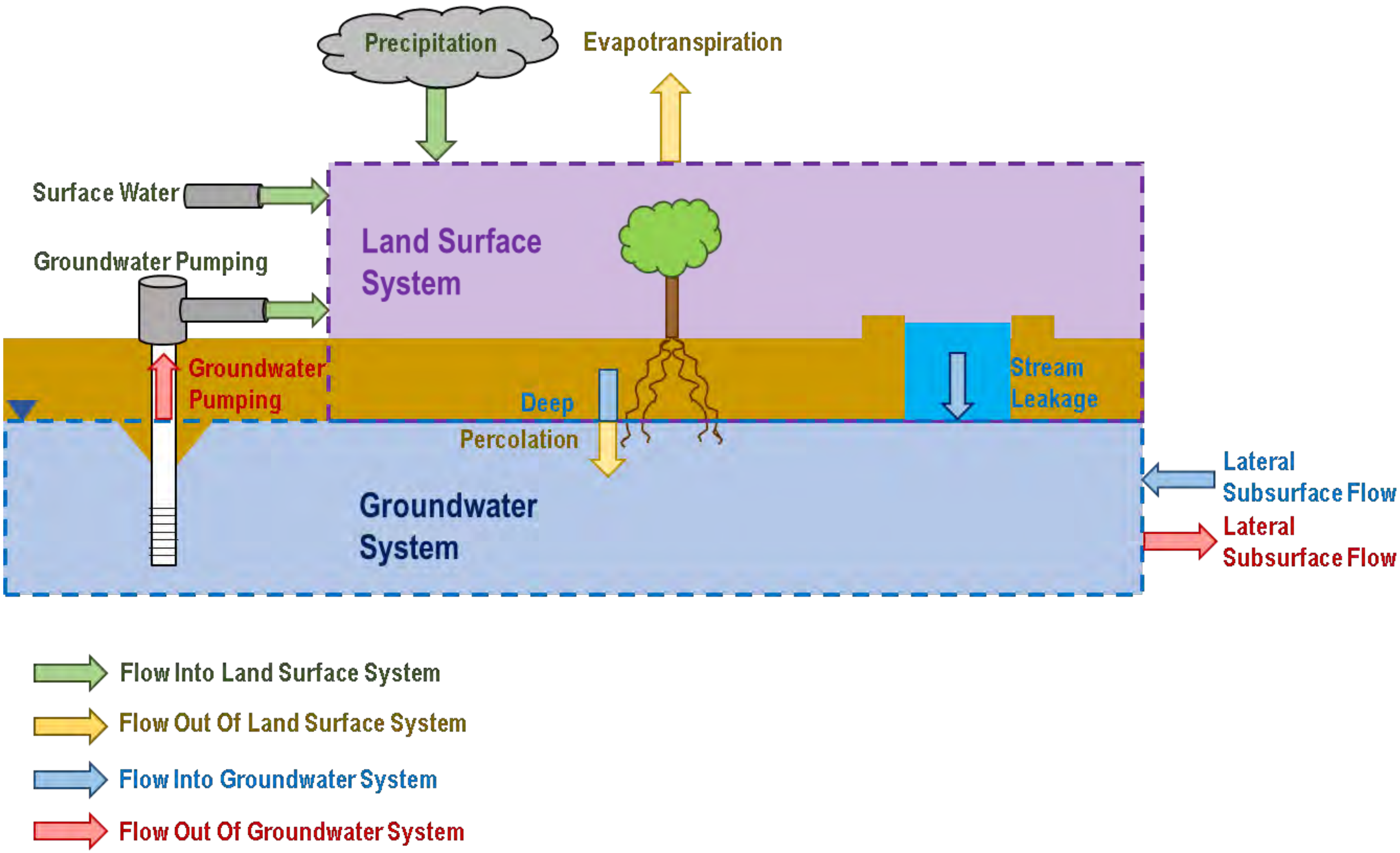

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Figure 2-87
Summary of Westside Subbasin Water Budget

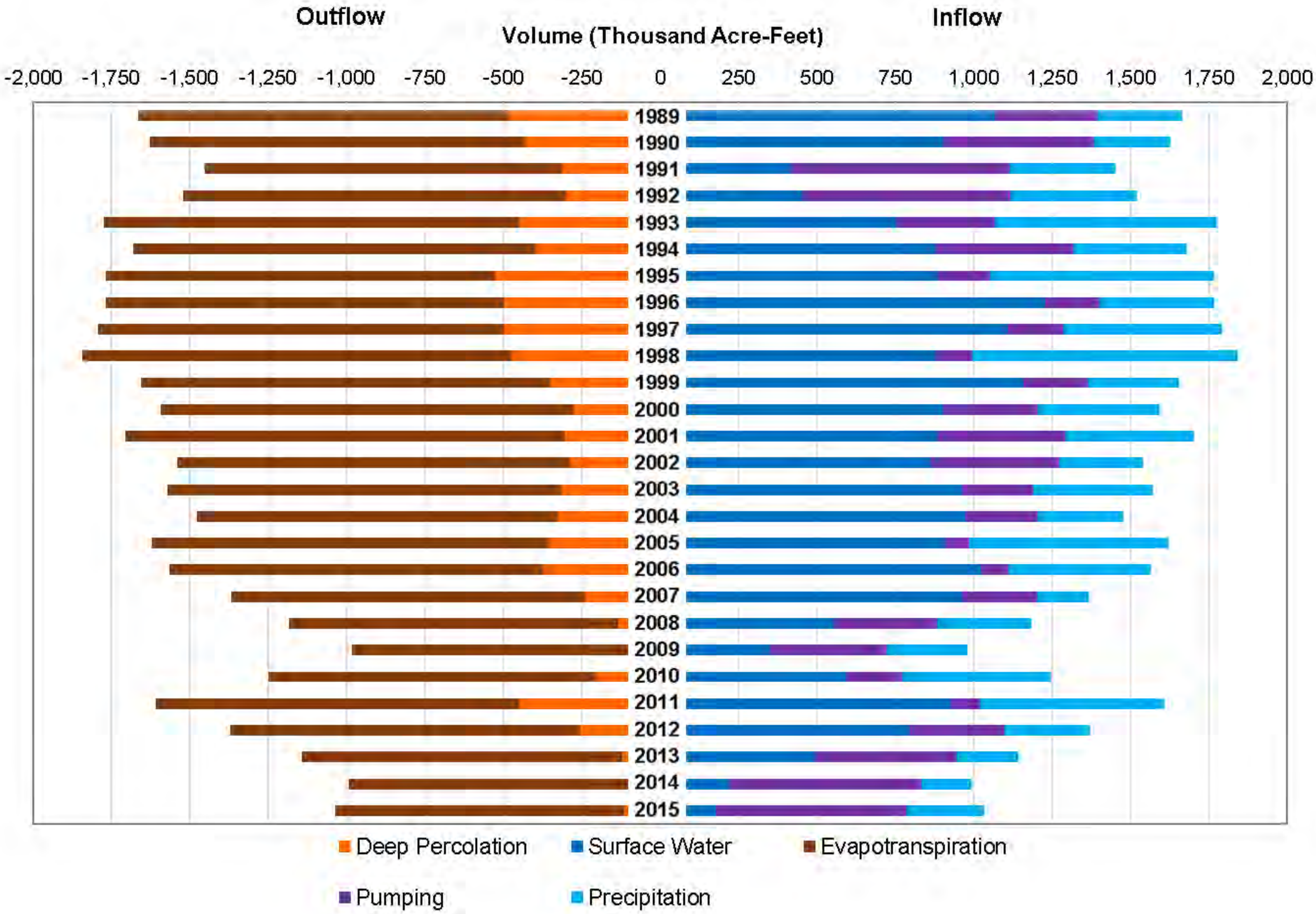

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Figure 2-88
Historical Land Surface System Water Budget (1989-2015)

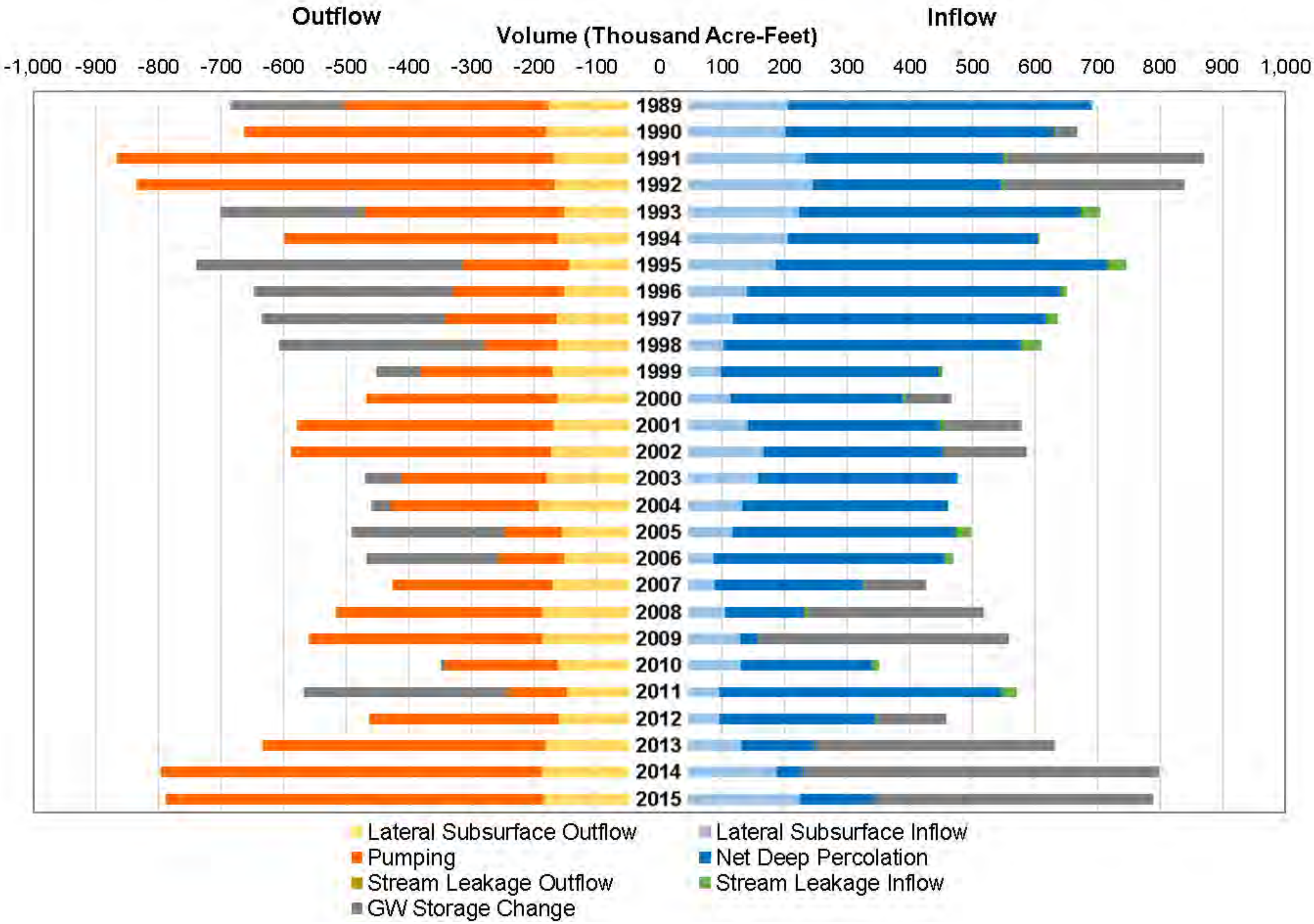

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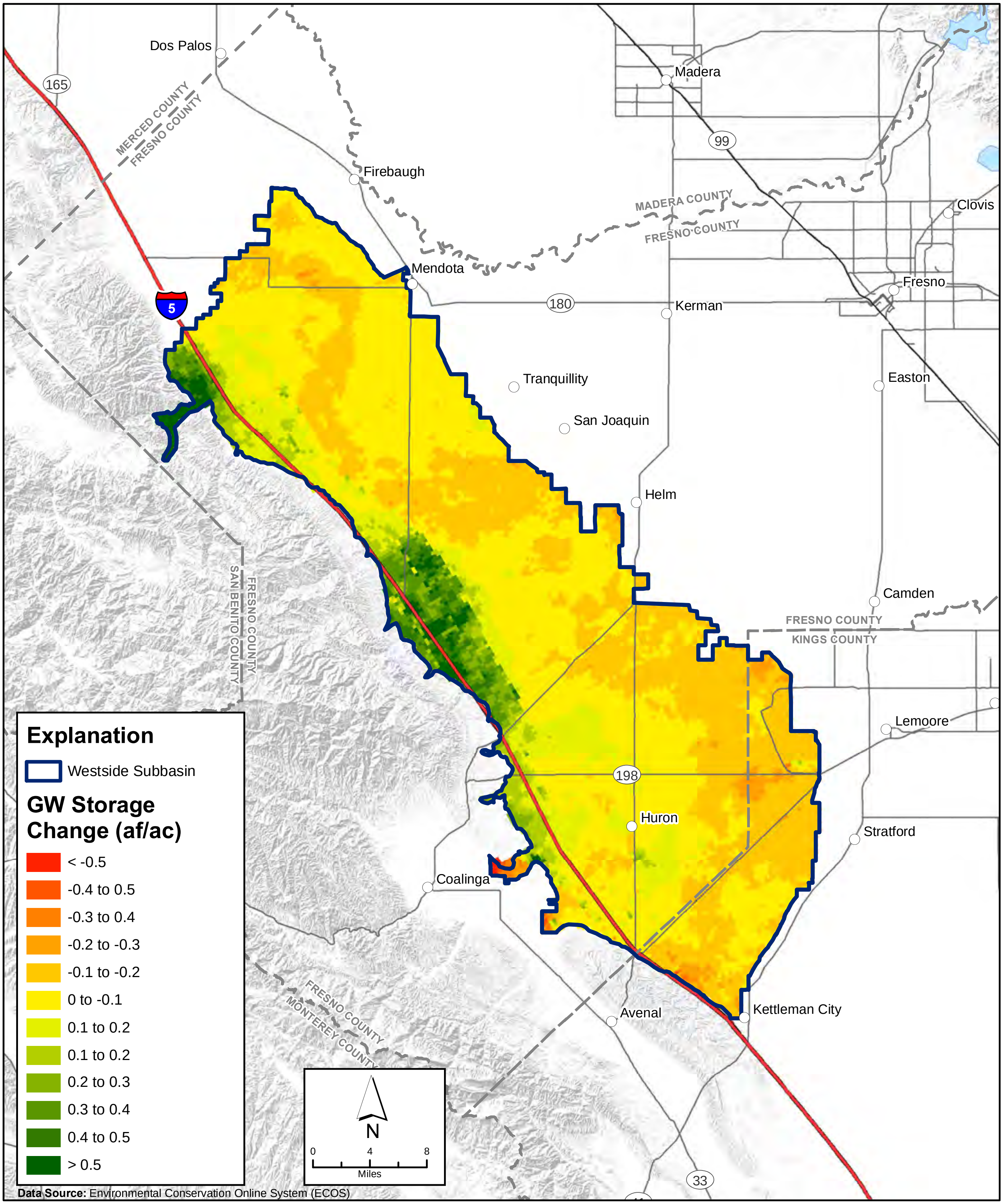
Figure 2-89
Historical Groundwater Budget (1989-2015)



X:\2017\17-082 Westlands WD - GSP Support Services\GIS\MapFiles\Chapter_2\Figure 2-67 Groundwater Storage Distribution.mxd

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FIGURE 2-90
Change in Average Annual Simulated Groundwater Storage
Water Years 1989 - 2015
Groundwater Sustainability Plan
Westside Subbasin

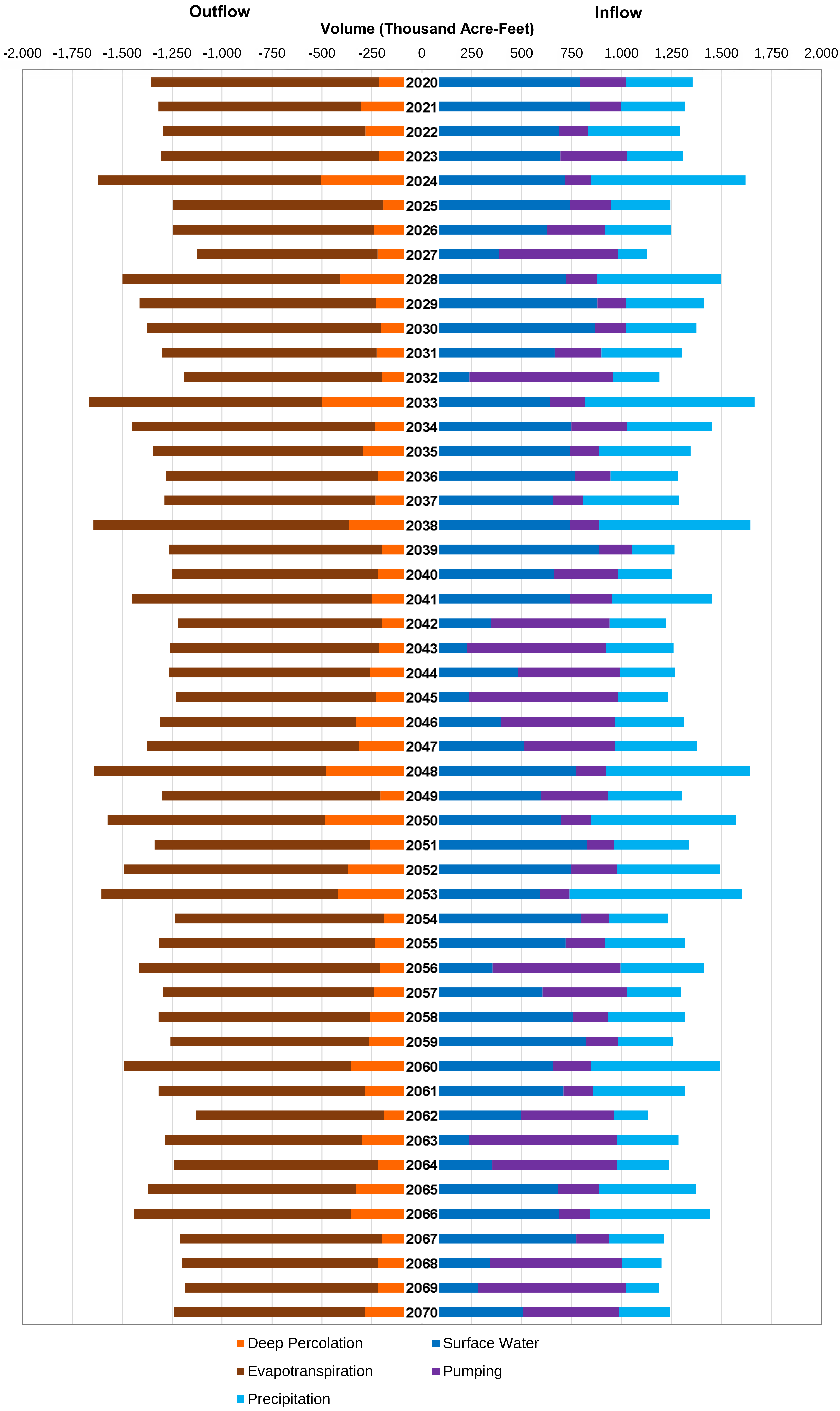

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Figure 2-91
Projected Land Surface System Budget
2020 - 2070

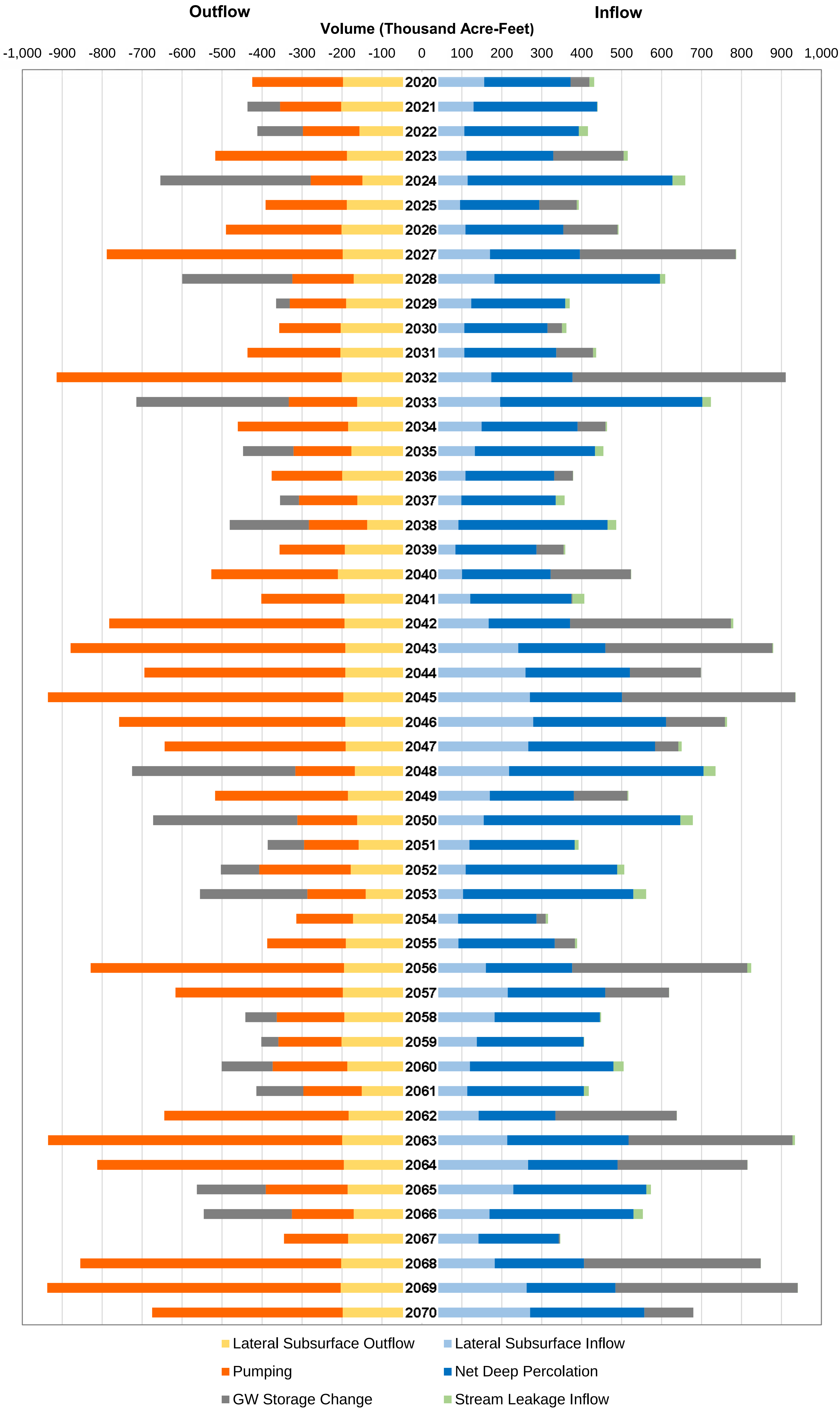

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Figure 2-92
Projected Groundwater Budget
2020 - 2070

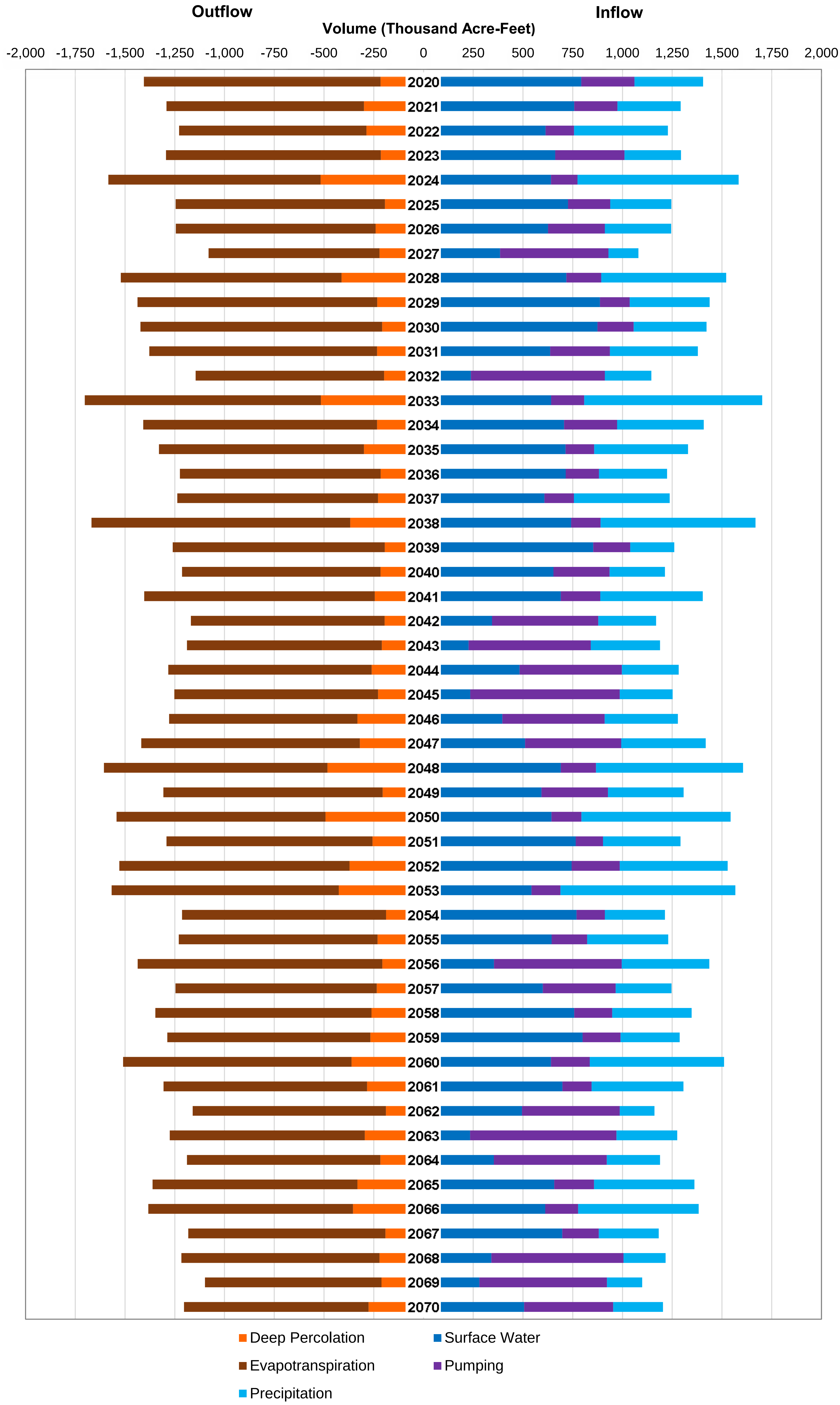

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Figure 2-93
Projected Land Surface System Budget - 2030 Climate Change Factors
2020 - 2070

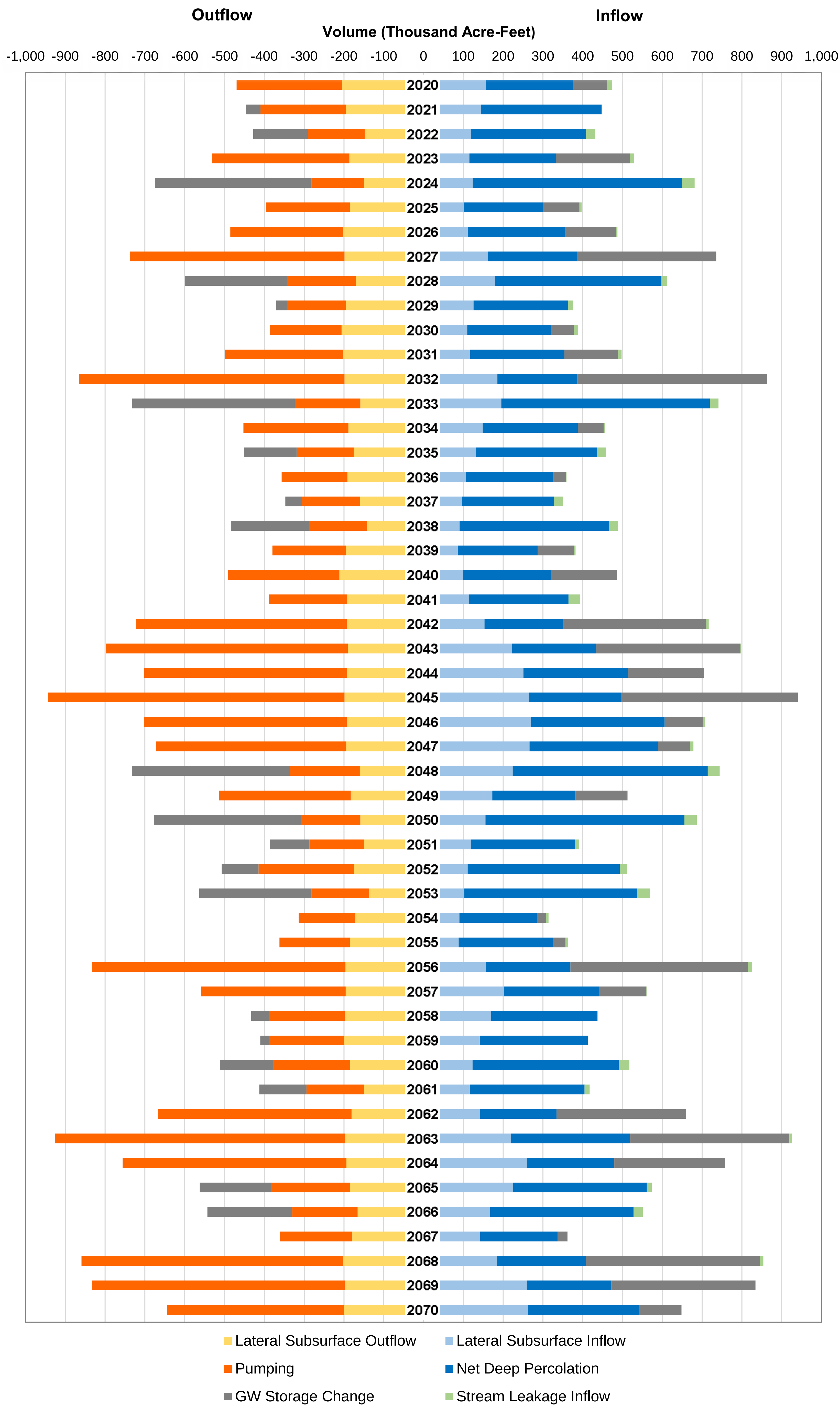

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Figure 2-94
Projected Groundwater Budget – 2030 Climate Change Factors
2020 – 2070

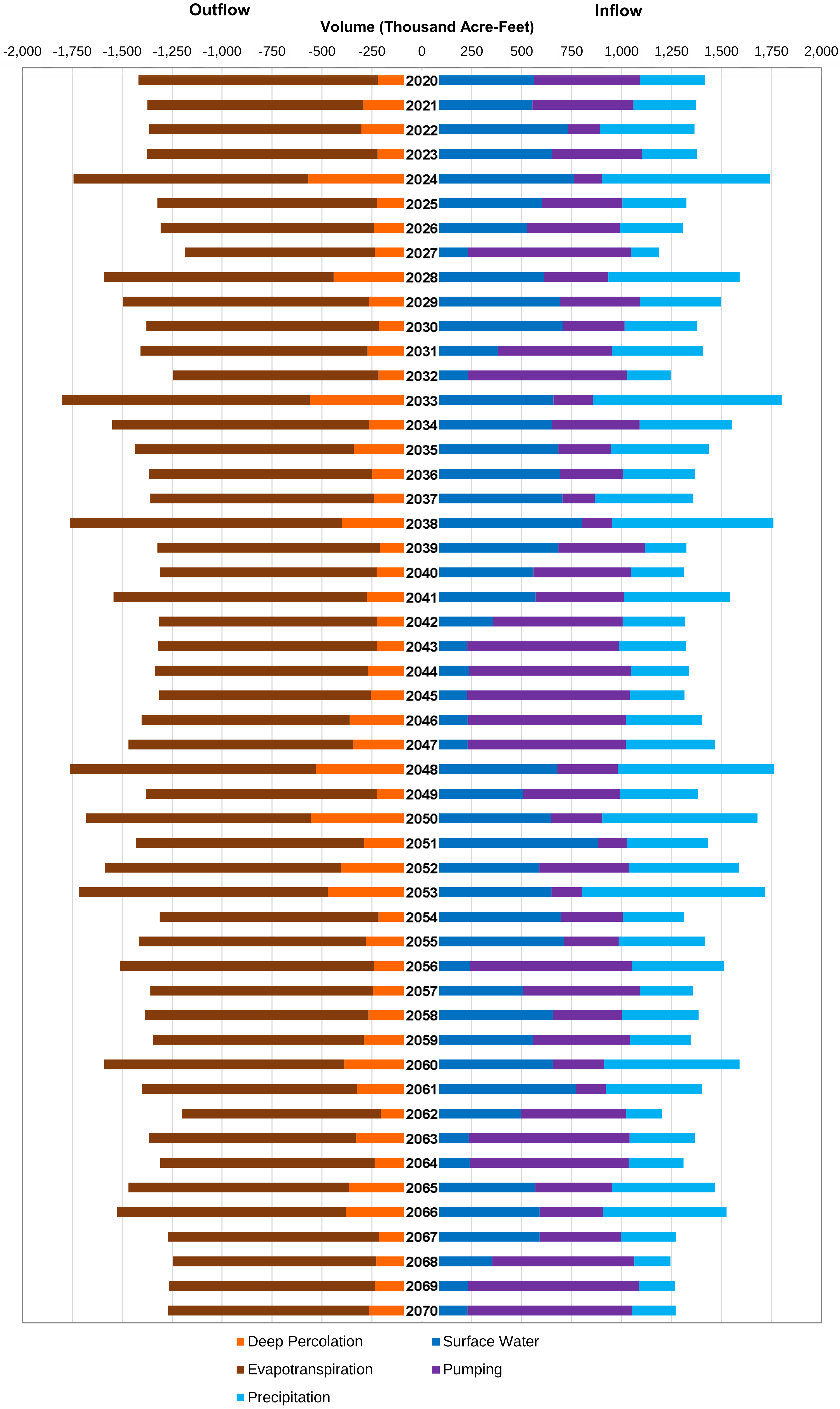

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Figure 2-95
Projected Land Surface System Budget - 2070 Climate Change Factors
2020 - 2070

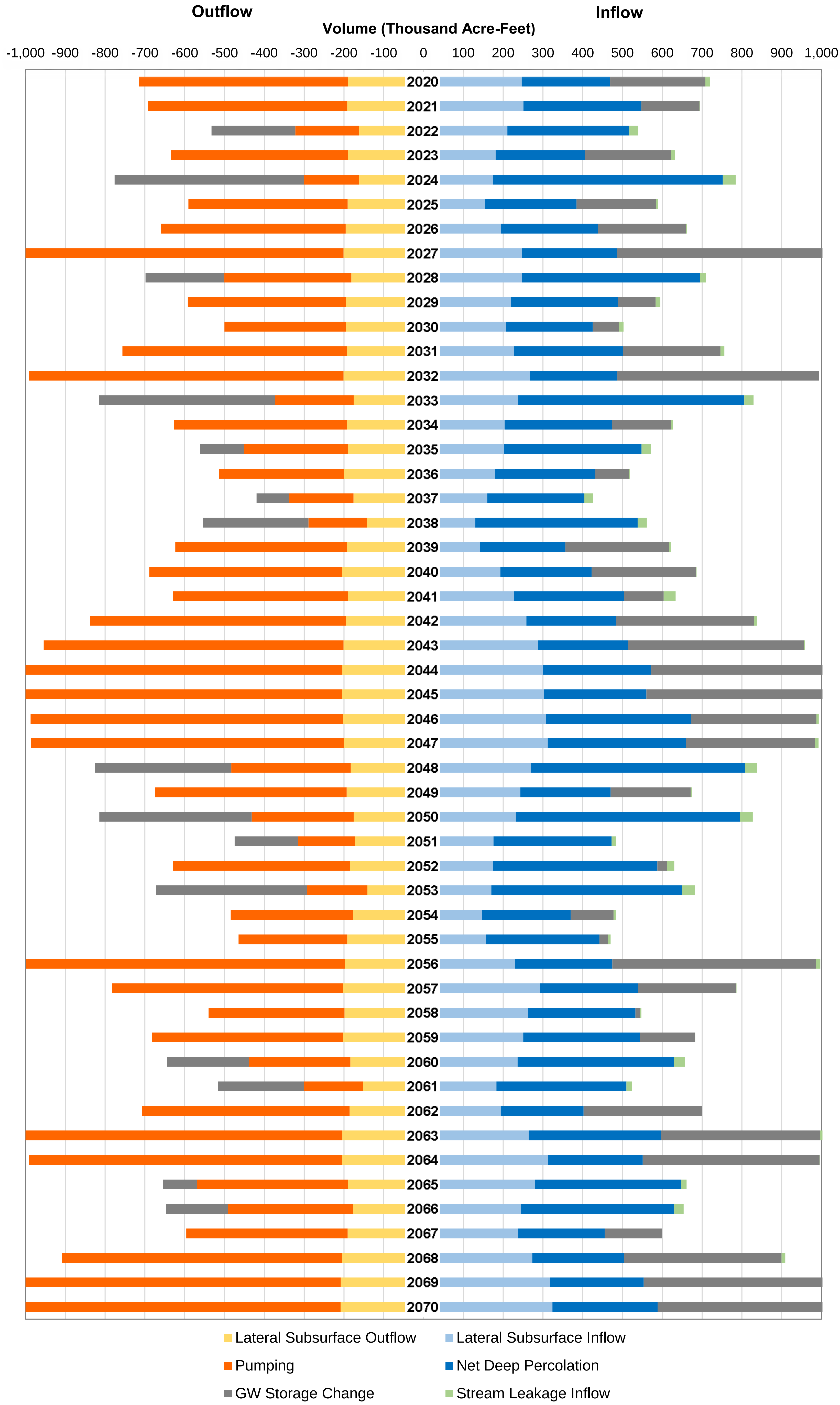

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Figure 2-96
Projected Groundwater Budget – 2070 Climate Change Factors
2020 – 2070

3 SUSTAINABLE MANAGEMENT CRITERIA

This chapter of the Groundwater Sustainability Plan (GSP or Plan) provides a discussion of the sustainability goals, measurable objectives, interim milestones, minimum thresholds, undesirable results, and the monitoring network for each sustainability indicator within the Plan area encompassed by the WWD GSP.

This chapter defines sustainability in the Plan area. The measurable objectives (MO), minimum thresholds (MT), and undesirable results presented in this chapter describe the future sustainable conditions in the Plan area and commit the GSA to actions that will achieve these future conditions.

This chapter utilizes data and information provided in **Chapter 2** and describes the data and methods used to develop the sustainable management criteria (SMC) and demonstrates their influence on beneficial uses and users. The SMC presented in this chapter are based on current available data and applications of the best available science.

As noted in this GSP, data gaps and uncertainty exist in the characterization of the hydrogeologic conceptual model and groundwater conditions. The uncertainty was considered when developing the SMC and because of these uncertainties, the SMC presented herein are considered initial criteria. The GSA will periodically evaluate this GSP, assess changing conditions in the Plan area that may warrant modifications of the GSP or management objectives and may adjust components accordingly. The GSA will focus its evaluation on determining whether the actions under the GSP are meeting the Plan's management objectives and whether those objectives are meeting the sustainability goal of the Plan area.

This chapter is organized to address all the GSP regulations regarding SMC and is organized in accordance with DWR's GSP annotated outline. This chapter includes a description of:

- Development of locally defined significant and unreasonable conditions related to the sustainability indicators that exist in the Subbasin.
- How minimum thresholds were developed, including:
  - The information and methodology used to develop minimum thresholds,
  - The relationship between minimum thresholds and significant and unreasonable undesirable results,
  - The relationship of these minimum thresholds to other sustainability indicators,
  - The effect of minimum thresholds on neighboring basins,
  - The effect of minimum thresholds on beneficial uses and users,
  - The relationship of minimum thresholds to relevant Federal, State or local standards and
  - The method for quantifying measurable minimum thresholds.
- How measurable objectives were developed, including:
  - The methodology for setting measurable objectives

    - The quantification of Interim milestones that represent the estimated pathway to sustainable management of groundwater resources in the Subbasin by 2040.
- How undesirable results were developed, including:
    - The criteria defining when and where the effect of the groundwater conditions cause undesirable results based on a quantitative description of minimum threshold exceedances
    - The potential causes of undesirable results
    - The effect of these undesirable results on the beneficial use and users.

The SMC presented in this chapter were developed using information from interested parties and public input and correspondence with the GSAs, public meetings, hydrogeologic analysis, groundwater dependent ecosystem (GDE) analysis, and meetings with GSA technical representatives. The general process for establishing SMC included:

- GSA public meetings that outlined the GSP development process and introduced interested parties to the SMC
- Conducting GSP public meetings to present proposed methodologies to establish minimum thresholds and measurable objectives and receive additional public input.
- Reviewing public input on preliminary SMC methodologies with GSA staff/technical representatives
- Providing a Draft GSP for public review and comment
- Establishing and modifying minimum thresholds, measurable objectives, and undesirable results based on feedback from public meetings, public/interested party review of the Draft GSP, and input from GSA staff/technical representatives.

To ensure the Plan area shows progress in meeting its sustainable goal by 2040, the GSA proposes projects and management actions (PMAs) described in **Chapter 4**, to address undesirable results. The proposed PMAs include augmentation projects and management actions that optimize groundwater use in the Subbasin. The sustainability goals will be maintained through proactive monitoring and management by the GSA as described in this chapter and throughout the GSP.

Conditions within the Subbasin will be considered sustainable when all of the following goals are met:

1. Long-term aggregate groundwater use is equal to the Subbasin's estimated sustainable yield.
2. The average annual volume of groundwater storage changes within the Subbasin—averaged across the Subbasin—is approximately zero, representing generally stable conditions coincident with the achievement of sustainable groundwater levels at measurable objective groundwater elevations.
3. Groundwater levels are maintained at the set measurable objectives. The measurable objectives represent water levels present during sustainable conditions, including a margin of operational flexibility, and will avoid undesirable results, such as lowering groundwater levels that result in significant and unreasonable depletions of available water supply for beneficial uses available to groundwater users.

4. Groundwater quality will be maintained at constituent concentrations in those areas of the Subbasin where degraded water quality does not already exist prior to the 2015 baseline period. Groundwater extractions will be managed to ensure that beneficial users of groundwater can utilize groundwater that meets drinking water standards for urban and domestic users and agricultural guidelines for agricultural beneficial users without the implementation of PMAs.
5. Subsidence is maintained at levels that do not significantly impact the operations of critical infrastructure such as the SLC within the Subbasin.
6. Sustainability goals for interconnected surface water and seawater intrusion are not provided as a result of the absence of these sustainability indicators in the Subbasin.

3.1 Sustainability Goal (Reg §354.24)

The sustainability goal for the Subbasin has three sections:

1. A description of the sustainability goal;
2. A discussion of the measures that will be implemented to ensure the Subbasin will operate within the sustainable yield; and
3. An explanation of the Subbasin's pathway to achieve the sustainability goal within 20 years of GSP implementation and to maintain the goal through the planning and implementation horizon.

3.1.1 Goal Description

The goal of this GSP is to develop projects and management actions that result in the sustainable management of the groundwater resources of the Subbasin for long-term community, financial, and environmental benefits of residents and business in the Subbasin. This GSP outlines the approach to achieve sustainable management of groundwater resources within 20 years, while maintaining the unique cultural, community, and agricultural business aspects of the Subbasin. The GSA's sustainability goal is to ensure that by 2040, and thereafter within the planning and implementation horizon of this GSP (50 years to 2070), the Subbasin is operated within its sustainable yield and does not exhibit undesirable results.

3.1.2 Description of Measures

Meeting this goal requires achieving a balance of water demand with available water supply for all beneficial users in the Subbasin, while monitoring groundwater quality and working with beneficial users to ensure sustainable groundwater supplies, by the end of the GSP implementation timeframe, carrying through the SGMA planning and implementation horizon.

3.1.3 Description of Measures and Explanation of How the Goal Will Be Achieved in 20 Years

To ensure the Subbasin meets its sustainability goal by 2040, the GSA proposed several PMAs, described in Chapter 4, to address conditions that would lead to undesirable results. The PMAs, listed below, were developed to ensure the Subbasin Goal is achieved by 2040.

1. Surface Water Deliveries described in PMA 1 provide in-lieu recharge through the direct delivery of surface water in the Subbasin coupled with a reduction in groundwater pumping.
2. Groundwater Allocation Program described in PMA 2 promotes conjunctive use in the Subbasin to ensure groundwater resources are used in sustainable quantities.

3. Aquifer Storage and Recovery (ASR) described in PMA 3 increases groundwater storage and groundwater levels, minimizes the potential for subsidence and improves water quality in the ASR well.
4. Targeted Pumping Reductions described in PMA 4 ensure that an alternative water supply is provided to subsidence prone areas of the Subbasin.
5. Recharge Projects described in PMA 5 enable the GSA and landowners to develop recharge projects throughout the Subbasin to augment groundwater storage, quality, and groundwater levels.

The sustainability goal as well as the absence of undesirable results are expected to be achieved by 2040 through implementation of the PMAs. The sustainability goals will be tracked and maintained through monitoring and management by the GSA as described in this GSP.

3.2 Measurable Objectives and Interim Milestones (GSP Reg. § 354.30)

Measurable objectives, as well as interim milestones, that represent the path to sustainability in 5-year increments, are detailed below. Measurable objectives represent the quantified metric at each representative monitoring site for each sustainability indicator that is expected to occur under sustainable groundwater pumping conditions. If the GSA successfully manages groundwater pumping which results in the achievement of the measurable objectives described, the Subbasin will be operating sustainably. Measurable objectives and interim milestones are detailed below. A description of the measurable objectives and how they were established are provided, along with recognition of the anticipated fluctuations in basin conditions around the established measurable objectives. In addition, this section describes how the GSP helps to meet each measurable objective, how each measurable objective is intended to achieve the sustainability goal for the Plan area for the long-term beneficial uses, and how the interim milestones are intended to reflect the anticipated progress toward the measurable objectives during the 2020 to 2040 implementation period.

The GSP regulations define measurable objectives as specific, quantifiable goals for the maintenance or improvement of specific groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin.

Per GSP Regulations (GSP Reg. § 354.30):

1. Measurable objectives shall be established, "…including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon." (GSP Reg. § 354.30(a).)
2. "Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metric and monitoring sites as are used to define the minimum thresholds." (GSP Reg. § 354.30(b).)
3. "Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty." (GSP Reg. § 354.30(c).)

4. "…a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators…" may be established where "…the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence." (GSP Reg. § 354.30(d).)
5. "Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years." (GSP Reg. § 354.30(e).)

The measurable objectives developed for each applicable sustainability indicator in this GSP are based on the current understanding of the Plan Area and Basin Setting as discussed in detail in Chapter 2. Representative Monitoring Sites (RMS) are identified for monitoring of interim milestones, measurable objectives, and minimum thresholds for each sustainability indicator, and are also referred to as sustainability indicator wells.

3.2.1 Measurable Objectives for Chronic Lowering of Water Levels

Measurable objectives and interim milestones for chronic lowering of groundwater levels are described below.

3.2.1.1 Description of Measurable Objectives

Measurable objectives for groundwater levels were established by analyzing historical groundwater level data during the historical water budget period when the Subbasin was pumping groundwater consistent with the sustainable yield and avoiding undesirable results. As discussed in Section 2.3.7.4, the sustainable yield of the Subbasin was estimated utilizing the numerical flow model simulation of projected conditions in the Subbasin. The estimation of sustainable yield also accounted for the effects of climate change and on groundwater levels in the future. This analysis of the sustainable yield formed the basis for determining the MOs.

The MOs were established using a multi-step process. The first step was to identify a time period from the model where pumping occurred within the range of the sustainable yield. This time frame would provide groundwater level conditions present in a sustainable condition. This process identified 2006 through 2012 as a time frame where annual pumping was within the range of the sustainable yield. This time frame was also favorable as it encompassed a year (2007) when groundwater levels were high enough that subsidence did not occur. Therefore, 2006 through 2012 was chosen as the time frame on which to base the MOs. Specifically, MOs were set to the average Spring water levels from 2006 through 2012.

In order to establish these MOs, observed water levels from 2006 through 2012 were analyzed at the representative monitoring wells. This analysis revealed that most wells only contained data for Fall water levels as opposed to spring. In order to extrapolate spring water level averages for the wells, model data were used. Average fall water levels for 2006 through 2012 were calculated at each site based on observed values. Fall water level averages were also calculated at each of the wells using modeled data for 2006 through 2012. The magnitude of difference between these two datasets was then used to extrapolate the spring observed average water levels from the spring modeled average water levels at each site. Wherever historical data was not available for this extrapolation, recent (2017 through 2020) Spring averages were used as the MOs.

MOs were set at each of the monitoring sites (**Table 3-1 and 3-2 and Figure 3-1and 3-2**). These sites were selected in order to provide an even distribution of coverage over the Subbasin. The individual wells were selected based on the well's historical record, location within each hexagon, and viability for continued monitoring. The construction information for the selected wells was also analyzed to ensure they were screened in the appropriate aquifer for monitoring.

Groundwater level hydrographs showing measurable objectives for each groundwater level sustainable indicator well are provided in **Appendix 3A.** Measurable objectives for each groundwater level monitoring well in the upper and lower aquifers are summarized in **Tables 3-1 and 3-2.**

3.2.1.2 Interim Milestones (Operational Flexibility)

Interim milestones at 5, 10, and 15 years are summarized in **Table 3-1 and Table 3-2.** Interim milestones convey a series of milestones that demonstrate progress towards achieving sustainability as represented by the measurable objective values. The starting point in the development of interim milestones was assumed to be the minimum threshold value at each monitored well in the GSP network. The interim milestones are the difference between the measurable objectives and minimum thresholds equally distributed over four interim milestones.

3.2.1.3 Path to Achieve and Maintain the Sustainability Goal

Historic trends and planned groundwater extraction and management actions provide a reasonable path to maintain the sustainability goal with stable groundwater elevation. Recent water levels remain above the MO and the recovery of groundwater elevation is not required to reach the sustainability goal. The interim milestones served to maintain the existing sustainable conditions. The sustainability goal for groundwater elevation is to prevent a trend of declining water levels. Planned management actions in conjunction with coordination of SMC with adjacent GSAs will ensure the MOs for groundwater elevation are met. However, preliminary reviews of draft GSPs from the Kings and Tulare Lake subbasins indicate that MOs and MTs in these adjacent subbasins are lower than 2015 baseline conditions in the Westside Subbasin and could impact GSP implementation and sustainability goals in the Westside Subbasin, especially in areas of the Subbasin adjacent to the Kings and Tulare Lake subbasins. If the District determines activities in Kings and Tulare Lake subbasins are affecting sustainability in the Westside Subbasin, the District will engage in inter-basin outreach efforts with neighboring GSAs to minimize the potential impact to the achievement of sustainability in the Subbasin.

The combination of interim milestones and measurable objectives reflect how the basin anticipates achieving and maintaining sustainability. It should be noted that future projections require assumptions about future hydrologic conditions, including the sequence of wet, average, and dry climatic years. The future climatic assumptions for the Implementation Period (through 2040) used in this GSP incorporate sequences of wet, average, and dry years that represent overall long-term average historical climatic conditions over the Implementation Period. Under these climatic assumptions, the Implementation Period is expected to experience annual variations in groundwater levels, with an overall stable trend through 2040 during which time, the GSA is implementing projects and management actions to ensure sustainable conditions are maintained through 2070.

3.2.1.4 Impact of Selected Measurable Objectives on Adjacent Basins

The measurable objectives established for the Subbasin provide a good basis for evaluation of anticipated impacts on adjacent subbasins from implementation of the GSP. This is because MOs are set to reflect the average groundwater levels to be maintained during the Sustainability Period. Ultimately, the potential for impacts on adjacent subbasins will be primarily a function of average water levels in the Subbasin during the Sustainability Period, average water levels in adjacent subbasins during the Sustainability Period, and natural groundwater flow conditions that would be expected to occur at Plan area boundaries. The average groundwater levels expected for the Plan area are reflected in the measurable objectives **Table 3-1 and Table 3-2.** Groundwater model results indicate that the average groundwater levels reflected in the MOs will result in greatly reduced net subsurface inflow to the Plan area from surrounding subbasins compared to historic net subsurface inflow. Therefore, the projects and management actions implemented for this GSP are expected to benefit adjacent subbasins and not hinder the ability of adjacent subbasins to be sustainable.

3.2.2 Measurable Objectives for Reduction in Groundwater Storage

Measurable objectives and interim milestones for reduction in groundwater storage are described below.

3.2.2.1 Description of Measurable Objectives

The measurable objective, reduction of groundwater in storage, was developed using the same methodology as chronic lowering of groundwater levels. The estimated reduction of groundwater in storage simulated using the District's Model to establish the interim milestones and measurable objective. The measurable objective of the reduction of groundwater storage is zero once the measurable objective of chronic lowering of groundwater levels is achieved.

3.2.2.2 Interim Milestones (Operational Flexibility)

Interim milestones at 5, 10, and 15 years are summarized in **Table 3-1 and Table 3-2** for groundwater levels and when multiplied by the aquifer storage coefficient and areal extent of the Subbasin, will provide the interim milestones for change in groundwater storage (**Table 3-3**).

Table 3-3: Measurable Objectives and Interim Milestones for the Change in Groundwater Storage, Upper and Lower Aquifers, (acre-feet)

Aquifer	Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Measurable Objective
Upper	1,700,000	1,700,000	1,700,000	0
Lower	13,000	13,000	13,000	0

3.2.2.3 Path to Achieve and Maintain the Sustainability Goal

The combination of interim milestones and measurable objectives reflect how the Subbasin will achieve and maintain sustainability. Since groundwater levels serve as a practical proxy for evaluating reduction in groundwater storage, achieving and maintaining sustainability relative to this indicator is similar to the groundwater level section.

3.2.2.4 Impact of Selected Measurable Objectives on Adjacent Basins

Groundwater modeling results indicate the average groundwater levels reflected in the MO will result in reduced net subsurface inflow to the Subbasin from surrounding basins compared to historic net subsurface inflow. This will serve to allow more groundwater to remain in storage in adjacent basins. Therefore, the projects and management actions implemented for this GSP will not hinder the ability of adjacent basins to be sustainable with regards to groundwater storage.

3.2.3 Measurable Objectives for Subsidence

Measurable objectives and interim milestones for reduction in land subsidence are described below.

3.2.3.1 Description of Measurable Objectives

The MOs for subsidence and subsurface compaction were established based on (1) assessment of the susceptibility of critical infrastructure to future subsidence and coordination with beneficial users, (2) analysis of historical and current rates and total amounts of subsidence described in **Section 2.2.8.4**, and (3) anticipated benefits from Projects and Management Actions described in **Chapter 4**.

MOs are specified at the RMS within the GSA and described in **Section 3.5.1.3**. These include GPS locations measuring land surface displacement (subsidence), extensometers measuring subsurface compaction and wells measuring water levels as a proxy where more direct measurements of subsidence are not currently in place (**Figure 3-3**). At sites measuring vertical displacement or compaction, MOs are defined using an annual rate of subsidence or compaction which may occur in a given year measured between the winter of consecutive years coupled with a total cumulative amount measured during GSP implementation. Annual rates and total amounts of subsidence apply solely to inelastic (irreversible) subsidence described in **Section 2.2.8.1.4**. As a result, annual rates, total amounts of subsidence and groundwater elevations are evaluated from measurements taken after groundwater levels have recovered from pumping during the irrigation season to estimate inelastic subsidence.

MOs specified in sites selected adjacent to SLC establish the objective of a maximum annual rate of 0.0 feet of subsidence or compaction and a cumulative total of 0.0 feet of subsidence at GPS locations and extensometers (**Table 3-4**, **Appendix 3B**). Water level proxies are not used in evaluating subsidence adjacent to the SLC. The selection of subsidence criteria is targeted to address the threat of unreasonable subsidence along the California Aqueduct and the request from the DWR California Aqueduct Subsidence Program (CASP) to fully abate subsidence along the SLC particularly near Checks 16, 17 and 20.

MOs in other portions of the Subbasin allow for a maximum annual rate of 0.1 feet of subsidence and a total cumulative amount of 0.5 feet of subsidence or compaction at GPS sites and extensometers (**Table 3-4**, **Appendix 3B**). Where water level proxies are used, MOs are specified to be consistent with MOs defined for chronic lowering of water levels defined in **Section 3.2.1.1**. Some additional subsidence is expected in less sensitive portions of the Subbasin as a result of the implementation of Projects and Management Actions during GSP implementation from 2020-2040 and possibly beyond. PMAs targeted towards the management of groundwater pumping through allocations, aquifer storage and recovery and pumping reductions may lead to changes in the spatial distribution and amounts of groundwater pumping. As a result, it is anticipated that implementation of the PMAs in some areas may lead to (1) local relative increases in groundwater pumping and (2) groundwater extraction from previously undeveloped portions of the aquifer system. Both instances might lead to local, short-term increases in inelastic subsidence. Consequently, the District will continue active monitoring and data collection efforts to identify special areas of concern and develop potential conditions and as well as further refinements of management measures designed to avoid undesirable results to critical infrastructure and minimize these impacts. Furthermore, GSPs submitted in adjacent groundwater basins suggest groundwater levels may continue to decline (leading to possibly commensurate rates of subsidence) within those basins which could propagate across shared jurisdictional boundaries. These external hydraulic influences and variable localized conditions could lead to impacts within the District that cannot be managed without inter-basin coordination.

3.2.3.2 Interim Milestones (Operational Flexibility)

Interim Milestones at 5, 10, 15 and 20 years are summarized in **Table 3-4**. Interim milestones for sites adjacent to the SLC are defined as an annual rate of 0.0 feet of subsidence and total amount of 0.0 feet in extensometers and GPS sites. In other portions of the Subbasin, Interim Milestones allow for up to 0.1 feet of subsidence annually and up to 0.5 feet of subsidence through the 2040 GSP implementation period for extensometers and GPS sites. In cases where measured groundwater levels are used as a proxy for subsidence, Interim Milestones are consistent with those for chronic lowering of water levels described in **Section 3.2.1.2**.

3.2.3.3 Path to Achieve and Maintain the Sustainability Goal

The path to achieve and maintain the sustainability goal will be accomplished through implementation of planned PMAs aimed at augmenting groundwater supply and reducing demand described in **Chapter 4**. Historically, subsidence has largely resulted due to high amounts of groundwater extraction which coincide with dry years and periods of prolonged drought. PMA No. 2 was developed to allocate groundwater extraction based on the sustainable yield of the Subbasin in order to reduce regional impacts of groundwater overdraft on subsidence. PMA No. 4 was developed to reduce the acute impacts of groundwater extraction subsidence through targeted reductions in groundwater pumping in subsidence-prone portions of the SLC, which impacts the freeboard required to maintain operational flexibility for the CVP and SWP. These demand-driven PMAs are coupled PMA No. 3 and 5 intended to augment water supply through Aquifer Storage and Recovery and targeted recharge through percolation basins. Supply-driven PMAs are designed to increase the volume of stored groundwater during wet periods mitigating pumping impacts during subsequent droughts. In conjunction, planned management actions will ensure the measurable objective for subsidence is met.

3.2.3.4 Impact of Selected Measurable Objective on Adjacent Basins

The anticipated effect of the subsidence measurable objectives on each of the neighboring subbasins is not expected to be significant as a result of the following factors:

- The District retired approximately 94,000 acres of land primarily located adjacent to neighboring subbasins. As a result, groundwater pumping from the Lower Aquifer within the Subbasin is not expected to result in significant amounts of subsidence that may occur miles away in adjacent subbasins.
- Neighboring basins such as the Kings and Tulare Lake Subbasins are expected to continue to have declining groundwater levels below historic lows as part of those basins' implementation of their GSPs, in contrast to this GSA which is planning on minimizing the exceedance of historic lows. As a result, it is unlikely that GSP implementation actions by the GSA will result in a proportion of subsidence in the adjacent basins.

3.2.4 Measurable Objectives for Degraded Water Quality

3.2.4.1 Description of Measurable Objectives

Based on the review of groundwater quality in **Chapter 2**, TDS was selected as a proxy for constituents of concern to the beneficial users that primarily exist in the Subbasin. Constituents of concern for domestic and urban beneficial users are those constituents that are regulated under the State of California's drinking water standards. As described in **Section 2.2.7**, TDS was shown to be a proxy for constituents that may exceed drinking water standards in the Subbasin where domestic and urban beneficial users of groundwater for drinking water purposes exist. As presented in Chapter 2, there was either a correlation between TDS and other constituents or TDS was shown as being conservative in relation to trace elements in the sense that where trace elements were observed, the concentrations of trace elements were mostly below maximum contaminant levels (MCLs) while TDS concentrations were above the drinking water standards. In addition, the District coordinated with Fresno County on its approach to use TDS as a proxy for other constituents in monitoring groundwater quality in the Subbasin and the influence groundwater pumping activities have on groundwater quality. Fresno County supports the District's approach to use TDS as a proxy for other constituents (Appendix O).

In order to select representative monitoring wells and set measurable objectives, all available TDS data was evaluated on a hexagon basis. Hexagons where TDS measurements exceeded 1,000 mg/L were not assigned sustainable management criteria, however, these areas will continue to be monitored under the groundwater quality monitoring program. This approach received support from Fresno County Dept. of Public Works and Planning (Appendix O). As explained in **Chapter 2**, **Sections 2.2.7.1** and **2.2.7.2**, these areas with elevated TDS concentrations represent baseline conditions. These areas with elevated concentrations are the result of marine sediments. As a result, those areas with historical exceedances of TDS above the MCL are not assigned a MO, however, those areas of the Subbasin that are below the 1,000 mg/L TDS concentration are assigned a MO of 500 mg/L TDS for municipal and domestic beneficial users consistent with application drinking water standards and 800 mg/L TDS for agricultural beneficial users. The MO for agricultural beneficial users was based on outreach and discussions with the District that conveyed that the MO for agricultural beneficial users was a concentration that, without any management action, could be sustainably applied for agricultural beneficial users in the Subbasin.

As mentioned above, because the goal of the MOs is to minimize groundwater quality degradation resulting from groundwater pumping activities that are not sustainable, the areas of the Subbasin that have naturally degraded groundwater quality were excluded from being assigned MOs. Instead, the GSP sets MOs at wells in hexagons that had less than two exceedances of 1,000 mg/L TDS (**Figures 3-4 and 3-5**) for municipal and domestic beneficial users of groundwater. The 1,000mg/L threshold was utilized as an upper limit based on the published drinking water MCL. This concentration was also utilized for agricultural beneficial users of groundwater. If a well's groundwater quality is above this threshold, management to mitigate a potential undesirable result is required. In the Westside Subbasin, mitigation could include, among other actions, blending with surface water, treatment and/or applying groundwater to salt tolerant crops.

Different MOs were set for hexagons where domestic and urban users were present compared to hexagons where only agricultural users were present. In hexagons with domestic or urban users, MOs were set to 500 mg/L. This value reflects the drinking water standards for TDS. For hexagons where only agricultural users are present, MOs were set to 800 mg/L. This value ensures that the TDS concentration in groundwater will be at a level that is not harmful to the crops and other vegetation that generally exist in the Subbasin (UCANR, 2016).

All available water quality data was plotted by hexagon and analyzed to determine where MOs and MTs would be set based on the criteria described above. In the Upper Aquifer, this analysis yielded two (2) hexagons. One well per hexagon was chosen to be included in the RMS network with MOs and MTs set. Because only one hexagon had domestic and urban users present within it, the MO at the representative well was set to 500 mg/L for this hexagon. The other hexagon only had agricultural users present so the MO was set to 800 mg/L for these hexagons. Both wells were chosen due to their locations within their respective hexagons and are irrigation wells.

The same analysis was done for the Lower Aquifer and four (4) hexagons met the criteria for establishing MOs and MTs. One (1) well per hexagon was chosen to be included in the RMS network. Each well was chosen based on its location, length of record when available, and for also serving as a groundwater level monitoring site. MOs at three (3) of the sites were set to 500 mg/L due to the presence of a domestic users within the hexagon. The remaining site had an MO of 800 mg/L because only agricultural users were present within that hexagon. All four (4) RMS wells are irrigation wells.

The wells to be utilized for monitoring in the Upper and Lower Aquifers are summarized in **Table 3-5** and **Table 3-6** and show on **Figure 3-4** and **Figure 3-5.**

3.2.4.2 Interim Milestones (Operational Flexibility)

Interim Milestones are summarized on **Table 3-5 and Table 3-6.** Interim milestones were set based on the MOs and current TDS concentrations at the representative monitoring wells. The interim milestones are a progression towards sustainability. Therefore, the difference between the current conditions and the MOs was equally distributed amongst each five-year period to reach the MOs. The interim milestones focus on agricultural beneficial users since the occurrence of drinking water wells for domestic and municipal beneficial users are already under the oversight of the Regional Water Quality Control Board and the Department of Drinking Water.

3.2.4.3 Path to Achieve and Maintain the Sustainability Goal

Planned groundwater extraction, imported water supplies, blending, retired lands, and management actions provide a reasonable path to achieve the groundwater quality objectives. The GSP monitoring program for groundwater quality will provide the GSA with a more comprehensive understanding of groundwater quality and trends in the Subbasin. As the GSP monitoring program progresses and data gaps in groundwater quality are filled, the measurable objectives and minimum thresholds may be adjusted to accurately represent trends in groundwater quality.

3.2.4.4 Impact of Selected Measurable Objectives on Adjacent Basins

There are no known areas of degraded water quality from human activities within the Subbasin's primary aquifer systems that are known to have migrated to adjacent subbasins north, east, and south of the Westside Subbasin; therefore, there is not any impact from the measurable objectives and minimum thresholds on adjacent subbasins.

3.2.5 Measurable Objectives for Interconnected Surface Waters

3.2.5.1 Description of Measurable Objectives

As described in **Chapter 2**, interconnected surface water likely does not exist in the Subbasin and is currently designated as a data gap due to a lack of monitoring facilities in some areas of the Subbasin and historical data. In addition, streams in the Subbasin are ephemeral in nature and have historically not had sufficient flows to maintain GDEs. Therefore, no measurable objectives were developed for this sustainability indicator. If in the future, data from groundwater level monitoring indicate that surface water from the ephemeral streams in the Subbasin and groundwater are interconnected, the GSA will develop minimum thresholds, undesirable results and measurable objectives. Since sustainable management criteria were not developed for the GSP, information about the methods used to develop minimum thresholds, the quantitative metrics to track compliance with minimum thresholds, and their impacts on other sustainability indicators, other Subbasins, and beneficial use and users of groundwater is not presented in this Chapter.

3.2.5.2 Interim Milestones (Operational Flexibility)

Not currently applicable for this sustainability indicator.

3.2.5.3 Path to Achieve and Maintain the Sustainability Goal

Not currently applicable for this sustainability indicator.

3.2.5.4 Impact of Selected Measurable Objectives on Adjacent Basins

Not currently applicable for this sustainability indicator.

3.3 Minimum Thresholds (GSP Reg. § 354.28)

The GSP Regulations define undesirable results as occurring when significant and unreasonable effects are caused by groundwater conditions occurring throughout the Plan area for a given sustainability indicator. (GSP Reg. § 354.26.) Significant and unreasonable effects occur when minimum thresholds (MTs) are exceeded for one or more sustainability indicators. Minimum thresholds refer to a numeric value for each sustainability indicator used to define undesirable results. A GSP must establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site. The numeric value used to define the minimum threshold shall represent a point for conditions in the Subbasin that, if exceeded may cause significant and unreasonable undesirable results. A GSA may establish a representative minimum threshold, such as groundwater elevation (GWE) to serve as the value for multiple sustainability indicators, if the GSA can demonstrate the representative value is a reasonable proxy for multiple individual minimum thresholds, as supported by adequate evidence. Minimum thresholds are not required for sustainability indicators that are not present and not likely to occur in the Subbasin.

The description of minimum thresholds shall include the following:

1. The information and criteria relied upon to establish and justify the minimum threshold for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate and qualified by uncertainty in the understanding of basin setting. (GSP Reg. § 354.28(b)(1).)
2. The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency determined that basin conditions at each minimum threshold will avoid undesirable results from each sustainability indicator. (GSP Reg. § 354.28(b)(2).)
3. How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting adjacent basin's ability to achieve sustainability goals. (GSP Reg. § 354.28(b)(3).)
4. How minimum thresholds may affect the interests of beneficial users and users of groundwater or land uses and property interests. (GSP Reg. § 354.28(b)(4).)
5. How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference. (GSP Reg. § 354.28(b)(5).)
6. How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements (GSP Reg. § 354.28(b)(6)).

3.3.1 Minimum Thresholds for Chronic Lowering of Groundwater Levels

3.3.1.1 Description of Minimum Threshold

Groundwater levels will be measured at existing or new monitoring wells to gauge if minimum thresholds are being met. The groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in **Section 3.5.2.1**. Furthermore, the groundwater level monitoring will meet the requirements of the technical and reporting standards included in the GSP regulations. As noted in **Section 3.5.1.1**, the current groundwater monitoring network includes 22 wells in the Upper Aquifer and 44 wells in the Lower Aquifer (**Figure 3-1 and Figure 3-2**). The GSA also installed five nested monitoring wells in 2019 which will augment the existing wells in the network. The GSA will evaluate whether further monitoring wells or refinement to these minimum thresholds are needed to monitoring boundary conditions with adjacent basins to ensure subsurface inflow and outflow conditions remain consistent with water budget and model results.

The GSP regulations provide that “[t]he minimum thresholds for chronic lowering of groundwater levels shall be the groundwater level indicating a depletion of supply at a given location that may lead to undesirable results.” (GSP Reg. § 354.28(c)(1).) Chronic lowering of groundwater levels in the Subbasin cause significant and unreasonable declines if they are sufficient in magnitude to lower the rate of production of pre-existing groundwater wells below that necessary to meet the minimum required to support beneficial use(s) where alternative means of obtaining sufficient water resources are not technically or financially feasible. In addition, GWEs will be managed at levels above the minimum thresholds to ensure the major aquifers in the Subbasin are not depleted in a manner to cause significant and unreasonable impacts to other sustainability indicators. At the same time, the GSA is mindful that groundwater levels may decline on a short-term basis below 2015 levels before they are stabilized by the end of the GSP implementation period. Thus, the minimum thresholds have been designated with that circumstance in mind.

The minimum thresholds are intended to protect against significant and unreasonable levels of chronic groundwater storage declines, water quality degradation from human activities and subsidence in areas where critical infrastructure is located. The development of minimum thresholds for chronic lowering of groundwater levels included a review of the magnitude of historical groundwater level declines during extended drought periods. Hydrographs were generated for all representative monitoring wells and analyzed for seasonal fluctuations and changes in water levels during drought periods. The baseline measurements were established using the lowest water levels encountered during the 2012-2016 drought period. However, these water level measurements (including those captured in 2015) were measured in the fall and are not representative of the seasonal low that would have been measured in the summer. To account for this discrepancy, the seasonal low water level was estimated using available data. The largest fluctuation in water levels was utilized to establish the MTs. MTs were calculated by subtracting this number (40 feet) from the baseline water level elevation at each well. Forty feet represents the projected average seasonal low.

In the Lower Aquifer, the MTs were calculated differently for seven wells located in subsidence prone areas near the SLC and highlighted in **Table 3-8**. In the cases of these seven wells, the 40 feet was not subtracted from the baseline value. Instead, the MTs were set to the measured low water level elevation in 2015 which reflects a groundwater level that is above the pre-consolidation head. The MT is specified to maintain groundwater levels above the pre-consolidation head to prevent further subsidence in subsidence prone areas.

The MTs for chronic lowering of groundwater levels are based on documented screen intervals of key wells located both in the upper and lower aquifers in the Subbasin. Key indicator wells and the subsequent minimum thresholds are listed in **Table 3-7 and Table 3-8**. Groundwater level hydrographs from which the minimum thresholds were developed are provided in **Appendix 3A**

3.3.1.2 Quantitative Measurement

Groundwater elevations will be determined by collecting depth to groundwater measurements from a known reference point and converted to an elevation relative to mean sea level. Measured values will be compared to the established minimum threshold value set at each individual well.

3.3.1.3 Existing Local, State, or Federal Standards

No Federal, State, or local standards exist for chronic lowering of groundwater elevations. Similarly, subsidence minimum thresholds on the San Luis Canal system do not exist, however, the GSA and DWR are communicating on efforts to minimize impacts from subsidence on the San Luis Canal within the Subbasin.

3.3.1.4 Avoidance of Undesirable Results

A prolonged period of extracting groundwater in excess of the sustainable yield has historically caused chronic lowering of groundwater levels in some areas of the Subbasin and could cause an undesirable result in the future. Conditions that may lead to an undesirable result include the following:

- Localized over pumping of groundwater. Even if regional pumping is maintained within the sustainable yield, a cluster (or pumping centers) of high capacity wells may cause excessive localized drawdowns that lead to undesirable results in specific areas.
- Extensive, unanticipated drought and associated drastic curtailments of imported surface water supplies. Minimum thresholds were established based on historical groundwater elevation and reasonable estimates of future groundwater elevations. Extensive, unanticipated droughts and associated curtailment of imported water supplies will likely lead to excessively low groundwater elevations and undesirable results.

As described in Chapter 4, PMA 1 (Surface Water Deliveries), PMA 3 (ASR), and PMA 5 (Recharge Project) were included to avoid undesirable results and increase groundwater levels in the Subbasin. Additionally, PMA 2 (Groundwater Allocation Program) and PMA 4 (Target Pumping Reductions) are physical solutions that when implemented protect groundwater levels, MTs, and avoid undesirable results. The efficacy of these PMAs in avoiding undesirable results is demonstrated through numerical modeling documented in **Chapter 7** of **Appendix I**.

3.3.1.5 Effects of the Beneficial Uses and Users of Groundwater

The primary detrimental effects to beneficial users from water levels falling below the minimum threshold are loss of significant well capacity, increased costs due to higher pumping lifts, lack of groundwater extraction due to groundwater levels declining below the pump setting depth or the bottom of the well, or subsidence impacts on well structures and above ground infrastructure, especially if the pumping is concentrated in a small geographic area.

The beneficial users with the shallowest wells that would be impacted are domestic well owners. To ensure these beneficial users would not be impacted by the established MTs, all active domestic wells within the Subbasin were plotted on the hexagonal grid. **Figure 3-8 and Figure 3-9** compare the screen intervals of the domestic wells and the established water level MTs for Upper Aquifer and Lower Aquifer monitoring wells for each hexagon, respectively. This comparison resulted in no domestic wells where the water level at the MT would potentially drop below the screen interval. One Upper Aquifer well located in the northern portion of the Subbasin had insufficient information to adequately evaluate the impact of MTs on well capacity. Since no agricultural groundwater pumping occurs in this portion of the Subbasin and groundwater conditions are relatively stable, impacts to this well are not anticipated.

Similarly, the District plotted all the municipal and industrial wells within the Subbasin by hexagonal grid to ensure the established MTs would not deplete access to groundwater. **Figure 3-8 and Figure 3-9** compare the screen intervals of the municipal and industrial wells and the established water level MTs for Upper Aquifer and Lower Aquifer monitoring wells for each hexagon, respectively. This comparison resulted in all municipal and industrial wells with screen intervals below the MTs.

Other beneficial users of groundwater in the Subbasin are agricultural well owners. However, all of these wells are screened deeper than the domestic wells. Therefore, if the MTs do not adversely affect the domestic wells, the municipal, industrial, and agricultural well owners will also not be impacted.

3.3.2 Minimum Thresholds for Reduction in Groundwater Storage

3.3.2.1 Description of Minimum Threshold

GSP Regulation § 354.28(c)(2) states that "[t]he minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results." Minimum thresholds for reduction of groundwater storage shall be calculated based on historical trends, water year type and projected water use in the Subbasin. Reduction in groundwater storage is not a parameter that can be directly measured; rather, change in storage is calculated from change in groundwater levels and aquifer material storage coefficients. Change in groundwater storage will be regularly estimated based on monitoring results derived from analysis of groundwater elevations and aquifer properties. Periodically, during periods that correspond with GSP updates, an analysis of groundwater storage change using the water budget information from the numerical flow model will be used to verify changes in groundwater storage estimates from analysis of groundwater level monitoring data.

The minimum threshold for decline in groundwater storage will be equivalent to the maximum decline in groundwater levels between 2017 levels and groundwater level minimum thresholds. This will be calculated by developing a spatially weighted average of the difference between 2017 groundwater levels and minimum thresholds for groundwater levels at each well. For the Subbasin, the minimum threshold is estimated to be a decline in storage of 240,000 AFY using an average storage coefficient of 0.15 for the Upper Aquifer and a storage coefficient of 0.001 for the Lower Aquifer. The storage coefficients are average values obtained from the numerical flow model of the Subbasin and are consistent with literature values (Freeze and Cherry, 1971).

3.3.2.2 Quantitative Measurement

The minimum threshold for reduction in groundwater storage is a single value of average groundwater elevation over the entire Subbasin. Therefore, the potential conflict between minimum thresholds at different locations in the Subbasin is not applicable. The reduction in groundwater storage minimum threshold was selected to avoid undesirable results for other sustainability indicators as outlined below:

1. Chronic lowering of groundwater levels. Since groundwater elevation will be used for estimating changes in groundwater storage, the reduction in groundwater storage would not cause undesirable results for this sustainability indicator.

2. Degraded water quality. Exceedances of the minimum threshold for declines in groundwater storage is not expected to lead to a degradation of groundwater quality.
3. Subsidence. Future average groundwater levels and changes in long-term aquifer storage will be stable and will not induce any additional subsidence in areas where additional subsidence will adversely impact the operations of the San Luis Canal near checks 16, 17, and 20.

The minimum thresholds for reducing groundwater storage are based on groundwater levels set at a minimum water level over the historical period. Most representative wells use the groundwater elevation to avoid reduction in groundwater storage. Groundwater levels will be measured at existing and new monitoring wells. The groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in **Section 3.5**. Furthermore, the groundwater level monitoring will meet the requirements of the technical and reporting standards included in the GSP Regulations. The change in groundwater elevations from year to year will be determined and multiplied by the storage coefficients associated with the specific aquifer being measured and multiplied by the areal extent of the Subbasin to derive the annual change in storage.

3.3.2.3 Existing Local, State, or Federal Standards

No Federal, State or local standards exist for reduction in groundwater storage.

3.3.2.4 Avoidance of Undesirable Results

A prolonged period of extracting groundwater in excess of the sustainable yield has historically caused groundwater storage declines, which when coupled with reductions in imported water supplies in some areas of the Subbasin, could cause an undesirable result in the future. Conditions that may lead to an undesirable result include the following:

- Localized over pumping of groundwater. Even if regional pumping is maintained within the sustainable yield, a cluster (or pumping centers) of high-capacity wells may cause excessive localized drawdowns that lead to undesirable results in specific areas.
- Extensive, unanticipated drought and associated drastic curtailments of imported surface water supplies. Minimum thresholds were established based on historical groundwater elevation and reasonable estimates of future groundwater elevations. Extensive, unanticipated droughts and associated curtailment of imported water supplies will likely lead to excessively low groundwater elevations and undesirable results.

3.3.2.5 Effects of the Beneficial Uses and Users of Groundwater

The practical effect of implementing this management criteria is that it encourages no net change in groundwater elevation and storage during average, long-term hydrologic conditions. Therefore, during average, long-term hydrologic conditions, beneficial uses and users will have access to the same amount of groundwater in storage that currently exists, and the undesirable result will not have a negative effect on the beneficial users and uses of groundwater. Pumping during dry years will temporarily lower groundwater elevations, reduce the amount of groundwater in storage and could result in short-term impacts from a reduction in groundwater in storage on all beneficial users and users of groundwater.

However, the GSP is designed to promote conjunctive use in the Subbasin and acknowledges the sustainable yield as an average value that can experience annual variations in storage.

3.3.3 Minimum Thresholds for Subsidence

3.3.3.1 Description of Minimum Threshold

GSP Regulations state that "[t]he minimum thresholds for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results." (GSP Reg. § 354.28(c)(5)). The MT for subsidence and subsurface compaction were established based on (1) assessment of the susceptibility of critical infrastructure to future subsidence and coordination with beneficial users of groundwater and other interested parties, (2) analysis of historical and current rates and total amounts of subsidence described in **Section 2.2.8.4**, and (3) anticipated impacts of Projects and Management Actions described in **Chapter 4**.

MTs are specified at the RMS within the GSA and described in **Section 3.5.1.3** and shown in **Figure 3-3**. These include GPS locations measuring land surface displacement (subsidence), extensometers measuring subsurface compaction and wells measuring water levels as a proxy where more direct measurements of subsidence are not currently in place (**Figure 3-3**). In sites measuring vertical displacement or compaction, MTs are defined using an annual rate of subsidence or compaction which may occur in a given year measured between the winter of consecutive years coupled with a total cumulative allowable amount measured during GSP implementation. The winter to winter comparison was selected because there is less ground disturbance activity (e.g., agricultural grading) to interfere with the vertical displacement measurements and provides accurate inelastic subsidence measurements. As is the case in evaluating MOs, annual rates and total amounts of subsidence apply solely to inelastic (irreversible) subsidence. As a result, annual rates, total amounts of subsidence and groundwater elevations are evaluated from measurements taken after groundwater levels have recovered from pumping during the irrigation season.

MTs specified in monitoring sites selected adjacent to SLC allow for a maximum annual rate of 0.3 feet of subsidence or compaction and a cumulative total of 1.5 feet of subsidence (**Table 3-9**, **Appendix 3B**). The annual rate of 0.3 feet per year of subsidence was determined based on the approximate rates of subsidence which occurred during droughts in the early 1990's and between 2012-2016 described in **Section 2.2.8.4**. Cumulative total amounts of subsidence were determined based on recent rates of groundwater pumping, subsidence, and the timeline for implementation of PMAs. Cumulative total amounts were also compared to estimates of freeboard in the SLC to evaluate how MTs would impact the conveyance capacity in the canal and coordination meetings with the DWR CASP (**Appendix 3C**). PMAs are intended to substantially reduce and ultimately abate subsidence by 2040. However, it is anticipated that some subsidence will occur during the GSP implementation period as PMAs are employed and refined to reach this goal. It is also recognized that some subsidence may occur locally due to future groundwater management (e.g., pumping rates, distribution of pumping, ASR), which is tolerable provided subsidence does not exceed the cumulative MT. The DWR CASP expressed a willingness to support proposed MTs presented during a follow up GSA engagement meeting citing that although the MT will allow for some additional subsidence, the plan illustrates a pathway to arrest subsidence along the SLC (DWR CASP, personal comm., May 25, 2022).

MTs in other portions of the Subbasin allow for a maximum annual rate of 0.3 feet of subsidence and a total cumulative amount of 2.5 feet of subsidence or compaction at GPS sites and extensometers. The annual rate of 0.3 feet per year of subsidence was determined based on the approximate rates of subsidence which occurred during droughts in the early 1990's and between 2012 and 2016 described in **Section 2.2.8.4**. Cumulative total amounts of subsidence were determined based on recent rates of groundwater pumping and subsidence and the timeline for implementation of PMAs. Where water level proxies are used, MTs for subsidence are consistent with MTs for chronic lowering of water levels defined in **Section 3.3.1.1**. Groundwater level MTs at these sites were specified at the estimated historical low groundwater levels encountered in the 2012-2016 drought which are representative of the pre-consolidation head. Provided groundwater levels are above the pre-consolidation head (MT), high rates of subsidence are not anticipated at these sites. As described in Section 3.3.3.5 and 3.4.3.3, infrastructure in other portions of the Subbasin have been less impacted by past subsidence and are likely less prone to interference and repairs due to future subsidence. Based on coordination with the District's Supervisor of Field Engineering and input from Caltrans, the total cumulative subsidence MT was set at an amount that is unlikely to produce substantial impacts to surface land uses which may lead to undesirable results. Historical subsidence caused limited impacts to District infrastructure and no reported impacts to roads and bridges. Future subsidence will be constrained by the MT which allows for substantially less subsidence than has occurred historically. As a result, it can be qualitatively inferred that it is unlikely that future subsidence will significantly interfere with surface land uses.

3.3.3.2 Quantitative Measurement

MTs for annual rates of subsidence or compaction and cumulative total subsidence or compaction measured at GPS and extensometer sites will be evaluated based on measurements taken in the winter of each year. Cumulative total amounts of subsidence and compaction will be calculated in each given year based on a baseline January 2020. January 2020 serves as a meaningful benchmark for inelastic subsidence as this period coincides with the GSAs' adoption of the GSP and GSP implementation activities to address undesirable results from subsidence that may occur as a result of unsustainable groundwater pumping in the Subbasin. Unlike other sustainability indicators, inelastic subsidence (or compaction) is irreversible. As a result, the SMCs do not include prior inelastic subsidence because the GSAs cannot address irreversible subsidence occurring before the GSAs had the authority to implement the projects and management actions to mitigate subsidence described in the GSP. The January 2020 benchmark was established from direct measurement at USBR and UNAVCO GPS sites and USGS extensometer sites. The baseline was established indirectly using TREA InSAR where January 2020 measurements were unavailable at DWR and WWD GPS sites.

Quantitative measurements of MTs in GPS and extensometer sites vary depending on the monitoring agency. Subsidence at GPS sites operated by DWR is calculated based on measurements of land surface elevation taken by static GPS benchmarks in January and February of each year and provided to the GSA following internal QA/QC. Subsidence at the UNAVCO PBO site (P302) is collected as relative vertical displacement and uploaded continuously to the UNAVCO webpage. Subsidence is calculated using a 10-day moving average and evaluated in the winter of each year. Subsidence at USBR sites is calculated based on measurements of land surface elevation from static GPS benchmarks taken in December of each year and published to the USBR San Joaquin Restoration Project (SJRRP) webpage. Subsidence at GPS sites monitored by WWD is calculated based on measurements of land surface elevation taken at static GPS benchmarks in March of each year by the District consultant (Blair, Church & Flynn) and provided to the GSA after internal QA/QC. Compaction at USGS extensometer sites is measured and provided continuously through the USGS NWIS webpage. Compaction is evaluated in the winter of each year.

Quantitative measurement in sites where groundwater levels will be used as a proxy for subsidence are described in the methodology for chronic lowering of groundwater levels presented in **Section 3.3.1.2**.

3.3.3.3 Existing Local, State, or Federal Standards

Specific standards for subsidence minimum thresholds do not exist on the San Luis Canal system, however, the GSA and DWR are communicating on efforts to minimize impacts from subsidence on the San Luis Canal within the Subbasin.

3.3.3.4 Avoidance of Undesirable Results

Avoidance of undesirable results will be accomplished through implementation of planned projects and management actions aimed at augmenting groundwater supply and reducing demand described in **Section 4**. PMA No. 2 was developed to allocate groundwater extraction based on the sustainable yield of the Subbasin in order to reduce regional impacts of groundwater overdraft on subsidence. PMA No. 4 was developed to reduce the acute impacts of groundwater extraction subsidence through targeted reductions in groundwater pumping in subsidence-prone portions of the SLC, which impacts the freeboard required to maintain operational flexibility for the CVP and SWP. These demand-driven PMAs are coupled with PMA No. 3 and 5 intended to augment water supply through ASR and targeted recharge through percolation basins. Supply-driven PMAs are designed to increase the volume of stored groundwater during wet periods mitigating pumping impacts during subsequent droughts. In conjunction with the proposed monitoring network, planned management actions are targeted to avoid and respond to undesirable results and emergent impacts on surface land uses.

3.3.3.5 Effects on the Beneficial Uses and Users of Groundwater

The effects of MTs may affect beneficial uses and users of groundwater, land uses and other infrastructure. Potential effects on entities with infrastructure sensitive to subsidence are described below:

- MTs specified at sites along the SLC may further impact short-term operational flexibility due to subsidence in pools 17, 18 and 20 until liner raises are completed. Impacts are less likely to impact operations in other pools. Specific thresholds with relation to MTs from monitoring sites are shown in **Appendix 3C; Figure 3-10**.
- Pipelines and turnout structures operated by the District may be impacted by MTs which allow for between 1.5 and 2.5 feet of additional subsidence. While specific thresholds are not available, given the relatively limited existing impacts relative magnitude of past subsidence, it is unlikely that subsidence allowed under the MTs will lead to substantial impacts to WWD operations. Pipelines which could be potentially impacted by subsidence are shown in **Figure 3-11**.

- The impact of subsidence on well casings for agricultural wells owned and operated by landowners has been known to occur but is not well documented. It is anticipated that the subsidence MTs may lead to additional well retrofits, but this is challenging to predict.
- It is the District's understanding that the impact of subsidence on roads and bridges maintained by Caltrans is not identified as a design factor. When designing roadways and structures, Caltrans focuses its design on the soil five feet below groundwater surface, strength of the soil, and potential to collapse given an assumed vehicle miles traveled. Roadway repairs are usually due to rain migrating into the aggregate, roadways lifespan and/or the collapse due to the weight of the aggregate. Further, Caltrans does not identify subsidence as a design factor because impacts from subsidence on roadways are repaired as result of normal maintenance and structures, such as bridges, are designed to withstand vertical displacement associated with subsidence. The District confirmed its understanding of the effects, if any, of subsidence on Caltrans infrastructure through personal communication with the Caltrans Maintenance Engineering Chief from Region 6 on June 10, 2022. It is anticipated that the subsidence MTs may lead to impacts to roads and bridges, but since specific thresholds are unavailable, specific impacts cannot be predicted. Roads and bridges which could be potentially impacted by subsidence are shown in **Figure 3-12**. Historically Caltrans has not attributed roadway repairs to land subsidence and during the implementation of the GSP land subsidence is not projected to impact the beneficial use of infrastructure within the Subbasin.

3.3.4 Minimum Thresholds for Groundwater Quality

3.3.4.1 Description of Minimum Threshold

The MT for degraded water quality for beneficial uses and users in the Subbasin are based on drinking water standards for domestic and municipal beneficial users and outreach to interested parties, and discussions with the Advisory Committee and Technical Advisory Committees for agricultural beneficial users. As mentioned in the discussion for MOs, TDS is being used as a proxy for other main constituents of concern for agricultural users and constituents monitored for drinking water standards are of primary concern for municipal and domestic users. However, TDS will be used as a proxy for these additional drinking water constituents because of the correlation between TDS and the presence of these additional constituents. In addition, other water quality constituents are being monitored by other water quality programs (e.g., CV-SALTS and ILRP). The District will monitor these other programs to ensure water quality constituents impacted by the implementation of the Westside Subbasin GSP are sustainably managed to protect beneficial uses.

1. Minimum thresholds for all representative monitoring wells were set at the same concentration. All minimum thresholds were set to 1,000 mg/L. This concentration is the short-term MCL for drinking water. Also, this concentration of TDS is tolerable for crops and vegetation for the short-term. Any TDS concentrations exceeding 1,000 mg/L may be considered undesirable and use of such water quality would need to be treated, blended with other better quality water supplies, or used on salt tolerant crops. However, if this threshold is exceeded, the GSA has defined a process to prevent undesirable results from occurring (described further in **Section 3.3.4.4**). These measures include investigating the causes of TDS exceedances, development of appropriate management actions to address the exceedances with affected beneficial users.

These measures may include blending, changes in land use, changes in groundwater pumping patterns, treatment, and other options.

Minimum thresholds for TDS concentrations for wells in the Upper and Lower Aquifers in those areas of the Subbasin that have not already been degraded prior to the 2015 baseline are presented are summarized in **Table 3-10 and Table 3-11** along with wells used for groundwater quality monitoring in the degraded areas that are not assigned a minimum threshold**.**

3.3.4.2 Quantitative Measurement

Groundwater quality will be monitored on an annual basis at key, representative monitoring and production wells (**Table 3-10 and 3-11**). All measurements will comply with the Sampling and Analysis Plan and Quality Project Plan and be recorded in the GSA's data management system. The monitoring network and monitoring protocols are described in **Section 3.5** (Monitoring Network and Monitoring Protocols for Data Collection). **Tables 3-10 and 3-11** include each well being monitored in the GSP monitoring program for groundwater quality in the Upper and Lower Aquifers, along with the 2015 baseline TDS concentration (if available), MT, MO, and interim milestones. Generally, MTs were set at 1,000 milligrams per liter (mg/L) TDS in the Upper and Lower Aquifers.

The MOs for groundwater quality are concentrations of TDS that are generally representative of secondary drinking water standards and tolerable for most crops grown in the Subbasin without blending with surface water supplies due to the salt tolerance of most crops.

3.3.4.3 Existing Local, State, or Federal Standards

The minimum threshold for TDS is based on the Regional Water Quality Control Board Basin Plan Amendment that is currently being updated and developed. The minimum thresholds, if exceeded for a prolonged period, may indicate impacts from human activities at the land surface that will be addressed in coordination with Regional Water Quality Control Board direction.

3.3.4.4 Avoidance of Undesirable Results

In order to prevent undesirable results from occurring, if the minimum thresholds are exceeded at any representative monitoring well, the GSA will conduct additional sampling in the impacted wells and any domestic or urban use wells within the hexagon. This sampling will confirm whether the wells are exceeding the MT of 1,000 mg/L. If exceedances are present, the GSA will work with well owners to mitigate these concentrations and bring them back to levels below the minimum threshold in addition to taking other actions that ensure domestic and urban uses meet applicable water quality standards. The same approach will be utilized in the case of agricultural wells exceeding the threshold. In that case, the GSA will work with well owners to implement management actions such as changing crops or blending water to mitigate impacts.

3.3.4.5 Effects of the Beneficial Uses and Users of Groundwater

Urban and domestic beneficial uses are impacted if groundwater of degraded quality is the only source of water for potable use. The impacts include the need to utilize alternative sources of water that may be more expensive than groundwater and potential requirement to treat prior to use. The effect of degraded groundwater quality from SGMA activities on agricultural beneficial users is manifested in crop damage and reduced yields, and a reduction in the use of land for irrigated agriculture if the sole water supply is groundwater.

3.3.5 Minimum Thresholds for Interconnected Surface Waters

3.3.5.1 Description of Minimum Threshold

As described in Chapter 2, interconnected surface waters are currently designated as a data gap due to a lack of historical data and monitoring facilities. Therefore, no minimum thresholds were developed for this sustainability indicator. If in the future, data from a groundwater level monitoring indicate that surface water from the ephemeral streams in the Subbasin and groundwater are interconnected, minimum thresholds and measurable objectives will be developed. Since minimum thresholds were not developed for the GSP, information about the methods used to develop minimum thresholds, the quantitative metrics to track compliance with minimum thresholds, and their impacts on other sustainability indicators, other Subbasins, and beneficial use and users of groundwater is not presented in this section.

3.3.5.2 Quantitative Measurement

Not currently applicable for this sustainability indicator.

3.3.5.3 Existing Local, State, or Federal Standards

Not currently applicable for this sustainability indicator.

3.3.5.4 Avoidance of Undesirable Results

Not currently applicable for this sustainability indicator.

3.3.5.5 Effects of the Beneficial Uses and Users of Groundwater

Not currently applicable for this sustainability indicator.

3.3.6 Relationship Between the Established Minimum Threshold and Sustainability Indicator(s)

The wells described in **Tables 3-1** through **Table 3-11** were selected to reflect a diverse and wide cross section of the Subbasin's groundwater conditions. These locations are representative of the overall Subbasin conditions because the monitoring sites are spatially distributed throughout the Subbasin both vertically (across the Upper and Lower Aquifers) and laterally. The GSA determined that use of the minimum elevation thresholds at each of the listed wells will help avoid the undesirable results of chronic lowering of groundwater levels because it should preserve access to adequate water resources for beneficial users within the Subbasin.

Groundwater elevation minimum thresholds can influence other sustainability indicators. The groundwater elevation minimum thresholds were selected to avoid undesirable results for other sustainability indicators.

1. Change in groundwater storage. A significant and unreasonable condition for change in groundwater storage is pumping groundwater in excess of the sustainable yield that would result in groundwater

levels to decline below minimum thresholds for an extended period of years. Pumping at or less than the sustainable yield will maintain or raise average groundwater elevations in the Subbasin. The groundwater elevation minimum thresholds are set consistent with 2012-2015 drought baseline groundwater elevations, consistent with the potential action of pumping in excess of the sustainable yield during a drought type period that spans multiple years. Therefore, the exceedance of the groundwater elevation minimum threshold will not result in long-term significant or unreasonable change in groundwater storage.

2. Degraded water quality. Preserving groundwater quality is important to the groundwater resource. A significant and unreasonable condition of degraded water quality from management of groundwater resources is exceeding concentrations of constituents of concern in groundwater due to actions proposed in the GSP. Water quality could be affected through two processes:

    a. Low groundwater elevations in an area could cause deeper, poor-quality groundwater (saline groundwater located below the base of freshwater) to flow upward into existing wells. Groundwater elevation minimum thresholds are set at, or above historic low levels experienced in the 1950s and 1960s, preventing a return to changes to those historical vertical flow gradients, thereby avoiding upward flow of deep, poor-quality groundwater. The groundwater elevation minimum threshold will avoid poor-quality water from impacting existing wells and beneficial users.

    b. Declines in groundwater elevations east of the Subbasin as a result of adjacent subbasin’s measurable objectives and minimum thresholds that change historical groundwater gradients, which could cause changes in flow patterns of poor-quality groundwater towards wells that would not have otherwise been impacted.

3. Subsidence. A significant and unreasonable condition for subsidence is any measurable permanent subsidence that results in severe impacts to the operations of existing infrastructure to a degree that would require design and construction projects to mitigate the impact. Subsidence is caused by dewatering and compaction of clay-rich sediments in response to lowering groundwater levels. The groundwater elevation minimum thresholds are set at or above groundwater elevations that will induce additional subsidence in areas that currently have minimum tolerances for additional subsidence along the San Luis Canal.

4. Depletion of interconnected surface waters. Existing streams in the Subbasin are ephemeral in nature and flow infrequently. Therefore, interconnected surface water that sustains GDEs and is affected by groundwater pumping historically has not occurred. In addition, in many parts of the Subbasin where the ephemeral streams are located, Upper Aquifer groundwater quality is degraded and, as a result, groundwater pumping in the Upper Aquifer that could influence surface water flows directly and potential GDEs does not likely occur from examination of Upper Aquifer groundwater pumping distribution and analysis of streamflow occurrence. These conditions have led to a lack of monitoring facilities and historical data based on these observations of groundwater pumping and ephemeral streamflow patterns along with analysis of shallow zone groundwater conditions. Therefore, there are no current minimum thresholds or undesirable results that could be affected by the groundwater elevation minimum thresholds.

5. Seawater Intrusion. The location of the Subbasin in the San Joaquin Valley and physically separated from the Pacific Ocean precludes the existence or presence of seawater intrusion. Therefore, there are no minimum thresholds or undesirable results for this sustainability indicator.

3.3.7 Minimum Thresholds Impacts to Adjacent Basins

Four neighboring groundwater basins (Delta-Mendota, Kings, Tulare Lake, and Pleasant Valley) are required to develop a GSP. Implementation of the Westside Subbasin GSP's anticipated effect of the groundwater elevation minimum thresholds on each of the four subbasins is not expected to impact adjacent basins GSP implementation efforts. In fact, review of GSPs from adjacent basins indicate that Westside Subbasin efforts to achieve sustainability will be beneficial to adjacent basins. This is due to the fact that the Subbasin is not planning on minimum thresholds being below historic lows and 2015 baseline levels for a significant amount of time. In contrast, adjacent basins, Kings and Tulare Lake are planning on measurable objectives and minimum thresholds that are lower than historic lows and 2015 baseline levels. As a result, those basins may impact the ability of the Westside Subbasin to become sustainable in some areas of the Subbasin. It is anticipated that ongoing outreach efforts will be conducted with adjacent basins to mitigate impacts to the Subbasins implementation of the Westside Subbasin's sustainability goal. The Pleasant Valley Subbasin is planning on developing MTs that are higher than the Westside Subbasin, however it is not anticipated that the groundwater elevation MTs in the Westside Subbasin will impact the ability of the Pleasant Valley Subbasin to be sustainable due to the presence of geologic features such as an anticline (see discussion in Section 2.2.3.7) located between the two subbasins which impedes groundwater flow between the two subbasins.

3.3.8 Minimum Thresholds Impacts on Beneficial Users

The minimum thresholds established for the sustainability indicators that are present in the Subbasin may have several effects on beneficial users and land use in the Subbasin. Since the minimum thresholds are set at levels that are equivalent to historic lows or 2015 levels in most areas of the Subbasin, agricultural beneficial uses may be impacted in a way that would limit or prevent an expansion of groundwater use to the extent that minimum thresholds are continuously exceeded. In subsidence prone areas near Checks 16, 17, and 20, the minimum thresholds for groundwater levels and subsidence will result in reductions in groundwater use during drought periods.

Urban beneficial users should not be impacted since urban water supplies are primarily met with imported water supplies rather than groundwater. Groundwater use for urban beneficial users is limited in nature and primarily used to supplement imported water supplies. As described in **Sections 2.1.1.1 and 3.3.1.5**, domestic users of groundwater are not expected to be impacted by the minimum thresholds since those thresholds have already experienced historical lows without documented impacts to domestic users. Lack of groundwater availability for domestic water uses in the Subbasin during the last drought as a result of declining groundwater levels was not reported. Additionally, DWR's Dry Wells Reporting System has not reported dry wells in the Westside Subbasin.

3.4 Undesirable Results (GSP Reg. § 354.26)

According to GSP Regulations, the GSP's description of undesirable results is to include the following:

1. The cause of groundwater conditions occurring throughout the basin that would lead to or has led to the undesirable results based on information described in the basin setting, and other data or models as appropriate. (GSP Reg. § 354.26(b)(1).)
2. The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin. (GSP Reg. § 354.26(b)(2).)
3. Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results. (GSP Reg. § 354.26(b)(3).)

Under SGMA, undesirable results occur when significant and unreasonable effects for any of the six sustainability indicators are caused by groundwater conditions occurring throughout the basin. These sustainability indicators are:

1. Chronic lowering of groundwater levels,
2. Reduction of groundwater storage,
3. Seawater intrusion,
4. Degraded water quality,
5. Land subsidence, and
6. Depletion of interconnected surface water.

A summary of criteria used to define undesirable results is provided below in **Table 3-12**, and detailed discussion of each sustainability indicator is provided in subsequent sections of this Chapter.

3.4.1 Chronic Lowering of Groundwater Levels

3.4.1.1 Criteria Defining an Undesirable Result

The District will compare the measured water levels at the representative monitoring wells to the established MTs. If water levels fall below the established MTs, domestic beneficial users may be impacted as those are the shallowest wells. Modeling described in **Section 7.2.3.1** in **Appendix I** suggests that through implementation of PMAs, groundwater levels will stabilize during the GSP planning and implementation period. However, if an exceedance of the MT is observed, the District will communicate with domestic well users within the hexagon to determine whether those wells have been impacted and the District will attempt to mitigate the impact at a local level.

An undesirable result will occur if groundwater levels fall below 50% of the screen interval of a domestic well within a hexagon due to an MT exceedance during the fall measurement of a non-drought year. If no domestic wells are present in a hexagon, an undesirable result will occur if 10% of agricultural wells within a hexagon go dry due to an MT exceedance during the fall measurement of a non-drought year. These triggers for undesirable results were established based on the existence of both well types within the Subbasin.

Due to the small number of domestic wells present, 50% of the screen interval of a single domestic well going dry is an undesirable result as the production from the well may be impacted. Although sparse, domestic wells are located throughout the Subbasin. This definition of an undesirable result ensures that each well is protected from going dry as the criteria is based on each individual well instead of a percentage of the total number of domestic wells.

Similarly, the threshold of 10% or more of agricultural wells within a hexagon going dry was considered an undesirable result because that threshold would reduce the available water supply capacity to a degree that may impact agricultural beneficial uses in the impacted hexagon and may cause long-term reductions in the viability of agricultural wells.

A prolonged period of extracting groundwater in excess of the sustainable yield has historically caused chronic lowering of groundwater levels in some areas of the Subbasin and could cause an undesirable result in the future. Conditions that may lead to an undesirable result include the following:

- Localized over pumping of groundwater. Even if regional pumping is maintained within the sustainable yield, a cluster (or pumping center) of high-capacity wells may cause excessive localized drawdowns that lead to undesirable results in specific areas.
- Extensive, unanticipated drought and associated drastic curtailments of imported surface water supplies. Minimum thresholds were established based on historical groundwater elevation and reasonable estimates of future groundwater elevations. Extensive, unanticipated droughts and associated curtailment of imported water supplies will likely lead to excessively low groundwater elevations and undesirable results.

3.4.1.2 Potential Effects on Beneficial Users

The primary detrimental effects to beneficial users from water levels falling below the minimum threshold area loss of significant well capacity, increased costs due to higher pumping lifts, lack of groundwater extraction due to groundwater levels declining below the pump setting depth or the bottom of the well, or subsidence impacts on well structures and above ground infrastructure, especially if the pumping is concentrated in a small geographic area. The undesirable results are set to avoid significant and unreasonable depletions of groundwater supply at existing domestic, M&I and agricultural wells within the Subbasin.

3.4.2 Reduction in Groundwater Storage

3.4.2.1 Criteria Defining an Undesirable Result

A significant and unreasonable condition for change in groundwater storage is pumping groundwater in excess of the sustainable yield that would result in groundwater levels to decline below minimum thresholds and lead to a decrease in groundwater storage. An undesirable result will have occurred and trigger management actions if the MT for groundwater storage has been exceeded for two (2) consecutive non-drought years.

3.4.2.2 Cause of Undesirable Result

The causes of undesirable results for groundwater storage are tied to those for groundwater levels at the representative monitoring wells. Drought conditions and water extraction in excess of the sustainable yield range would lead to undesirable results.

3.4.2.3 Potential Effects on Beneficial Users

An undesirable result for reduction of groundwater storage would decrease the sustainable yield for the Subbasin. The practical effect of implementing the undesirable result for reduction of groundwater storage is that it encourages no net change in groundwater elevation and storage during average, long-term hydrologic conditions. Therefore, during average, long-term hydrologic conditions, beneficial uses and users will have access to the same amount of groundwater in storage that currently exists, and the undesirable result will not have a negative effect on the beneficial users and uses of groundwater. Pumping during dry years will temporarily lower groundwater elevations, reduce the amount of groundwater in storage and could result in short-term impacts from a reduction in groundwater in storage on all beneficial users and users of groundwater. In addition, the GSP is designed to promote conjunctive use in the Subbasin and acknowledges the sustainable yield as an average value that can experience annual variations in storage.

3.4.3 Subsidence

3.4.3.1 Criteria Defining an Undesirable Result

An undesirable result for subsidence occurs when there are significant and unreasonable land subsidence that substantially interferes with surface land uses (DWR, 2017). Subsidence impacts vary depending on the magnitude of subsidence and location of critical infrastructure and other land uses. As described in **Section 3.4.3.3** below, impacts to the SLC are of heightened concern due to the existing subsidence and potential consequences of additional subsidence to SLC conveyance capacity and operational flexibility. The remainder of the Subbasin has fewer documented cases of subsidence impacts to surface land uses and is considered less susceptible to interference from subsidence. Accordingly, separate criteria are defined for monitoring sites located adjacent to the SLC and sites located in other portions of the Subbasin.

In the monitoring sites located adjacent to the SLC and listed on **Table 3-4**, an undesirable result is defined when:

- The annual rate of subsidence or compaction at three (3) GPS benchmarks or extensometers exceeds the annual rate MT for two (2) or more consecutive years. This condition is indicative of a regional or systemic increase in the rates of subsidence based on review of subsidence rates which occurred during past droughts where surface uses were impacted. Based on an engagement meeting with DWR CASP, such a condition is considered significant and unreasonable (DWR CASP, personal comm., May 25, 2022). Such a condition would be mitigated through implementation or modification of PMA No. 2, PMA No. 3 and PMA No. 4 as described in **Sections 3.3.3.4** and **4.2**.

- The cumulative total amount of subsidence or compaction at any GPS benchmark or extensometer exceeds the cumulative MT. As shown in **Appendix 3C**, subsidence exceeding the cumulative total MT at any of the 15 monitoring sites adjacent to the SLC would likely impact conveyance capacity and operational flexibility in the SLC. This condition is considered significant and unreasonable. Such a condition would require implementation of PMA No. 2, PMA No. 3 and PMA No. 4 as described in **Sections 3.3.3.4** and **4.4**.

In the monitoring sites located in other portions of the Subbasin and listed on **Table 3-4**, and undesirable result is defined when:

- The annual rate of subsidence or compaction or water level at three (3) GPS benchmarks, extensometers, or groundwater wells exceed the annual rate or water level MT for two (2) or more consecutive years. This condition is indicative of a regional or systemic increase in the rates of subsidence or groundwater level declines and is considered significant and unreasonable based on review of subsidence rates which occurred during past droughts where surface uses were impacted. Such a condition would be mitigated through implementation or modification of PMA No. 2 and PMA No. 3 as described in **Section 3.3.3.4** and **Section 4.2**.
- The cumulative total amount of subsidence or compaction at three (3) GPS benchmarks or extensometers exceeds the cumulative MT. While surface land uses in other portions of the Subbasin are less susceptible to interference due to subsidence, this condition is indicative of a regional or systemic increase in the total amount of subsidence or groundwater level declines and is considered significant and unreasonable based on review of subsidence which occurred during past droughts where surface uses were impacted. Such a condition would be mitigated through implementation or modification of PMA No. 2 and PMA No. 3 as described in **Section 3.3.3.4** and **Section 4.2**.

3.4.3.2 Cause of Undesirable Result

Conditions that may lead to an undesirable result of a significant and unreasonable amount for land subsidence have historically occurred during periods with surface water supply curtailments coupled with groundwater pumping in excess of sustainable yield in areas where critical infrastructure exists. Conditions that may lead to an undesirable result include the following:

- Prolonged drought conditions. Drought conditions result in curtailments of CVP and other supplemental surface water imports resulting in increases in groundwater demand causing regional groundwater level declines. Reduction in aquitard pore pressure beyond the preconsolidation head results in inelastic subsidence which can impact surficial land uses and damage or otherwise negatively impact critical infrastructure.
- Localized groundwater extraction. Even if regional pumping is maintained within the sustainable yield, cluster (or pumping centers) of high-capacity wells may cause localized reduction in aquitard pore pressure and subsidence causing undesirable results in specific areas.

3.4.3.3 Potential Effects on Beneficial Users

Undesirable results may affect beneficial uses and users of groundwater, land uses and other infrastructure. Potential effects on entities with infrastructure sensitive to subsidence are described below:

- Freeboard has been reduced due to subsidence impacting conveyance capacity and operational flexibility of the SLC (California Aqueduct) owned and operated by the USBR and DWR. Impacts to the SLC are unique in that downstream beneficial users who hold CVP and SWP contracts may also be affected by reduction in SLC conveyance. DWR CASP has indicated that the most severe impacts have occurred in Pools 17, 18 and 20. Comparisons of the design water level to the liner elevation in 2022 illustrate areas which are most impacted by subsidence and most sensitive to future subsidence (**Figure 3-10**). Continued subsidence along the SLC has the potential to impact the operational flexibility due to subsidence in Pools 17, 18 and 20. Impacts are less likely to impact operations in other pools. DWR CASP is in the process of completing environmental documentation and acquiring funding for liner raises in areas most impacted by subsidence (DWR, 2022). As a result, impacts to conveyance capacity and operational flexibility are considered relatively short-term. Specific thresholds with relation to MTs from monitoring sites are shown in **Appendix 3C**. and expected to avoid significant and unreasonable subsidence to the SLC near Pools 17, 18 and 20.
- Existing impacts to pipelines and turnout structures due to subsidence from groundwater are limited to sealing of the Lateral 1L headworks due to a canal raise in the area (**Figure 3-11**). Undesirable results to pipelines and turnout structures operated by WWD are likely to be small but could impact the efficiency of this infrastructure. While specific thresholds are not known, given the relatively limited existing impacts relative magnitude of past subsidence, it is unlikely that the amount subsidence allowed by the defined undesirable result will lead to substantial impacts to the District's operations.
- The impact of subsidence on well casings for agricultural wells owned and operated by landowners has been known to occur but is not well documented. It is anticipated that the subsidence MTs may lead to additional well retrofits but specific thresholds or number of wells which are susceptible to impacts are unknown. However, based on the total amount of pumping that occurred during the last drought period, modeling projections when groundwater levels exceed the MTs for two consecutive years shown in **Section 7.2.3.2** of **Appendix I**, and the fact that well casing operational impacts were not reported to the District, the undesirable results are defined such that the District does not expect impacts to well owners.
- As described in Section 3.3.3.5, it is the District's understanding that Caltrans does not identify subsidence as a design factor and does not attribute repairs to its infrastructure as a result of subsidence. Instead repairs to Caltrans infrastructure are typically due to heavy loads and vehicle miles traveled using the roadways. The District confirmed its understanding of the effect of subsidence, if any, on Caltrans infrastructure through personal communication with the Caltrans Maintenance Engineering Chief from Region 6 (Caltrans, personal comm., June 10, 2022). While specific thresholds are not known, given the relatively limited existing impacts relative magnitude of past subsidence, it is unlikely that the amount subsidence allowed by the minimum threshold

will lead to substantial impacts to Caltrans operations. Roads and bridges which could be potentially impacted by subsidence are shown in **Figure 3-12**.

3.4.4 Degraded Groundwater Quality

3.4.4.1 Criteria Defining an Undesirable Result

The undesirable result for degradation of groundwater quality is avoiding groundwater degradation due to actions directly resulting from GSP implementation on the beneficial users of groundwater.

The GSA will evaluate the annual TDS data collected from the monitoring network and compare the TDS concentrations at the representative monitoring wells to the established MTs. An undesirable result will have occurred if a well exceeds its MT for two (2) consecutive measurements. Based on the available groundwater data in the Westside Subbasin, one year of an exceedance generally does not result in degraded groundwater quality because a single measurement may not represent groundwater quality conditions due to uncertainty in groundwater quality analyses, aquifer groundwater quality variability and other factors. Two consecutive years of exceeded measurements are consistent with groundwater quality QA/QC approaches used in the State Board's recommendation when determining a potential degraded groundwater quality trend. Whenever an MT exceedance is reported, the District will conduct additional sampling and may implement appropriate mitigation procedures to prevent undesirable results.

3.4.4.2 Cause of Undesirable Result

Degraded water quality in the Subbasin is generally naturally occurring as a result of marine sediments from the Coast Range impacting groundwater quality in some areas of the Upper and Lower Aquifers. Undesirable results from the naturally occurring degraded water quality is present in some geographic locations in the Subbasin that limit the beneficial use of the groundwater without blending with better quality water or treatment in order to serve certain beneficial uses. Groundwater quality changes are expected to occur but are not expected to be directly correlated to the implementation of the Westside Subbasin GSP. However, drought conditions and local extraction could cause a lowering of groundwater levels resulting in degraded water quality.

3.4.4.3 Potential Effects on Beneficial Users

Urban and domestic beneficial uses are impacted if water of degraded quality is the only source of water for potable use. The mitigation of impacts to potable supplies of groundwater includes the need to utilize alternative sources of water that may be more expensive than groundwater and the potential requirement to treat prior to use or the use of bottled water for potable purposes. The effect of degraded groundwater quality from SGMA activities on agricultural beneficial users is manifested in crop damage, reduced yields, increased costs, and a reduction in the use of land for irrigated agriculture if the sole water supply is groundwater. Mitigation measures for agricultural beneficial users may involve blending with other water supplies, shift in crop mix, or fallowing. The undesirable results for degradation of groundwater quality are defined allow the GSA to identify and engage in adaptive management prior to domestic and agricultural users experiencing significant and unreasonable impacts from poor water quality.

3.4.5 Depletion of Interconnected Surface Waters

Undesirable results for depletion of interconnected surface water were not developed for this GSP. Impacts to beneficial uses and users of groundwater, related to interconnected surface water and groundwater are not expected. If in the future, data from a more comprehensive monitoring program indicate that surface water and groundwater are interconnected, undesirable results related to interconnected surface water and groundwater will be assessed.

3.4.6 Potential Effects on the Beneficial Users of Groundwater

For agricultural beneficial users of groundwater, the most significant undesirable results are groundwater levels, groundwater storage, groundwater quality, and subsidence. The undesirable results for interconnected surface waters will not have a direct impact on agriculture. Undesirable results for any of the sustainability indicators of concern will limit the ability of agricultural users to extract groundwater and irrigate crops.

For domestic beneficial users of groundwater, the most significant undesirable results are groundwater levels, groundwater storage, and groundwater quality. Undesirables results for any of these three sustainability indicators could potentially restrict the ability of households to use water for domestic purposes. Subsidence and interconnected surface waters will not have direct impact on domestic users.

For environmental beneficial uses of groundwater in the Subbasin, the most significant undesirable result is subsidence. Continued subsidence in the WWD area will restrict the ability to flood areas in the Mendota Wildlife Area (MWA).

3.4.7 Management Areas

Management areas have not been established in the Subbasin.

3.5 Monitoring Network

This section describes the proposed monitoring network, including GSA monitoring objectives monitoring protocols, and data reporting requirements. This section was prepared in accordance with GSP Regulations. The monitoring network was developed to collect a sufficient amount of data to characterize groundwater and related surface water conditions in the Subbasin and to evaluate changing conditions and GSP implementation. The monitoring network was designed to collect data to allow for the analysis of short- and long-term trends, seasonal variations and estimate annual changes in aquifer storage. The monitoring sites have been distributed across the Subbasin to provide a comprehensive analysis of current and ongoing conditions within the GSA. This widespread distribution coupled with the monitoring frequency will allow the GSA to chart its progress towards the established sustainability goals and also ensure real time tracking of any impacts on beneficial users. Specifically, the monitoring program will allow the GSA to quantify changes in groundwater storage and quality and assess the efficacy of any implemented management programs. These data will facilitate changes to management programs to maintain continued progress towards the GSA's sustainability objectives.

The GSP Regulations require monitoring networks to be developed to promote the collection of a data set of enough quality, frequency, and spatial distribution to characterize groundwater and related surface water conditions in the Subbasin and to evaluate changing conditions that occur through implementation of the GSP. (GSP Reg. § 354.34(b).) The monitoring network should accomplish the following:

- Demonstrate progress towards achieving measurable objectives described in the GSP;
- Monitor impacts to the beneficial uses and users of groundwater;
- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds; and
- Quantify annual changes in water budget components. (GSP Reg. § 354.34(b)(1)-(4).)

The minimum thresholds and measurable objectives for the network are described above.

The GSP Regulations require that if management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the Subbasin setting sustainable management criteria specific to that area. (GSP Reg. § 354.34(c).) At this time, management areas have not been defined for the Subbasin. If management areas are developed in the future, the monitoring network will be reevaluated to ensure that there is sufficient monitoring to evaluate conditions.

3.5.1 Description of Monitoring Network (GSP Reg. § 354.34)

The GSP monitoring network is composed of aquifer specific wells that are screened in the Upper or Lower Aquifers. The network will not include composite wells that span both the Upper and Lower Aquifers. The network will enable the collection of data to assess sustainability indicators, the effectiveness of management actions and projects to achieve sustainability and evaluate the measurable objectives of each applicable sustainability indicator (i.e., chronic lowering of groundwater levels, reduction in groundwater storage, degraded water quality, land subsidence). For depletion of interconnected surface waters, there is little data to indicate the ephemeral streams in the Subbasin have direct connections to groundwater. The Subbasin is isolated from the Pacific Ocean; therefore, this GSP does not provide monitoring for seawater intrusion sustainability indicators.

3.5.1.1 Groundwater Elevation Monitoring Network

The District currently has over 1,200 wells that were actively monitored for water level data in 2018. However, for the purposes of the GSP monitoring program, a subset of these wells was identified that represent geographical variation along with a historical data record. (GSP Reg. § 354.36.) This effort resulted in the selection of 22 wells in the Upper Aquifer and 44 wells in the Lower Aquifer as documented in **Tables 3-13 and 3-14** (the selection process is described further below). The GSA has well construction information for these wells, which allows the GSA to determine the aquifer being monitored with certainty. Furthermore, composite wells that span both the Upper and Lower Aquifers were not selected for this GSP monitoring program in order to provide aquifer specific data.

Figures 3-1 and 3-2 illustrate the wells are distributed throughout the Westside Subbasin providing full coverage of the Subbasin. This coverage allows for the collection of data to evaluate groundwater gradients and flow directions over time and the annual change in storage. Furthermore, the monitoring frequency of the wells will allow for the monitoring of seasonal highs and lows. Because wells were chosen with the existing length of historical data record in mind, future groundwater data will be able to be compared to historical data.

The minimum thresholds and measurable objectives for the chronic lowering of groundwater levels sustainability indicator are evaluated by monitoring groundwater levels. The GSP Regulations require a network of monitoring wells to demonstrate groundwater occurrence, flow direction and hydraulic gradients between principal aquifer and surface water features. (GSP Reg. § 354.32.)

The objectives of the groundwater level monitoring program include the following:

- Improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater levels including seasonal and long-term trends; and identify vertical hydraulic head differences in the aquifer system and aquifer-specific groundwater conditions, especially in areas where short-term and long-term development of groundwater resources are planned;
- Detect the occurrence of, and factors attributable to, natural recharge (e.g., direct infiltration of precipitation), irrigation, and surface water seepage to groundwater or recharge projects and management actions (recharge basins, aquifer storage and recovery) that affect groundwater levels and trends;
- Identify appropriate monitoring sites to further evaluate groundwater-surface water interaction, and recharge/discharge mechanisms, including whether groundwater utilization is affecting surface water flows;
- Establish a monitoring network to aid in the assessment of changes in groundwater storage; and
- Generate data to better estimate groundwater basin conditions and assess local current and future water supply availability and reliability; update analyses, including the groundwater model and water budget, as additional data become available.

Figures 3-1 and **3-2** illustrate the locations of the wells selected for monitoring of groundwater levels in the upper and lower aquifers, respectively. **Tables 3-13** and **3-14** list the well identification, location, monitoring frequency, well construction data (which includes well depth, perforation intervals, and ground surface elevation (GSE)), and measurement years, and number of measurements for the Upper and Lower Aquifer, respectively.

In order to assist local agencies with the preparation of their GSP's, DWR released a series of best management practices (BMPs). The BMPs document for monitoring networks provides guidance on determining an appropriate number of monitoring wells. The method developed by Hopkins (1984) was applied to the Westside Subbasin. This methodology states that for districts pumping more than 10,000 AFY per 100 square miles, they should have four monitoring wells for every 100 square miles. The Westside Subbasin is approximately 927 square miles, yielding 37 monitoring wells minimum. Additional wells were added based on informational needs resulting from management actions and historical trends in groundwater levels.

After computing the appropriate number of monitoring wells for the Subbasin based on the Hopkins method, a hexagonal tessellation was generated over the basin area in ArcPro. All available wells with complete construction data and aquifer assignment were then mapped onto this grid. Wells were weighted based on their length of record in the following manner: (1) 0-9 years received a weight of 0, (2) 10-19 years of data were weighted 1, 20-29 were weighted 2, (3) 30-39 were weighted 3, (4) 40-49 were weighted 4, and (5) 50-59 were weighted 5, consistent with the Hopkins method.

Once the wells were plotted against the hexagons, each hexagon (numbered 1 through 37) was examined separately for both the Upper Aquifer and Lower Aquifer. Within a hexagon, wells were selected on both their proximity to the center of the hexagon and the length of record. A minimum length of record weight of two was required for well selection. From the wells with a weight of two or more, the location was examined, and a well was selected. After the initial selection of wells, the resulting network was examined for distribution across the basin. In cases where no well fulfilled the length requirement, the well was chosen solely for its location within the hexagon.

After selecting the first round of wells for each aquifer, the hexagon grid was overlain with a layer representing the areas of concern for subsidence. This layer highlighted data gaps in two specific areas; one in the northern and one in the southern portion of the Subbasin. Additional wells were added to these areas (based on availability) in order to obtain a higher resolution of monitoring in these two regions. The selection rationale for all water level monitoring wells is summarized in **Tables 3-13 and 3-14.**

The GSA will evaluate whether further monitoring wells or refinement to these measurable objectives are needed to monitor boundary conditions with adjacent basins to ensure subsurface inflow and outflow conditions remain consistent with water budget and model results.

3.5.1.2 Groundwater Storage Monitoring Network

The objective of the monitoring program is to utilize groundwater level data and knowledge of aquifer storage coefficients to calculate changes in groundwater storage. The goal includes the following:

- Improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater levels including seasonal and long-term trends in the aquifer system to calculate changes in groundwater storage on an annual basis and in areas where management actions and projects are planned.

Changes in groundwater storage cannot be measured directly, therefore this GSP adopts groundwater levels as a proxy for assessing change in storage, as described previously in Chapter 3. The wells selected for monitoring changes in groundwater storage will be the same wells used for groundwater level monitoring. **Figures 3-1** and **3-2** illustrate the locations of the wells selected for monitoring of groundwater levels for the Upper Aquifer and Lower Aquifer, respectively. **Tables 3-13** and **3-14** list the well identification, location, monitoring frequency, well construction data, and measurement years, and number of measurements for the Upper Aquifer and Lower Aquifer wells, respectively. The same wells for water level monitoring are proposed for groundwater storage monitoring and the selection process and rationale for selection is consistent with **Section 3.5.1.1** (**Table 3-13 and 3-14**).

3.5.1.3 Subsidence Monitoring Network

The sustainability indicator for land subsidence is evaluated by monitoring land surface elevation from various agencies within the Subbasin. In areas where land surface elevation data are not available, groundwater levels from the Groundwater Elevation Monitoring Network (**Section 3.5.1.1**) are used as a proxy for subsidence monitoring. The monitoring network includes data from various agencies at 46 locations shown in **Figure 3-3**:

- Aquifer system compaction collected continuously by the USGS from three (3) extensometers described in **Section 2.2.8.3.2**;
- Land surface elevation collected annually by the DWR CASP in the winter from ten (10) GPS benchmarks adjacent to the SLC described in **Section 2.2.8.3.3**;
- Land surface displacement collected continuously by UNAVCO from one (1) GPS benchmark as part of the GPS PBO and described in **Section 2.2.8.3.4**;
- Land surface elevation collected bi-annually by USBR in the summer and winter from four (4) GPS benchmarks described in **Section 2.2.8.3.5**;
- Land surface elevation collected bi-annually by the District in the summer and winter from sixteen (16) GPS benchmarks described in **Section 2.2.8.3.6**; and
- Groundwater elevation collected bi-annually by the District in the summer and winter from twelve (12) Lower Aquifer monitoring wells used as a proxy for subsidence measurements described in **Section 3.5.1.1**.

InSAR data collected from Sentinel-1 made available by DWR will also be evaluated periodically where direct measurement of land subsidence or aquifer system compaction is not currently available. InSAR will be used to identify emerging areas of concern within the Subbasin and inform future monitoring.

The objectives and rationale for selection of sites included in the subsidence monitoring network are described in **Table 3-15**:

- Monitor and inform management of areas that have previously or are currently experiencing high rates of subsidence. Monitoring density is increased near SLC checks 16, 17 and 20 which showed both high rates of subsidence and substantial impacts on SLC conveyance.
- Ensuring accuracy and reliability of measurements to effectively quantify and manage land surface subsidence. These goals are achieved by incorporating measurements from numerous entities (USGS, USBR, UNAVCO, DWR and WWD).
- The subsidence monitoring network is designed to provide robust information for the GSA to successfully measure and manage subsidence impacts along the SLC. Sites were prioritized to provide a sufficient number of sides adjacent to the SLC which measure subsidence or compaction.
- The subsidence monitoring network is designed to provide sufficient spatial coverage to adequately monitor both existing and future areas which are experiencing or may experience high

rates of subsidence. Sites are selected to provide sufficient horizontal coverage in all areas of the Subbasin that have the potential for subsidence. Where groundwater levels are used as a proxy, monitoring targets wells completed in the Lower Aquifer where the majority of subsidence is believed to occur.

- The frequency of data collection should provide sufficient information to quantify inelastic subsidence. Selected sites include measurements taken in the winter or spring. To better disaggregate inelastic subsidence from elastic subsidence, all sites include winter or spring measurements. Since historical subsidence may also play a role in future management, sites with a long period of record were also prioritized.

In order to make progress towards achieving measurable objectives defined in **Section 3.2.3.1** and implement projects and management to avoid undesirable results defined in **Section 3.4.1.1**, measurements from the monitoring network will be evaluated annually.

3.5.1.4 Groundwater Quality Monitoring Network

The sustainability indicator for degraded water quality is evaluated by monitoring groundwater quality at a network of existing supply wells.

The objectives of the groundwater quality monitoring program for the Subbasin include the following:

- Evaluate groundwater quality conditions in the various areas of the basin, and identify differences in water quality spatially between areas and vertically in the aquifer system;
- Detect the occurrence of and factors attributable to natural (e.g., general minerals and trace metals) constituents of concern as represented by TDS;
- Assess the changes and trends in groundwater quality (seasonal, short- and long-term trends); and
- Identify the natural and human factors that affect changes in water quality.

Figures 3-6 and **3-7** illustrate the locations of the wells selected for monitoring of groundwater quality in the Upper and Lower Aquifers, respectively. The methodology to determine the minimum thresholds and measurable objectives is described in **Section 3.3.4.1**. **Tables 3-16** and **3-17** list the well identification, location, monitoring frequency, well construction data, and measurement years, and number of measurements for the upper and lower aquifer, respectively.

As indicated by the number of water level monitoring wells utilized for the groundwater quality monitoring network, data collection for groundwater quality has been limited in recent years in the Subbasin. Although spatial and temporal data gaps exist in groundwater quality data, this network will allow for a comprehensive mapping of TDS trends. Data collection in both spring and fall will allow for the analysis of seasonal trends. Further, continuous monitoring at the sites selected will establish a temporal record moving forward and assist in evaluating management actions implemented moving forward. The distribution of wells will also highlight areas in need of management actions in the future. Subsequent updating of the groundwater quality constituents will be developed in future GSP updates based on annual evaluation of TDS concentrations.

The first step involved in constructing the water quality monitoring network and well selection was to map all wells with available TDS data onto the hexagonal tessellation grid for the Subbasin by aquifer. Wells were then examined for their number of records, years with data, and location within each hexagon. In the Upper Aquifer, most of the wells only had one to two data points dating back to the mid-1990s. In addition to wells with TDS data, wells selected for the regional Groundwater Quality Trend Monitoring program (GQTM) classified as being in the Upper Aquifer also were considered. In contrast, the Lower Aquifer provided a larger selection of wells with TDS data.

Data within each hexagon were analyzed for TDS concentrations over time. Hexagons were evaluated for the number of exceedances above 1,000 mg/L. Based on this analysis, all hexagons in the Upper and Lower Aquifers with two or more exceedances were excluded from the monitoring network. The rationale behind this exclusion relates to pre-existing elevated TDS concentrations due to marine sediments. The objective of this monitoring program is to monitor water quality degradation caused by human activities and therefore, these hexagons with high TDS concentrations were not included in the monitoring program. Data in the remaining hexagons were reviewed to ensure that each hexagon had at least two wells with data points. Any hexagons without two wells with measurements were classified as areas with data gaps and excluded. This analysis resulted in two monitoring wells being selected in the Upper Aquifer, and four wells in the Lower Aquifer.

Wells available for monitoring within the hexagons were analyzed for historical records and well location and selected based on these criteria. In cases where wells with water quality data were unavailable, groundwater level monitoring wells were selected. The selection rationale for groundwater quality monitoring wells is summarized in **Tables 3-16 and 3-17.** Each site will comply with the data and reporting standards that are described in **Section 3.5.2.4**.

3.5.1.5 Interconnected Surface Water Monitoring Network

Not currently applicable; however, the GSA will continue to evaluate whether interconnected surface water exists within the Subbasin based, in part, on data available from wells screened in the Shallow Zone. If appropriate, the GSA will develop a monitoring network and sustainability indicators for interconnected surface waters in a subsequent update to this GSP.

3.5.2 Description of Monitoring Protocols (GSP Reg. § 354.34)

The monitoring protocols that will be used by the GSA as part of implementing this Groundwater Sustainability Plan are largely based on the *Best Management Practices for the Sustainable Management of Groundwater: Monitoring Protocols, Standards, and Sites* produced by the DWR. The recommended monitoring protocols were adjusted and added to fit the specific monitoring needs of the Subbasin to achieve sustainability. Monitoring protocols for seawater intrusion were not necessary as the Subbasin is not connected to the coast. Monitoring protocols regarding groundwater pumping were not described in the BMP document and accounting for groundwater pumping will be an integral part of achieving sustainability in Subbasin. The monitoring protocols that are described in this document will provide the necessary data to track the minimum thresholds and measurable objectives for each of the sustainability indicators. The monitoring protocols established herein will be reviewed every five years as a part of periodic GSP updates. The following protocols will be applied to all monitoring sites:

- A unique identifier that includes a written description of the site location, date established, access instructions, type(s) of data to be collected, latitude, longitude, and elevation.
- A modification log is to be kept in order to track all modifications to the monitoring site.
- Geographic locations shall be reported in GSP coordinates to a minimum accuracy of 30 feet or relative to NAD83.
- Reference point elevations shall be measured in feet to an accuracy of at least 0.5 feet relative to NAVD88

3.5.2.1 Groundwater Level Elevation

Protocols for measuring groundwater levels including the following:

- Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. Groundwater levels should be measured to at least the nearest 0.1 foot relative to the Reference Point (RP).
- For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a questionable measurement.
- The groundwater elevation should be calculated using the following equation.

$$GWE = RPE - DTW$$

Where: GWE is the groundwater elevation in NAVD88 datum
RPE is the reference point elevation in NAVD88 datum
DTW is the depth to water

- The well caps or plugs should be secured following depth to water measurement.
- Groundwater level measurements are to be made on a semi-annual basis at a minimum during periods which will capture seasonal highs and lows.

3.5.2.1.1 Recording Groundwater Level Measurements

- The sampler should record the well identifier, date, time (24-hour format), RPE, height of RP above or below ground surface, DTW, GWE, and comments regarding any factors that may influence the depth to water readings such as weather, nearby irrigation, flooding, potential for tidal influence, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. Standardized field forms should be used for all data collection.

- All data should be entered into the GSA data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by the QA/QC Officer.

3.5.2.1.2 Installing Pressure Transducers and Downloading Data

The following procedures will be followed in the installation of a pressure transducer and periodic data downloads:

- The sampler must use an electronic sounder or chalked steel tape and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in the monitoring well to properly program and reference the installation. It is recommended that transducers record measured groundwater level to conserve data capacity; groundwater elevations can be calculated at a later time after downloading.
- The sampler must note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.
- Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. Professional judgment will be exercised to ensure that the data being collected is meeting the Data Quality Objectives (DQO) and that the instrument is capable. Consideration of the battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers should be included in the evaluation.
- The sampler must note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented units provide accurate data if properly corrected for natural barometric pressure changes. This requires the consistent logging of barometric pressures to coincide with measurement intervals.
- Follow manufacturer specifications for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.
- Secure the cable to the well head with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker. This will allow estimates of future cable slippage.
- The transducer data should periodically be checked against hand measured groundwater levels to monitor electronic drift or cable movement. This should happen during routine site visits, at least annually to maintain data integrity.
- The data should be downloaded as necessary to ensure no data is lost and entered into the basin's DMS following the quality assurance/quality control (QA/QC) program established for the GSP. Data collected with non-vented data logger cables should be corrected for atmospheric barometric pressure changes, as appropriate. After the sampler is confident that the transducer data have been safely downloaded and stored, the data should be deleted from the data logger to ensure that adequate data logger memory remains.

3.5.2.2 Groundwater Storage Measurements

The monitoring protocols for evaluating change in groundwater storage are the same as the protocols described above for groundwater levels.

3.5.2.3 Subsidence Measurements

Monitoring sites included in the subsidence monitoring network are managed by multiple entities. Additional information regarding monitoring sites is described in **Section 2.2.8.3**.

- Aquifer system compaction is measured continuously (daily) from three (3) extensometers in the Subbasin by the USGS. Compaction data are published continuously to the USGS NWIS webpage (https://waterdata.usgs.gov/ca/nwis/). Compaction measurements will be downloaded and used to estimate compaction annually. Protocols and measurement error for data collected by the USGS are published on the NWIS webpage (USGS, 2022).
- Vertical displacement is acquired from one (1) high-precision continuous GPS PBO site operated by UNAVCO. Daily measurements of vertical displacement are published to the UNAVCO website (https://www.unavco.org/data/gps-gnss/gps-gnss.html). Daily measurements will be downloaded annually and filtered using a 10-day moving average to estimate subsidence.
- Land surface elevation is acquired from ten (10) benchmarks along the SLC by GPS in January and February and are supplied annually to the GSA from the DWR CASP office through an informal agreement. Land surface elevation provided in NGVD29 will be used to calculate vertical displacement (subsidence) annually. Specific data collection protocols and quantification of measurement error are not currently available from the CASP.
- Land surface elevation is acquired by GPS by USBR from four (4) benchmarks bi-annually in July and December. Land surface elevation data are published to the SJRRP subsidence monitoring webpage following QA/QC (https://www.restoresjr.net/science/subsidence-monitoring/). Land surface elevation provided in NAVD88 will be used to calculate vertical displacement (subsidence) annually. Protocols and measurement error for data collected by USBR are published on the SJRRP webpage (USBR, 2011).
- Land surface elevation is acquired by GPS from the District's consultant for WWD from sixteen (16) benchmarks bi-annually in October and March. Land surface elevation provided to the GSA in NAVD88 will be used to calculate vertical displacement (subsidence) annually. GPS measurements are tied to Continuously Operating Reference Stations (CORS) to calculate precise location information (Blair, Church & Flynn, 2021).
- Groundwater level data collected as part of the subsidence monitoring program will follow protocols for groundwater level monitoring described in **Section 3.5.2.1**.

3.5.2.4 Groundwater Quality Measurements

Annual monitoring of groundwater quality will include sampling and laboratory analysis of TDS and Nitrate. Additional constituents will be considered in the future as additional information becomes available. Additional information will be made available through the Groundwater Quality Trend Monitoring program. These wells will also be sampled for nitrate as nitrogen (as N) on an annual basis.

Furthermore, during the first sampling event, these wells will also be tested for major anions (carbonate, bicarbonate, chloride, sulfate) and major cations (boron, calcium, sodium, magnesium, potassium). Following the first sampling event, these anions and cations will be tested for every five years. During sampling events, measurement of select water quality parameters will take place in the field. These field parameters should be measured at an annual frequency and include electrical conductivity at 25 °C (EC) in µS/cm, pH, temperature (in °C), and dissolved oxygen (DO) in mg/L. The annual testing is summarized in **Table 3-18**.

The GSP monitoring program will utilize the following protocols for collecting groundwater quality samples:

- Prior to sampling, the analytical laboratory will be contacted to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- Each well used for groundwater quality monitoring will have a unique identifier. This identifier will appear on the well housing or the well casing to verify well identification.
- In the case of wells with dedicated pumps, samples should be collected at or near the wellhead following purging.
- Prior to sampling, the sampling port and sampling equipment will be cleaned of any contaminants. The equipment will be decontaminated between each sampling locations or wells to avoid cross-contamination.
- The groundwater elevation in the well should be measured following appropriate protocols described above in the groundwater level measuring protocols.
- For any well not equipped with low-flow or passive sampling equipment, an adequate volume of water should be purged from the well to ensure that the groundwater sample is representative of ambient groundwater and not stagnant water in the well casing. Purging three well casing volumes is generally considered adequate. Professional judgment should be used to determine the proper configuration of the sampling equipment with respect to well construction such that a representative ambient groundwater sample is collected. If pumping causes a well to be evacuated (go dry), document the condition and allow well to recover to within 90% of original level prior to sampling.
- Field parameters of pH, electrical conductivity and temperature should be collected during purging and prior to the collection of each sample. Field parameters should be evaluated during the purging of the well and should stabilize prior to sampling. Measurements of pH should only be measured in the field; lab pH analysis are typically unachievable due to short hold times. Other parameters, such as Oxidation-Reduction Potential (ORP), Dissolved Oxygen (DO) (in situ measurements preferable), or turbidity, may also be useful for assessing purge conditions. All field instruments will be calibrated daily and evaluated for drift throughout the day.
- Sample containers should be labeled prior to sample collection. The sample label must include sample ID (often well ID), sample date and time, sample personnel, sample location, preservative used, and analytes and analytical method.

- Samples should be collected under laminar flow conditions. This may require reducing pumping rates prior to sample collection.
- All samples requiring preservation must be preserved as soon as practically possible, ideally at the time of sample collection. Ensure that samples are appropriately filtered as recommended for the specific analyte. Entrained solids can be dissolved by preservative leading to inconsistent results of dissolve analytes. Specifically, samples to be analyzed for metals should be field filtered prior to preservation; do not collect an unfiltered sample in a preserved container.
- Samples should be chilled and maintained at 4 °C to prevent degradation of the sample. The laboratory's Quality Assurance Management Plan should detail appropriate chilling and shipping requirements.
- Samples must be shipped under chain of custody documentation to the appropriate laboratory promptly to avoid violating holding time restrictions.
- Groundwater quality samples shall be collected annually.
- All data will be entered into the GSA data management system (DMS) as soon as possible. Data entries should be checked by a second person to avoid incorrect data.

Table 3-18: Summary of Groundwater Quality Monitoring Constituents and Measurement Frequency for Representative Monitoring Sites

Field Measurements (Annual)	Laboratory Measurements (Annual)	Laboratory Measurements (Five-Year)
Specific Conductance pH Dissolved Oxygen Oxidation-Reduction Potential Temperature	Nitrate TDS	Carbonate Bicarbonate Chloride Sulfate Calcium Sodium Magnesium

3.5.2.5 Groundwater Pumping Measurements

Measurements of groundwater extractions are conducted in the Subbasin in the vast majority of wells. Measurement devices utilized by the GSA consist of totalizer meters that record extractions. The few remaining active wells will be fitted with meters within the GSP implementation period. The meters will be periodically checked for accuracy utilizing manufacturers recommendations. If necessary, meters will be periodically calibrated according to manufacturer specifications. The meters will be read on a quarterly basis and the data collected will be recorded in gallons and converted to acre feet.

3.5.2.6 Interconnected Surface Water Measurements

No monitoring protocols are included since this sustainability indicator is not present in the Subbasin. However, as noted, the GSA will develop monitoring protocols for interconnected surface waters if areas are identified within the Subbasin.

3.5.3 Representative Monitoring (GSP Reg. § 354.36)

Representative Monitoring Sites (RMS) are defined in the GSP Regulations as a subset of monitoring sites that are representative of conditions in the Subbasin. All the monitoring sites in this section are considered RMS utilizing methods of selection consistent with best management practices described above under the groundwater level protocols. Groundwater level monitoring will be used to determine changes in groundwater storage and to assist in monitoring subsidence near existing subsidence monitoring locations. As previously stated in Chapter 3, reduction in groundwater storage cannot be directly measured. However, groundwater level data will be used in conjunction with aquifer parameters and the groundwater model to compute changes in groundwater storage Subbasin wide. In the case of subsidence, representative monitoring using the approach used for selecting groundwater level monitoring sites is conducted. In areas experiencing high rates of subsidence or co-located with critical infrastructure, more detailed monitoring is implemented.

3.5.4 Assessment and Improvement of Monitoring Network (GSP Reg. § 354.38)

The GSA does not anticipate that the data gaps will impact the Subbasin's ability to achieve sustainability and is committed to fill in data gaps as described in **Section 3.5.4.3.**

As described in section 354.38 of the GSP Regulations, each agency is required to analyze the monitoring network for improvements as follows:

- Each GSA shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.
- Each GSA shall identify data gaps wherever the basin does not contain enough monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the GSA.
- If the monitoring network contains data gaps, the Plan shall include a description of the following:
    - The location and reason for data gaps in the monitoring network
    - Local issues and circumstances that limit or prevent monitoring
- Each GSA shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.
- Each GSA shall adjust the monitoring frequency and distribution of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:
    - Minimum threshold exceedances
    - Highly variable spatial or temporal conditions
    - Adverse impacts to beneficial uses and users of groundwater

- The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin

3.5.4.1 Review and Evaluation of the Monitoring Network

The monitoring networks described above for each of the applicable sustainability indicators will be evaluated on a yearly basis. This evaluation will involve a review of the described minimum thresholds and measurable objectives and their comparison to observed trends in the networks. Furthermore, a more comprehensive review of the monitoring networks will be conducted every five years as part of the GSP update. During this review, management actions and projects will be evaluated, and the monitoring networks will be assessed for their efficacy in tracking progress based on the actions and projects. These evaluations and assessments also will highlight any additional data gaps and recommended changes to the monitoring networks.

3.5.4.2 Identification and Description of Data Gaps

Identification and description of data gaps for the monitoring networks for each of the applicable sustainability indicators are described below.

3.5.4.2.1 Groundwater Elevation

Groundwater elevation data has been extensively collected within the subbasin over the past several decades. However, despite this data collection effort, spatial data gaps still exist. Specifically, in the Upper Aquifer, the northern portion of the Subbasin along the northern and western boundary is lacking in monitoring wells. This spatial gap exists due to the absence of wells in these regions and associated groundwater extraction. In the Lower Aquifer, a spatial gap exists in the southern portion of the Subbasin, along the western boundary. These gaps are evident in the designed monitoring network as no wells represent the areas described. In addition to these spatial gaps, data collection gaps also exist at the sites available. The lack of measurements is often related to the inaccessibility of the monitoring wells or active pumping. The groundwater level data gaps described above have not impacted the ability of the GSA to adequately characterize long-term trends in groundwater levels or understanding groundwater level conditions in the Subbasin as a whole.

3.5.4.2.2 Groundwater Storage

As described in **Section 3.5.3.,** groundwater level data will be used in conjunction with aquifer parameters and the groundwater model to compute changes in groundwater storage Subbasin wide. Because water levels are being used as a proxy for groundwater storage, data gaps for groundwater levels will also impact the calculation of groundwater storage. These data gaps are described in **Section 3.5.4.2.1.**

3.5.4.2.3 Subsidence

The subsidence monitoring network provides robust spatial coverage and sufficient frequency to measure vertical displacement, compaction and groundwater levels. The primary data gap results from locations where subsidence is quantified indirectly through measurement of groundwater levels as a proxy. These sites fall generally along the western boundary of the Subbasin and east of the Huron where the Corcoran clay is not present.

Portions of the Upper Aquifer may be susceptible to significant compaction depending on local conditions as described in **Section 2.2.8.4.5**. Local geology, groundwater conditions and compaction in the Upper Aquifer may require further monitoring and study in portions of the Subbasin prior to the GSA considering a substantial shift in the vertical distribution of pumping from the Lower Aquifer to the Upper Aquifer as part of an aquifer-specific allocation contemplated as part of the PMA for the Groundwater Allocation Program. (See Section 4.2.1.2.)

3.5.4.2.4 Groundwater Quality

Groundwater quality data had the most pronounced data gaps of all the assessed sustainability indicators and these gaps spanned both spatial and temporal spectrums. Historical data related to TDS was sparse and not continuously collected for a long period of time at any monitoring wells. Most data collected was part of stand-alone programs. The Upper Aquifer wells exhibited higher levels of data gaps than the Lower Aquifer wells. This fact is reflected in the wells selected for the monitoring network. During analysis of the TDS data, 12 hexagons in the Upper Aquifer were found to have insufficient data to determine if they met the criteria for water quality monitoring.

The Upper Aquifer utilizes mainly water level monitoring wells whereas the Lower Aquifer contains more wells with historical TDS data. Due to the lack of historical data, measurable objectives, minimum thresholds, and interim milestones were difficult to set based on a 2015 baseline date. These data gaps will be addressed by the GSA early in the Implementation Period, in coordination with outreach to beneficial groundwater users and will influence how the groundwater quality monitoring program will evolve over time between 2020 and 2040.

3.5.4.3 Description of Steps to Remedy Data Gaps

Data gaps have been presented in the groundwater elevation, groundwater quality, and groundwater storage monitoring networks. The GSA will take the following steps, prior to the first five-year GSP update in 2025 to address these data gaps:

- The GSA installed five new aquifer-specific nested monitoring wells within the Subbasin in areas where data gaps historically existed. These new wells will address the data gaps described in the Upper and Lower Aquifers for groundwater elevation data (**Figure 3-13**). Furthermore, these new wells will also be added to the groundwater quality monitoring networks in both aquifers to fill spatial coverage gaps. Also represented in this figure are the proposed locations for additional shallow zone monitoring wells. For the purposes of identifying interconnected surface waters and groundwater dependent ecosystems, these shallow wells will be screened in the upper 40 feet. In an effort to fill this data gap, the GSA applied for the DWR Technical Support Services program in January 2021 to drill wells to acquire data and is coordinating with DWR to drill the shallow wells in late 2023/early 2024.
- The GSA will install sampling spigots taps on groundwater level wells designated for groundwater quality monitoring. These wells will then be sampled simultaneously for groundwater elevation data and groundwater quality data.
- Sampling events will be coordinated with well owners to prevent pumping and access issues.

- The GSA will evaluate conditions in the twelve (12) hexagons with insufficient water quality information in the Upper Aquifer. Groundwater conditions will be investigated to determine if areas identified as data gaps contain usable groundwater (i.e., are saturated above the Corcoran clay). The GSA will also evaluate data collected from the ILRP GQTM network to determine if that data can help bridge this data gap. Where appropriate, the GSA will conduct sampling to determine if any of these hexagons require management or further monitoring as part of the GSP monitoring network.
- Although no monitoring network is currently in place for interconnected surface water (ISW) due to the fact the streams in the Subbasin are ephemeral, the GSA will look at the data gaps brought forth in the GDE assessment and reevaluate this indicator in the future. If present, the GSA will establish a monitoring network to address the ISW data gap and incorporate depletion of inter-connected surface water as an undesirable result, including establishing minimum thresholds and measurable objectives, in subsequent updates to the GSP.
- The GSA also will continue to evaluate whether groundwater conditions in adjacent basins may affect Westside Subbasin subsurface inflows and outflows and supplement the monitoring network in these areas to ensure changes are monitored and as needed, address concerns about groundwater management in neighboring basins.
- The GSA installed ten (10) additional GPS benchmarks in 2022 to monitor land surface elevation and subsidence. This total twenty-five (25) benchmarks throughout the Subbasin. New GPS benchmarks were installed in portions of the Subbasin where the existing monitoring network is reliant on measurement groundwater levels as a proxy for subsidence. The additional sites are co-located with multi-completion wells installed by WWD and/or target areas where interferograms provided by DWR indicate high rates of subsidence. The monitoring network will be revised to include new benchmarks prior to the 2025 GSP update.
- The GSA will evaluate the susceptibility of the Upper Aquifer to compaction in areas where groundwater pumping in the Upper Aquifer is promoted during PMA implementation. Local geologic conditions will be evaluated through review of textural and electric resistivity logs to identify compressible geologic materials. This analysis will be coupled with review of available groundwater level, subsidence, InSAR or compaction data. Any additional data gaps will be identified and remedied through supplemental data collection and monitoring as appropriate.

In addition to these steps, the monitoring networks will be evaluated on a yearly and five-year basis. If additional data gaps arise, the GSA will consider the implications of these gaps, associated costs, and importance to the continued implementation of the GSP and take appropriate actions to address the gaps.

3.5.5 Description of Monitoring Frequency and Density of Sites

Monitoring frequency and density of sites for all sustainability indicators are described in previous sections in **Chapter 3** of this report.

Table 3-1: Measurable Objectives and Interim Milestones for the Chronic Lowering of Groundwater Elevations
Upper Aquifer

Well Name	Date of Baseline	Baseline	Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Measurable Objective
		Water Surface Elevation (feet NAVD88)				
14S/13E-23E02	11/27/2012[1]	-29.0	-2.1	24.9	51.9	78.8
14S/15E-20Q01	11/19/2013	50.0	64.4	78.7	93.1	107.4
15S/13E-05F04	11/18/2015	251.4	253.3	255.3	257.2	259.2
15S/13E-22A01	11/18/2015	153.6	158.0	162.4	166.8	171.2
15S/14E-10A06	11/25/2014	112.5	118.5	124.4	130.4	136.4
15S/15E-16K01	1/6/2015[1]	116.6	115.8	115.0	114.2	113.5
15S/14E-14R01	11/25/2014[1]	-11.4	21.1	53.5	86.0	118.5
16S/15E-10M01	1/1/2015[1]	1.6	24.1	46.5	69.0	91.5
16S/16E-09Q01	1/7/2014[1]	64.0	70.9	77.8	84.6	91.5
16S/16E-33G01	11/17/2016[1]	25.8	38.2	50.5	62.9	75.2
17S/17E-16C01	5/25/2016	-1.1	10.7	22.4	34.2	46.0
17S/17E-31N03	12/2/2015	-83.0	-68.4	-53.7	-39.1	-24.5
18S/16E-22Q03	12/26/2014	-64.9	-38.0	-11.2	15.7	42.6
18S/17E-11Q01	11/17/2015	11.0	29.6	48.1	66.7	85.2
18S/18E-05K01	1/8/2015[1]	27.9	27.4	27.0	26.5	26.0
18S/18E-28N04	1/9/2015[1]	62.9	70.7	78.6	86.4	94.2
18S/19E-20F01	1/23/2015	5.9	21.3	36.8	52.2	67.6
19S/18E-34N04	12/3/2015	-144.1	-106.1	-68.1	-30.0	8.0
19S/19E-08N04	1/1/2015[1]	30.0	62.0	94.0	126.0	158.0
19S/19E-26D02	1/1/2016[1]	3.2	3.4	3.7	3.9	4.1
20S/19E-07G02	12/7/2016[1]	49.5	57.5	65.5	73.5	81.5
21S/19E-07H01	12/12/2016[1]	34.2	38.6	42.9	47.3	51.6

1. Value interpolated for recent historical low (2015) using available data

Table 3-2: Measurable Objectives and Interim Milestones for the Chronic Lowering of Groundwater Elevations Lower Aquifer

Monitoring Site	Date of Baseline	Baseline	Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Measurable Objective
		Water Surface Elevation (feet NAVD88)				
13S/13E-24E02	9/30/2015	-10.7	2.8	16.4	29.9	43.4
14S/12E-35J01	1/5/2015[1]	-70.2	-37.8	-5.5	26.9	59.3
14S/13E-06P02	10/29/2015	-48.5	-22.3	3.9	30.0	56.2
14S/13E-12P01	1/6/2015[1]	-61.5	-31.7	-1.8	28.1	57.9
14S/15E-32N02	12/4/2015	-97.5	-49.7	-1.8	46.1	93.9
15S/12E-13D01	12/3/2015	-58.2	-44.5	-30.8	-17.1	-3.4
15S/13E-02P01	1/1/2015[1]	-132.0	-102.7	-73.5	-44.2	-14.9
15S/13E-24N01	9/28/2015	-95.3	-54.0	-12.6	28.8	70.2
15S/14E-19Q01	12/6/2016[1]	-169.4	-123.1	-76.8	-30.4	15.9
15S/14E-26N02	10/23/2015	-225.3	-180.4	-135.6	-90.7	-45.8
15S/14E-31N03	10/28/2015	-183.2	-123.2	-63.3	-3.3	56.7
15S/15E-04A03	12/21/2015	-70.5	-66.8	-63.0	-59.3	-55.5
15S/15E-29K01	10/28/2015	-178.4	-143.4	-108.4	-73.4	-38.4
16S/14E-03H01	10/28/2015	-42.3	-9.5	23.3	56.0	88.8
16S/14E-14F01	12/22/2014[1]	-120.2	-89.0	-57.8	-26.6	4.6
16S/14E-17A01	12/22/2014[1]	-152.1	-106.7	-61.2	-15.8	29.7
16S/14E-36E01	12/22/2014[1]	-156.1	-92.1	-28.1	36.0	100.0
16S/15E-16E01	10/23/2015	-233.3	-183.3	-133.3	-83.3	-33.3
16S/15E-32A06	1/1/2015[1]	-17.4	-9.8	-2.2	5.4	13.0
16S/16E-10Q01	5/31/2016	-136.3	-98.5	-60.7	-22.8	15.0
16S/16E-29E01	11/5/2015	-181.2	-139.4	-97.6	-55.8	-14.0
17S/15E-09N02	10/26/2015	-166.1	-104.1	-42.0	20.1	82.1
17S/15E-23D01	10/26/2015	-239.1	-177.0	-115.0	-52.9	9.2
17S/17E-09Q01	9/28/2015	-150.1	-118.3	-86.5	-54.7	-22.9
17S/18E-33H02	10/20/2015	-88.1	-59.9	-31.8	-3.6	24.6
18S/15E-15D01	11/9/2015	-23.6	5.4	34.4	63.4	92.4
18S/16E-04N02	10/30/2015	-188.9	-152.3	-115.7	-79.0	-42.4
18S/16E-34N02	11/19/2015	-52.9	-24.5	3.9	32.2	60.6
18S/17E-09P01	10/20/2015	-194.0	-142.9	-91.8	-40.6	10.5
18S/18E-01R02	11/17/2015	-41.2	-5.5	30.3	66.1	101.8
19S/16E-35N01	10/15/2015	77.9	82.2	86.5	90.7	95.0
19S/17E-28P01	10/20/2015	-87.0	-48.0	-9.0	30.1	69.1
19S/18E-04C01	1/1/2015[1]	-103.6	-72.4	-41.2	-10.0	21.2
19S/19E-29A01	11/19/2014[1]	-112.1	-83.5	-54.8	-26.2	2.5
20S/16E-21R01	10/21/2015	-23.0	41.6	106.2	170.8	235.4
20S/17E-09N03	12/29/2016[1]	-39.8	-8.1	23.7	55.5	87.2
20S/18E-04G01	5/5/2016[1]	-185.1	-111.6	-38.1	35.4	108.9
20S/18E-35D02	12/20/2016[1]	-126.0	-105.9	-85.9	-65.8	-45.7
20S/19E-02A01	1/1/2015[1]	-28.3	-8.2	12.0	32.1	52.2
20S/19E-17M01	10/2/2015	-107.1	-84.8	-62.6	-40.3	-18.0
21S/17E-11N01	1/21/2015	-58.1	-23.8	10.5	44.8	79.1
21S/18E-22E01	1/27/2015	-142.1	-104.2	-66.2	-28.3	9.7
21S/18E-35Q02	1/1/2015[1]	-42.9	-41.1	-39.3	-37.5	-35.7
21S/19E-20D02	12/12/2016[1]	-147.4	-130.6	-113.8	-97.0	-80.3

1. Value interpolated for recent historical low (2015) using available data

Table 3-4: Measurable Objectives and Interim Milestones Subsidence

Monitoring Site	Monitoring Type	Monitoring Entity	Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Interim Milestone 20 Years	Measurable Objective
			Subsidence (ft) Annual Rate (Cumulative Total[1])				
DWR Yard²	Extensometer	USGS	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Panoche	Extensometer	USGS	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
Rasta²	Extensometer	USGS	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
P302	CGPS	UNAVCO	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #1	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #2	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #3²	GPS	WWD	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
BM #4	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #5	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
CHK 6	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #7	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #8	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #9²	GPS	WWD	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
BM #10	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #11	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #12	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #13	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #14	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #15	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
BM #16	GPS	WWD	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
Burnside	GPS	USBR	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
HPGN 06 07²	GPS	USBR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Murietta	GPS	USBR	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
Peyton	GPS	USBR	0.1 (0.2)	0.1 (0.3)	0.1 (0.4)	0.1 (0.5)	0.1 (0.5)
M 1194²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
A 1093²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
P 1093 RESET 1983²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
132.46 L²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
136.05 L RESET 1984²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
H 1195²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
E 1075²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
E 1097²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
J 1097²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
M 1097²	GPS	DWR	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
13S/13E-24E02	Water Level[3]	WWD	2.8	16.4	29.9	43.4	43.4
14S/15E-32N02	Water Level[3]	WWD	-49.7	-1.8	46.1	93.9	93.9
15S/15E-29K01	Water Level[3]	WWD	-143.4	-108.4	-73.4	-38.4	-38.4
16S/16E-29E01	Water Level[3]	WWD	-139.4	-97.6	-55.8	-14.0	-14.0
17S/18E-33H02	Water Level[3]	WWD	-59.9	-31.8	-3.6	24.6	24.6
18S/17E-09P01	Water Level[3]	WWD	-142.9	-91.8	-40.6	10.5	10.5
19S/16E-35N01	Water Level[3]	WWD	82.2	86.5	90.7	95.0	95.0
19S/17E-28P01	Water Level[3]	WWD	-48.0	-9.0	30.1	69.1	69.1
19S/18E-04C01	Water Level[3]	WWD	-72.4	-41.2	-10.0	21.2	21.2
19S/19E-29A01	Water Level[3]	WWD	-83.5	-54.8	-26.2	2.5	2.5
20S/17E-09N03	Water Level[3]	WWD	-8.1	23.7	55.5	87.2	87.2
20S/19E-17M01	Water Level[3]	WWD	-84.8	-62.6	-40.3	-18.0	-18.0

1. Total cumulative land subsidence since January 2020
2. Site adjacent San Luis Canal (California Aqueduct)
3. Water Surface Elevation - Measured in feet above mean sea level (NAVD88)

Table 3-5: Measurable Objectives and Interim Milestones for Water Quality Upper Aquifer

Well Name	Measurable Objective TDS (mg/L)
22S/18E-11C03	800
MW-2A	500
14S/15E-20Q01	N/A
15S/13E-05F04	N/A
15S/13E-22A01	N/A
15S/14E-10A06	N/A
15S/14E-14R01	N/A
16S/15E-10M01	N/A
16S/16E-09Q01	N/A
16S/16E-33G01	N/A
17S/17E-16C01	N/A
17S/17E-31N03	N/A
18S/17E-11Q01	N/A
18S/18E-28N04	N/A
18S/19E-20F01	N/A
19S/19E-08N04	N/A
19S/19E-26D02	N/A
19S/19E-31N03	N/A
20S/17E-29J01	N/A
21S/18E-28Q02	N/A
21S/19E-07H01	N/A
FC-3 Shallow	N/A

Table 3-6: Measurable Objectives and Interim Milestones for Groundwater Quality
Lower Aquifer

Well Name	Measurable Objective TDS (mg/L)
17S/18E-33H02	500
18S/18E-01R02	800
21S/18E-28G06	500
21S/19E-20D02	500
13S/13E-24E02	N/A
14S/15E-32N02	N/A
15S/12E-13D01	N/A
15S/13E-02P01	N/A
15S/14E-31N03	N/A
15S/15E-04A03	N/A
15S/15E-29K01	N/A
16S/14E-36E01	N/A
16S/16E-10Q01	N/A
18S/15E-15D01	N/A
18S/17E-09P01	N/A
19S/18E-04C01	N/A
20S/19E-02A01	N/A
20S/19E-17M01	N/A
14S/12E-25D01	N/A
16S/14E-11G02	N/A
16S/15E-21L01	N/A
16S/17E-28M02	N/A
17S/16E-01N03	N/A
18S/16E-06F01	N/A
18S/16E-15N02	N/A
19S/18E-24N01	N/A
20S/17E-14K01	N/A
20S/18E-03N03	N/A
21S/18E-08B01	N/A

Table 3-7: Minimum Thresholds for the Chronic Lowering of Groundwater Elevations Upper Aquifer

Well Name	Date of Baseline	Baseline	Minimum Threshold
		Water Surface Elevation (feet NAVD88)	
14S/13E-23E02	11/27/2012[1]	-29.0	-69.0
14S/15E-20Q01	11/19/2013	50.0	10.0
15S/13E-05F04	11/18/2015	251.4	211.4
15S/13E-22A01	11/18/2015	153.6	113.6
15S/14E-10A06	11/25/2014	112.5	72.5
15S/15E-16K01	1/6/2015[1]	116.6	76.6
15S/14E-14R01	11/25/2014[1]	-11.4	-51.4
16S/15E-10M01	1/1/2015[1]	1.6	-38.4
16S/16E-09Q01	1/7/2014[1]	64.0	24.0
16S/16E-33G01	11/17/2016[1]	25.8	-14.2
17S/17E-16C01	5/25/2016	-1.1	-41.1
17S/17E-31N03	12/2/2015	-83.0	-123.0
18S/16E-22Q03	12/26/2014	-64.9	-104.9
18S/17E-11Q01	11/17/2015	11.0	-29.0
18S/18E-05K01	1/8/2015[1]	27.9	-12.1
18S/18E-28N04	1/9/2015[1]	62.9	22.9
18S/19E-20F01	1/23/2015	5.9	-34.1
19S/18E-34N04	12/3/2015	-144.1	-184.1
19S/19E-08N04	1/1/2015[1]	30.0	-10.0
19S/19E-26D02	1/1/2016[1]	3.2	-36.8
20S/19E-07G02	12/7/2016[1]	49.5	9.5
21S/19E-07H01	12/12/2016[1]	34.2	-5.8

1. Value interpolated for recent historical low (2015) using available data

Table 3-8: Minimum Threshold for the Chronic Lowering of Groundwater Elevations Lower Aquifer

Well Name	Date of Baseline	Baseline	Minimum Threshold
		Water Surface Elevation (feet NAVD88)	
13S/13E-24E02	9/30/2015	-10.7	-50.7
14S/12E-35J01	1/5/2015[1]	-70.2	-110.2
14S/13E-06P02	10/29/2015	-48.5	-88.5
14S/13E-12P01	1/6/2015[1]	-61.5	-101.5
14S/15E-32N02	12/4/2015	-97.5	-137.5
15S/12E-13D01	12/3/2015	-58.2	-98.2
15S/13E-02P01	1/1/2015[1]	-132.0	-172.0
15S/13E-24N01	9/28/2015	-95.3	-135.3
15S/14E-19Q01[2]	12/6/2016[1]	-169.4	-169.4
15S/14E-26N02	10/23/2015	-225.3	-265.3
15S/14E-31N03[2]	10/28/2015	-183.2	-183.2
15S/15E-04A03	12/21/2015	-70.5	-110.5
15S/15E-29K01	10/28/2015	-178.4	-218.4
16S/14E-03H01	10/28/2015	-42.3	-82.3
16S/14E-14F01[2]	12/22/2014[1]	-120.2	-120.2
16S/14E-17A01[2]	12/22/2014[1]	-152.1	-152.1
16S/14E-36E01[2]	12/22/2014[1]	-156.1	-156.1
16S/15E-16E01	10/23/2015	-233.3	-273.3
16S/15E-32A06	1/1/2015[1]	-17.4	-57.4
16S/16E-10Q01	5/31/2016	-136.3	-176.3
16S/16E-29E01	11/5/2015	-181.2	-221.2
17S/15E-09N02[2]	10/26/2015	-166.1	-166.1
17S/15E-23D01	10/26/2015	-239.1	-279.1
17S/17E-09Q01	9/28/2015	-150.1	-190.1
17S/18E-33H02	10/20/2015	-88.1	-128.1
18S/15E-15D01	11/9/2015	-23.6	-63.6
18S/16E-04N02	10/30/2015	-188.9	-228.9
18S/16E-34N02	11/19/2015	-52.9	-92.9
18S/17E-09P01	10/20/2015	-194.0	-234.0
18S/18E-01R02	11/17/2015	-41.2	-81.2
19S/16E-35N01	10/15/2015	77.9	37.9
19S/17E-28P01	10/20/2015	-87.0	-127.0
19S/18E-04C01	1/1/2015[1]	-103.6	-143.6
19S/19E-29A01	11/19/2014[1]	-112.1	-152.1
20S/16E-21R01	10/21/2015	-23.0	-63.0
20S/17E-09N03	12/29/2016[1]	-39.8	-79.8
20S/18E-04G01	5/5/2016[1]	-185.1	-225.1
20S/18E-35D02	12/20/2016[1]	-126.0	-166.0
20S/19E-02A01	1/1/2015[1]	-28.3	-68.3
20S/19E-17M01	10/2/2015	-107.1	-147.1
21S/17E-11N01	1/21/2015	-58.1	-98.1
21S/18E-22E01[2]	1/27/2015	-142.1	-142.1
21S/18E-35Q02	1/1/2015[1]	-42.9	-82.9
21S/19E-20D02	12/12/2016[1]	-147.4	-187.4

1. Value interpolated for recent historical low (2015) using available data
2. MT is historical low value in subsidence prone area

Table 3-9: Minimum Thresholds for Subsidence

Monitoring Site	Monitoring Type	Monitoring Entity	Minimum Threshold (ft)
DWR Yard²	Extensometer	USGS	0.3 (1.5)
Panoche	Extensometer	USGS	0.3 (2.5)
Rasta²	Extensometer	USGS	0.3 (1.5)
P302	CGPS	UNAVCO	0.3 (2.5)
BM #1	GPS	WWD	0.3 (2.5)
BM #2	GPS	WWD	0.3 (2.5)
BM #3²	GPS	WWD	0.3 (1.5)
BM #4	GPS	WWD	0.3 (2.5)
BM #5	GPS	WWD	0.3 (2.5)
CHK 6	GPS	WWD	0.3 (2.5)
BM #7	GPS	WWD	0.3 (2.5)
BM #8	GPS	WWD	0.3 (2.5)
BM #9²	GPS	WWD	0.3 (1.5)
BM #10	GPS	WWD	0.3 (2.5)
BM #11	GPS	WWD	0.3 (2.5)
BM #12	GPS	WWD	0.3 (2.5)
BM #13	GPS	WWD	0.3 (2.5)
BM #14	GPS	WWD	0.3 (2.5)
BM #15	GPS	WWD	0.3 (2.5)
BM #16	GPS	WWD	0.3 (2.5)
Burnside	GPS	USBR	0.3 (2.5)
HPGN 06 07²	GPS	USBR	0.3 (1.5)
Murietta	GPS	USBR	0.3 (2.5)
Peyton	GPS	USBR	0.3 (2.5)
M 1194²	GPS	DWR	0.3 (1.5)
A 1093²	GPS	DWR	0.3 (1.5)
P 1093 RESET 1983²	GPS	DWR	0.3 (1.5)
132.46 L²	GPS	DWR	0.3 (1.5)
136.05 L RESET 1984²	GPS	DWR	0.3 (1.5)
H 1195²	GPS	DWR	0.3 (1.5)
E 1075²	GPS	DWR	0.3 (1.5)
E 1097²	GPS	DWR	0.3 (1.5)
J 1097²	GPS	DWR	0.3 (1.5)
M 1097²	GPS	DWR	0.3 (1.5)
13S/13E-24E02	Water Level³	WWD	-50.7
14S/15E-32N02	Water Level³	WWD	-137.5
15S/15E-29K01	Water Level³	WWD	-218.4
16S/16E-29E01	Water Level³	WWD	-221.2
17S/18E-33H02	Water Level³	WWD	-128.1
18S/17E-09P01	Water Level³	WWD	-234
19S/16E-35N01	Water Level³	WWD	37.9
19S/17E-28P01	Water Level³	WWD	-127
19S/18E-04C01	Water Level³	WWD	-143.6
19S/19E-29A01	Water Level³	WWD	-152.1
20S/17E-09N03	Water Level³	WWD	-79.8
20S/19E-17M01	Water Level³	WWD	-147.1

1. Total cumulative land subsidence since January 2020
2. Site adjacent San Luis Canal (California Aqueduct)
3. Water Surface Elevation - Measured in feet above mean sea level

Table 3-10: Minimum Thresholds for Water Quality
Upper Aquifer

Well Name	Minimum Threshold TDS (mg/L)
22S/18E-11C03	1000
MW-2A	1000
14S/15E-20Q01	N/A
15S/13E-05F04	N/A
15S/13E-22A01	N/A
15S/14E-10A06	N/A
15S/14E-14R01	N/A
16S/15E-10M01	N/A
16S/16E-09Q01	N/A
16S/16E-33G01	N/A
17S/17E-16C01	N/A
17S/17E-31N03	N/A
18S/17E-11Q01	N/A
18S/18E-28N04	N/A
18S/19E-20F01	N/A
19S/19E-08N04	N/A
19S/19E-26D02	N/A
19S/19E-31N03	N/A
20S/17E-29J01	N/A
21S/18E-28Q02	N/A
21S/19E-07H01	N/A
FC-3 Shallow	N/A

Table 3-11: Minimum Thresholds for Groundwater Quality Lower Aquifer

Well Name	Minimum Threshold TDS (mg/L)
17S/18E-33H02	1000
18S/18E-01R02	1000
21S/18E-28G06	1000
21S/19E-20D02	1000
13S/13E-24E02	N/A
14S/15E-32N02	N/A
15S/12E-13D01	N/A
15S/13E-02P01	N/A
15S/14E-31N03	N/A
15S/15E-04A03	N/A
15S/15E-29K01	N/A
16S/14E-36E01	N/A
16S/16E-10Q01	N/A
18S/15E-15D01	N/A
18S/17E-09P01	N/A
19S/18E-04C01	N/A
20S/19E-02A01	N/A
20S/19E-17M01	N/A
14S/12E-25D01	N/A
16S/14E-11G02	N/A
16S/15E-21L01	N/A
16S/17E-28M02	N/A
17S/16E-01N03	N/A
18S/16E-06F01	N/A
18S/16E-15N02	N/A
19S/18E-24N01	N/A
20S/17E-14K01	N/A
20S/18E-03N03	N/A
21S/18E-08B01	N/A

Table 3-12: Summary of Undesirable Results Applicable to the Plan Area

Sustainability Indicator	Minimum Threshold	Measurable Objective	Undesirable Result
Chronic Lowering of Groundwater Levels	The lowest of a) projected lowest future groundwater level at end of estimated 10-year drought or b) lowest modeled groundwater level from projected with projects model simulation. The red zone as described in Chapter 4 equates to groundwater levels falling to a level to or slightly above the minimum threshold.	Projected average future groundwater level from projected with projects model simulation	25 percent of wells below minimum threshold for two consecutive spring measurements
Reduction of Groundwater Storage	No long-term reduction in groundwater storage based on measured groundwater levels	Projected average future groundwater level from projected with projects model simulation (2040-2070)	25 percent of wells below minimum threshold for two consecutive spring measurements
Land Subsidence	Protection of 2015 water levels and prevent increases in the rate of residual subsidence	Project residual subsidence rate in subsidence prone areas; minimal levels active and residual subsidence in other areas of the Subbasin	Two Monitoring Network locations in a subsidence prone area exceed the minimum thresholds in one year
Seawater Intrusion	Not Applicable	Not Applicable	Not Applicable
Degraded Water Quality	Variable TDS, dependent on location in the Subbasin , historical trends, and maximum historical deviation historical trends, and maximum historical deviation	TDS constituent concentrations related to historical trends observed in the well or nearby areas.	25 percent of wells above the minimum threshold for the same constituent, based on average of most recent three-year period
Depletion of Interconnected Surface Water	Not Currently Applicable	Not Currently Applicable	Not Currently Applicable

Table 3-13: Monitoring Network for Water Levels and Storage
Upper Aquifer

Well Name	Latitude (NAD83)	Longitude (NAD83)	Monitoring Frequency	Depth (ft bgs)	Perforations (ft bgs)	Ground-Surface Elevation (ft NAVD88)	Period of Record	Number of Measurements	Rationale[1,2,3]
14S/13E-23E02	36.70013	-120.53161	Bi-Annual	716	326-716	319.6	1977-2018	44	1,2
14S/15E-20Q01	36.69083	-120.36034	Bi-Annual	205	115-205	170.5	1991-2018	30	1,2
15S/13E-05F04	36.65638	-120.57873	Bi-Annual	215	199-209	408.64	2010-2018	16	1
15S/13E-22A01	36.61850	-120.53256	Bi-Annual	379	363-373	434.64	2010-2018	16	1
15S/14E-10A06	36.64697	-120.42445	Bi-Annual	582	150-582	224.5	1990-2018	33	1,2
15S/14E-14R01	36.61810	-120.40669	Bi-Annual	600	400-600	206.6	1991-2018	30	2
15S/15E-16K01	36.62312	-120.34270	Bi-Annual	500	300-500	174.6	1979-2019	44	1,2
16S/15E-10M01	36.55198	-120.33427	Bi-Annual	560	320-540	238.7	2007-2018	14	1
16S/16E-09Q01	36.54519	-120.23450	Bi-Annual	580	280-560	194.7	1992-2018	29	2
16S/16E-33G01	36.49476	-120.23433	Bi-Annual	520	300-520	233.8	1992-2018	29	1,2
17S/17E-16C01	36.45839	-120.13030	Bi-Annual	480	270-480	210.9	1988-2018	34	1,2
17S/17E-31N03	36.40062	-120.17558	Bi-Annual	780	498-738	253	1990-2018	30	2
18S/16E-22Q03	36.34233	-120.22092	Bi-Annual	400	280-400	300.1	1990-2018	30	1,2
18S/17E-11Q01	36.37182	-120.09403	Bi-Annual	630	350-630	257	1988-2018	33	1,2
18S/18E-05K01	36.39366	-120.04000	Bi-Annual	652	342-643	233.9	1978-2019	47	1,2
18S/18E-28N04	36.32833	-120.03050	Bi-Annual	670	300-660	262.9	1991-2018	30	1,2
18S/19E-20F01	36.35013	-119.93664	Bi-Annual	604	244-604	225.9	1988-2018	32	1,2
19S/18E-34N04[3]	36.22992	-120.01246	Bi-Annual	733	400-700	288.9	1994-2018	25	1,2
19S/19E-08N04	36.28475	-119.94090	Bi-Annual	620	300-620	236.9	1993-2018	27	1,2
19S/19E-26D02	36.25259	-119.88725	Bi-Annual	580	300-580	220.9	1992-2018	28	2
20S/19E-07G02	36.20367	-119.94992	Bi-Annual	690	175-670	250.9	2010-2018	12	1
21S/19E-07H01	36.11684	-119.95004	Bi-Annual	790	286-770	231.8	2016-2018	5	1

1. Location of Well
2. Number of Records
3. Well Construction Estimated

Table 3-14: Monitoring Network for Water Levels and Storage
Lower Aquifer

Well Name	Latitude (NAD83)	Longitude (NAD83)	Monitoring Frequency	Depth (ft bgs)	Perforations (ft bgs)	Ground-Surface Elevation (ft NAVD88)	Period of Record	Number of Measurements	Rationale[1,2,3]
13S/13E-24E02	36.78538	-120.51260	Bi-Annual	860	560-780	223	2015-2018	7	1,2,3
14S/12E-35J01	36.66652	-120.62223	Bi-Annual	1035	654-1035	435.8	1979-2018	44	1,2
14S/13E-06P02	36.73504	-120.59483	Bi-Annual	1214	702-1214	323.5	1979-2018	44	2
14S/13E-12P01	36.72006	-120.50911	Bi-Annual	1520	700-1400	275.5	1977-2018	44	1,2
14S/15E-32N02	36.66479	-120.36908	Bi-Annual	986	544-986	180.5	1977-2018	43	1,3
15S/12E-13D01	36.62694	-120.61508	Bi-Annual	998	698-998	552.8	1990-2018	23	1
15S/13E-02P01	36.64960	-120.52410	Bi-Annual	1244	884-1244	337.5	2009-2018	11	1
15S/13E-24N01[a]	36.60481	-120.51445	Bi-Annual	1849	917-1849	400.7	1963-2021	47	1
15S/14E-19Q01	36.60403	-120.48540	Bi-Annual	1265	865-1265	332.6	1994-2018	27	1,2
15S/14E-26N02	36.58913	-120.42465	Bi-Annual	1500	700-1500	230.7	1979-2018	44	1,2
15S/14E-31N03	36.57501	-120.49656	Bi-Annual	1918	915-1800	372.8	1965-2018	52	1,2
15S/15E-04A03	36.66072	-120.33393	Bi-Annual	1000	600-1000	164.5	2008-2019	15	1
15S/15E-29K01	36.59583	-120.35703	Bi-Annual	1162	600-1162	190.6	2013-2019	9	1,3
16S/14E-03H01	36.56752	-120.42545	Bi-Annual	2018	718-2018	275.7	1958-2018	57	1,2
16S/14E-14F01	36.53837	-120.41662	Bi-Annual	2803	1000-2803	358.8	1960-2019	55	1,2
16S/14E-17A01	36.54510	-120.46143	Bi-Annual	2230	930-2210	437.9	2003-2018	18	1,2
16S/14E-36E01	36.49438	-120.40687	Bi-Annual	2200	841-2104	477.9	1987-2019	34	1,2
16S/15E-16E01	36.53801	-120.35214	Bi-Annual	1200	840-1200	267.7	1992-2018	29	2
16S/15E-32A06	36.50061	-120.35328	Bi-Annual	1218	618-1218	328.8	1993-2019	29	1,2
16S/16E-10Q01	36.54539	-120.21163	Bi-Annual	965	645-945	187.7	1993-2018	30	1,2
16S/16E-29E01	36.50897	-120.26163	Bi-Annual	995	675-995	244.8	1992-2018	28	2,3
17S/15E-09N02	36.46126	-120.35602	Bi-Annual	2529	861-2529	392.9	1978-2019	35	1,2
17S/15E-23D01	36.44281	-120.32009	Bi-Annual	1500	842-1500	362.9	1978-2018	34	1,2
17S/17E-09Q01	36.45883	-120.12969	Bi-Annual	1002	602-1002	209.9	2009-2018	14	1
17S/18E-33H02	36.40831	-120.01361	Bi-Annual	1340	600-1310	216.9	2014-2019	8	1,3
18S/15E-15D01	36.36883	-120.33744	Bi-Annual	2583	1788-2488	541.4	1988-2018	23	1,2
18S/16E-04N02	36.38563	-120.24702	Bi-Annual	1760	942-1720	287.1	1989-2019	32	1,2
18S/16E-34N02	36.31265	-120.22875	Bi-Annual	2000	800-2000	337.1	1992-2018	29	1,2
18S/17E-09P01	36.37167	-120.13000	Bi-Annual	1187	700-1150	268	1991-2018	31	1,2,3
18S/18E-01R02	36.38645	-119.95955	Bi-Annual	1281	598-1281	217.8	2010-2018	10	1
19S/16E-35N01	36.22638	-120.20998	Bi-Annual	2035	719-2035	432.9	1978-2018	35	1,2,3
19S/17E-28P01	36.24105	-120.13212	Bi-Annual	2018	716-2005	368	1987-2018	35	2,3
19S/18E-04C01	36.31356	-120.02182	Bi-Annual	1620	866-1600	266.9	2008-2018	15	1,2,3
19S/19E-29A01	36.25485	-119.92323	Bi-Annual	1423	718-1423	237.9	1990-2018	31	2,3
20S/16E-21R01	36.16830	-120.22907	Bi-Annual	1418	806-1406	504	1978-2018	36	1,2
20S/17E-09N03	36.19597	-120.13880	Bi-Annual	2100	801-2067	413.9	1976-2018	45	1,2,3
20S/18E-04G01	36.21870	-120.02158	Bi-Annual	1040	600-1040	297.9	2000-2018	20	2
20S/18E-35D02	36.15212	-119.99251	Bi-Annual	1700	700-1700	272.8	1989-2018	32	1,2
20S/19E-02A01	36.22586	-119.86996	Bi-Annual	2130	869-2090	210.9	1988-2018	34	1,2
20S/19E-17M01	36.18903	-119.94072	Bi-Annual	1000	700-1000	245.9	1989-2018	34	1,2,3
21S/17E-11N01	36.10895	-120.11015	Bi-Annual	2008	628-1989	440.9	1978-2018	34	1,2
21S/18E-22E01	36.08951	-120.02142	Bi-Annual	1800	720-1780	271.9	2009-2018	13	1
21S/18E-35Q02	36.05101	-119.99421	Bi-Annual	1180	600-1180	278.1	2008-2018	13	1
21S/19E-20D02	36.09394	-119.94984	Bi-Annual	1160	449-1150	225.9	2016-2018	4	1

a. Replaces 15S/13E-22P01
1. Location of Well
2. Number of Records
3. Co-located with Subsidence Monitoring Network

Table 3-15 Subsidence Monitoring Network

Site Name	Site Type	Monitoring Agency	Latitude (NAD83)	Longitude (NAD83)	Monitoring Frequency	Depth (ft bgs)	Perforations (ft bgs)	Ground-Surface Elevation (ft NAVD88)[3]	Period of Record	Number of Measurements	Rationale[1,2,3]
DWR Yard[2]	Extensometer	USGS	36.32639	-120.23028	Continuous	1070	-	323	2011-2022	>1,000	2
Panoche	Extensometer	USGS	36.73278	-120.53139	Continuous	1358	-	288	2012-2022	>1,000	1
Rasta[2]	Extensometer	USGS	36.22611	-120.06528	Continuous	1007	-	327	2012-2022	>1,000	2
P302	CGPS	UNAVCO	36.63475	-120.61886	Continuous	-	-	402.3	2004-2022	>1,000	1
BM #1	GPS	WWD	36.10897	-120.08405	Bi-Annual	-	-	350.9	2020-2022	4	1
BM #2	GPS	WWD	36.12310	-120.03944	Bi-Annual	-	-	290.8	2020-2022	4	1
BM #3[2]	GPS	WWD	36.10879	-120.05731	Bi-Annual	-	-	303.5	2020-2022	4	2
BM #4	GPS	WWD	36.07276	-120.05712	Bi-Annual	-	-	408.3	2020-2022	4	1
BM #5	GPS	WWD	36.10145	-120.03939	Bi-Annual	-	-	281.3	2020-2022	4	1
CHK 6	GPS	WWD	36.09428	-120.02153	Bi-Annual	-	-	264.0	2020-2022	4	1
BM #7	GPS	WWD	36.09433	-119.99457	Bi-Annual	-	-	245.4	2020-2022	4	1
BM #8	GPS	WWD	36.10862	-120.00355	Bi-Annual	-	-	258.3	2020-2022	4	1
BM #9[2]	GPS	WWD	36.64744	-120.51424	Bi-Annual	-	-	306.2	2020-2022	4	2
BM #10	GPS	WWD	36.63296	-120.46939	Bi-Annual	-	-	257.2	2020-2022	4	1
BM #11	GPS	WWD	36.58924	-120.52278	Bi-Annual	-	-	437.2	2020-2022	4	1
BM #12	GPS	WWD	36.58187	-120.44273	Bi-Annual	-	-	238.7	2020-2022	4	1
BM #13	GPS	WWD	36.49514	-120.13427	Bi-Annual	-	-	194.2	2020-2022	4	1
BM #14	GPS	WWD	36.53058	-120.43390	Bi-Annual	-	-	398.7	2020-2022	4	1
BM #15	GPS	WWD	36.44331	-120.39279	Bi-Annual	-	-	447.4	2020-2022	4	1
BM #16	GPS	WWD	36.50166	-120.38885	Bi-Annual	-	-	410.2	2020-2022	4	1
Burnside	GPS	USBR	36.48784	-120.15205	Bi-Annual	-	-	196.7	2011-2021	19	1
HPGN 06 07[2]	GPS	USBR	36.50106	-120.35384	Bi-Annual	-	-	330.1	2011-2021	19	2
Murietta	GPS	USBR	36.63206	-120.31784	Bi-Annual	-	-	166.0	2011-2021	19	1
Peyton	GPS	USBR	36.70718	-120.45963	Bi-Annual	-	-	233.8	2012-2021	16	1
M 1194[2]	GPS	DWR	36.71708	-120.58603	Annual	-	-	334.7	1968-2022	26	2
A 1093[2]	GPS	DWR	36.57160	-120.47314	Annual	-	-	331.4	1967-2022	26	2
P 1093 RESET 1983[2]	GPS	DWR	36.52043	-120.36454	Annual	-	-	331.4	1967-2022	26	2
132.46 L[2]	GPS	DWR	36.46207	-120.30594	Annual	-	-	327.7	1967-2022	21	2
136.05 L RESET 1984[2]	GPS	DWR	36.41367	-120.28598	Annual	-	-	328.3	1967-2022	27	2
H 1195[2]	GPS	DWR	36.37546	-120.26347	Annual	-	-	325.1	1968-2022	25	2
E 1075[2]	GPS	DWR	36.29531	-120.14409	Annual	-	-	327.4	1967-2022	27	2
E 1097[2]	GPS	DWR	36.15257	-120.04974	Annual	-	-	322.5	1967-2022	24	2
J 1097[2]	GPS	DWR	36.11494	-120.06556	Annual	-	-	322.1	1967-2022	26	2
M 1097[2]	GPS	DWR	36.08494	-120.04511	Annual	-	-	323.8	1967-2022	26	2
13S/13E-24E02	Water Level	WWD	36.78538	-120.51260	Bi-Annual	860	560-780	223.0	2015-2018	7	1
14S/15E-32N02	Water Level	WWD	36.66479	-120.36908	Bi-Annual	986	544-986	180.5	1977-2018	43	1
15S/15E-29K01	Water Level	WWD	36.59583	-120.35703	Bi-Annual	1162	600-1162	190.6	2013-2019	9	1
16S/16E-29E01	Water Level	WWD	36.50897	-120.26163	Bi-Annual	995	675-995	244.8	1992-2018	28	1
17S/18E-33H02	Water Level	WWD	36.40831	-120.01361	Bi-Annual	1340	600-1310	216.9	2014-2019	8	1
18S/17E-09P01	Water Level	WWD	36.37167	-120.13000	Bi-Annual	1187	700-1150	268.0	1991-2018	31	1
19S/16E-35N01	Water Level	WWD	36.22637	-120.20998	Bi-Annual	2035	719-2035	432.9	1978-2018	35	1
19S/17E-28P01	Water Level	WWD	36.24105	-120.13212	Bi-Annual	2018	716-2005	368.0	1987-2018	35	1
19S/18E-04C01	Water Level	WWD	36.31356	-120.02182	Bi-Annual	1620	866-1600	266.9	2008-2018	15	1
19S/19E-29A01	Water Level	WWD	36.25485	-119.92323	Bi-Annual	1423	718-1423	237.9	1990-2018	31	1
20S/17E-09N03	Water Level	WWD	36.19597	-120.13880	Bi-Annual	2100	801-2067	413.9	1976-2018	45	1
20S/19E-17M01	Water Level	WWD	36.18903	-119.94072	Bi-Annual	1000	700-1000	245.9	1989-2018	34	1

1. Location of Site
2. Site adjacent San Luis Canal (California Aqueduct)
3. Elevation at time of installation

**Table 3-16: Monitoring Network for Water Quality
Upper Aquifer**

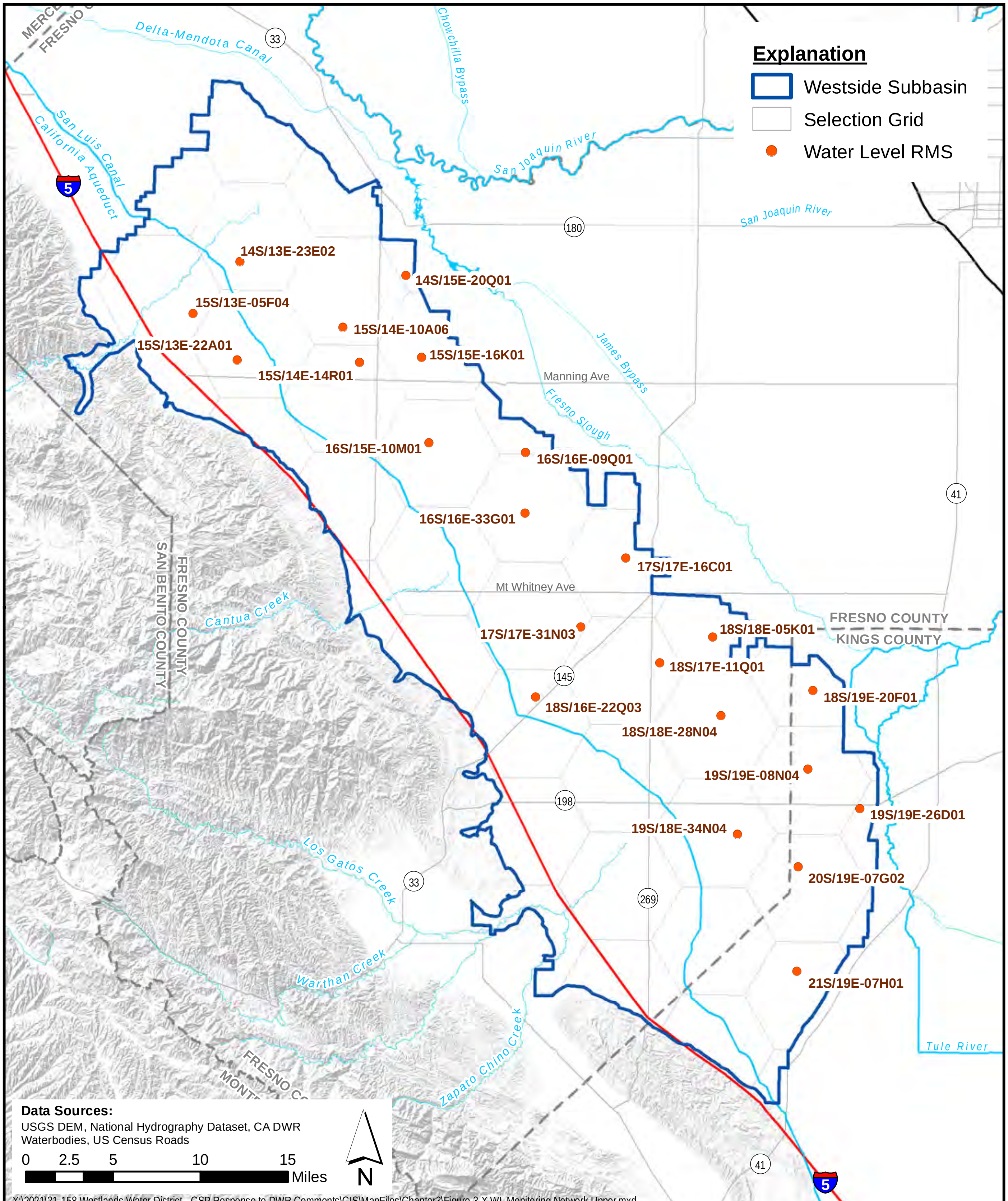
Well Name	Latitude (NAD83)	Longitude (NAD83)	Monitoring Frequency	Depth (ft bgs)	Perforations (ft bgs)	Ground-Surface Elevation (ft NAVD88)	Period of Record	Number of Measurements	Rationale[1,2,3]
22S/18E-11C03[a]	36.03588	-119.99847	Annual	840	400-840	343	2015-2022	4	1
MW-2A[a,b]	36.07702	-120.07525	Annual	370	330-360	445	2020	2	1,3
14S/15E-20Q01	36.69083	-120.36034	Annual	205	115-205	171	-	-	1,2
15S/13E-05F04	36.65638	-120.57873	Annual	215	199-209	409	1989	1	1,2,3,4
15S/13E-22A01	36.61850	-120.53256	Annual	379	363-373	435	1989	1	1,2,3,4
15S/14E-10A06	36.64697	-120.42445	Annual	582	150-582	225	-	-	1,2
15S/14E-14R01	36.61810	-120.40669	Annual	1055	465-1055	207	-	-	1,2
16S/15E-10M01	36.55198	-120.33427	Annual	560	320-540	239	-	-	1,2
16S/16E-09Q01	36.54519	-120.23450	Annual	580	280-560	195	-	-	1,2
16S/16E-33G01	36.49476	-120.23433	Annual	520	300-520	234	-	-	1,2
17S/17E-16C01	36.45839	-120.13030	Annual	480	270-480	211	-	-	1,2
17S/17E-31N03	36.40062	-120.17558	Annual	780	498-738	253	-	-	1,2
18S/17E-11Q01	36.37182	-120.09403	Annual	630	350-630	257	-	-	1,2,4
18S/18E-28N04	36.32833	-120.03050	Annual	670	300-660	263	-	-	1,2
18S/19E-20F01	36.35013	-119.93664	Annual	604	244-604	226	-	-	1,2
19S/19E-08N04	36.28475	-119.94090	Annual	620	300-620	237	-	-	1,2
19S/19E-26D02	36.25259	-119.88725	Annual	580	300-580	221	-	-	1,2
19S/19E-31N03	36.22663	-119.95370	Annual	N/A	N/A	257	-	-	1,4
20S/17E-29J01	36.15700	-120.13878	Annual	500	350-490	428	-	-	1,4
21S/18E-28Q02	36.01700	-119.97800	Annual	630	400-630	353	1996-2014	14	1,3
21S/19E-07H01	36.11684	-119.95004	Annual	790	286-770	232	-	-	1,2
FC-3 Shallow	36.42991	-120.04924	Annual	665	300-350	214	-	-	1,4

a. SMC is Assigned
b. Well Located Directly Adjacent to Targeted Hexagon due to Lack of Available Upper Aquifer Wells
1. Well Location
2. Co-located with Groundwater Level Monitoring Site
3. Number of Water Quality Records
4. GQMT Well

Table 3-17: Monitoring Network for Water Quality
Lower Aquifer

Well Name	Latitude (NAD83)	Longitude (NAD83)	Monitoring Frequency	Depth (ft bgs)	Perforations (ft bgs)	Ground-Surface Elevation (ft NAVD88)	Period of Record	Number of Measurements	Rationale[1,2,3]
17S/18E-33H02[a]	36.40831	-120.01361	Annual	1340	600-1310	217	-	-	1,2
18S/18E-01R02[a]	36.38645	-119.95955	Annual	1281	598-1281	218	2018	1	1,2
21S/18E-28G06[a]	36.07275	-120.02917	Annual	2045	617-2045	335	2015	8	1,3
21S/19E-20D02[a]	36.09394	-119.94984	Annual	1160	449-1150	226	2021	1	1,2
13S/13E-24E02	36.78538	-120.51260	Annual	860	560-780	223	-	-	1,2
14S/15E-32N02	36.66479	-120.36908	Annual	986	544-986	181	-	-	1,2
15S/12E-13D01	36.62694	-120.61508	Annual	998	698-998	553	-	-	1,2
15S/13E-02P01	36.64960	-120.52410	Annual	1244	884-1244	338	-	-	1,2
15S/14E-31N03	36.57501	-120.49656	Annual	1918	915-1800	373	-	-	1,2
15S/15E-04A03	36.66072	-120.33393	Annual	1000	600-1000	165	-	-	1,2
15S/15E-29K01	36.59583	-120.35703	Annual	1162	600-1162	191	-	-	1,2
16S/14E-36E01	36.49438	-120.40687	Annual	2200	841-2104	478	-	-	1,2
16S/16E-10Q01	36.54539	-120.21163	Annual	965	645-945	188	-	-	1,2
18S/15E-15D01	36.36883	-120.33744	Annual	2583	1788-2488	541	-	-	1,2
18S/17E-09P01	36.37167	-120.13000	Annual	1187	700-1150	268	-	-	1,2
19S/18E-04C01	36.31356	-120.02182	Annual	1620	866-1600	267	-	-	1,2
20S/19E-02A01	36.22586	-119.86996	Annual	2130	869-2090	211	-	-	1,2
20S/19E-17M01	36.18903	-119.94072	Annual	1000	700-1000	246	-	-	1,2
14S/12E-25D01	36.69148	-120.61966	Annual	1001	649-1001	397	1991-2015	7	1,3
16S/14E-11G02	36.55368	-120.41583	Annual	1672	716-1672	312	1992-2009	5	1,3
16S/15E-21L01	36.52295	-120.34341	Annual	1210	670-1190	291	2014-2015	7	1,3
16S/17E-28M02	36.50863	-120.13392	Annual	1040	640-1040	193	2001-2012	4	1,3
17S/16E-01N03	36.47414	-120.19386	Annual	1220	610-1200	217	2014-2015	7	1,3
18S/16E-06F01	36.39410	-120.27433	Annual	2996	1203-2690	323	1992-2015	7	1,3
18S/16E-15N02	36.35657	-120.22958	Annual	2050	763-2009	295	1991-2008	5	1,3
19S/18E-24N01	36.25635	-119.97668	Annual	2114	700-2020	266	1992-2002	4	1,3
20S/17E-14K01	36.18842	-120.09414	Annual	2160	782-2140	367	2013-2015	9	1,3
20S/18E-03N03	36.21153	-120.01250	Annual	1800	800-1800	290	1994-2000	2	1,3
21S/18E-08B01	36.12303	-120.04828	Annual	1570	780-1550	308	2014-2015	7	1,3

a. SMC is Assigned
1. Well Location
2. Co-located with Groundwater Level Monitoring Site
3. Number of Water Quality Records



Luhdorff & Scalmanini
Consulting Engineers

Representative Monitoring Sites for Groundwater Levels (Upper Aquifer)

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-1

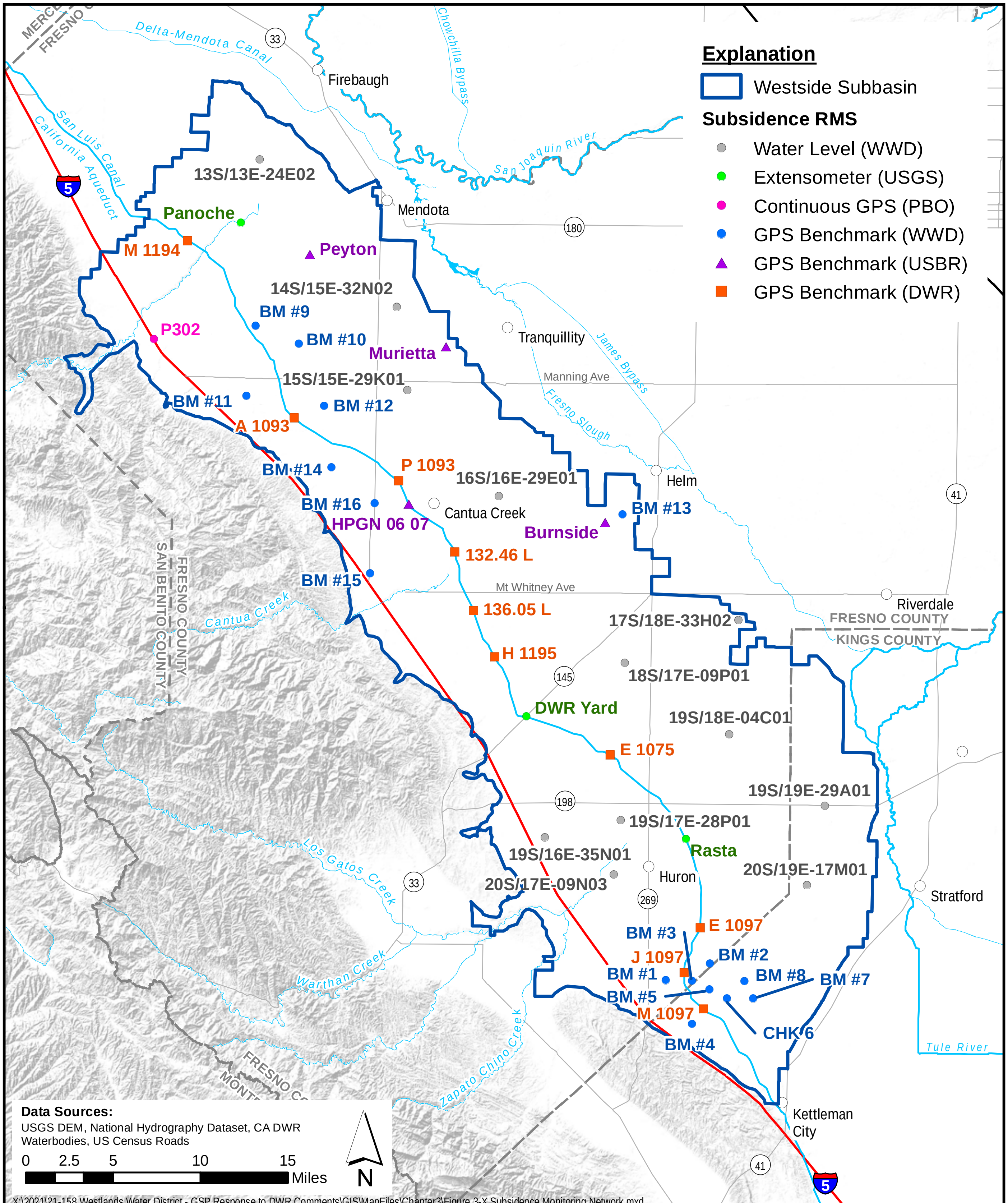
X:\2021\21-158 Westlands Water District - GSP Response to DWR Comments\GIS\MapFiles\Chapter3\Figure 3-X WL Monitoring Network Lower.mxd

Luhdorff & Scalmanini
Consulting Engineers

Representative Monitoring Sites for Groundwater Levels (Lower Aquifer)

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-2

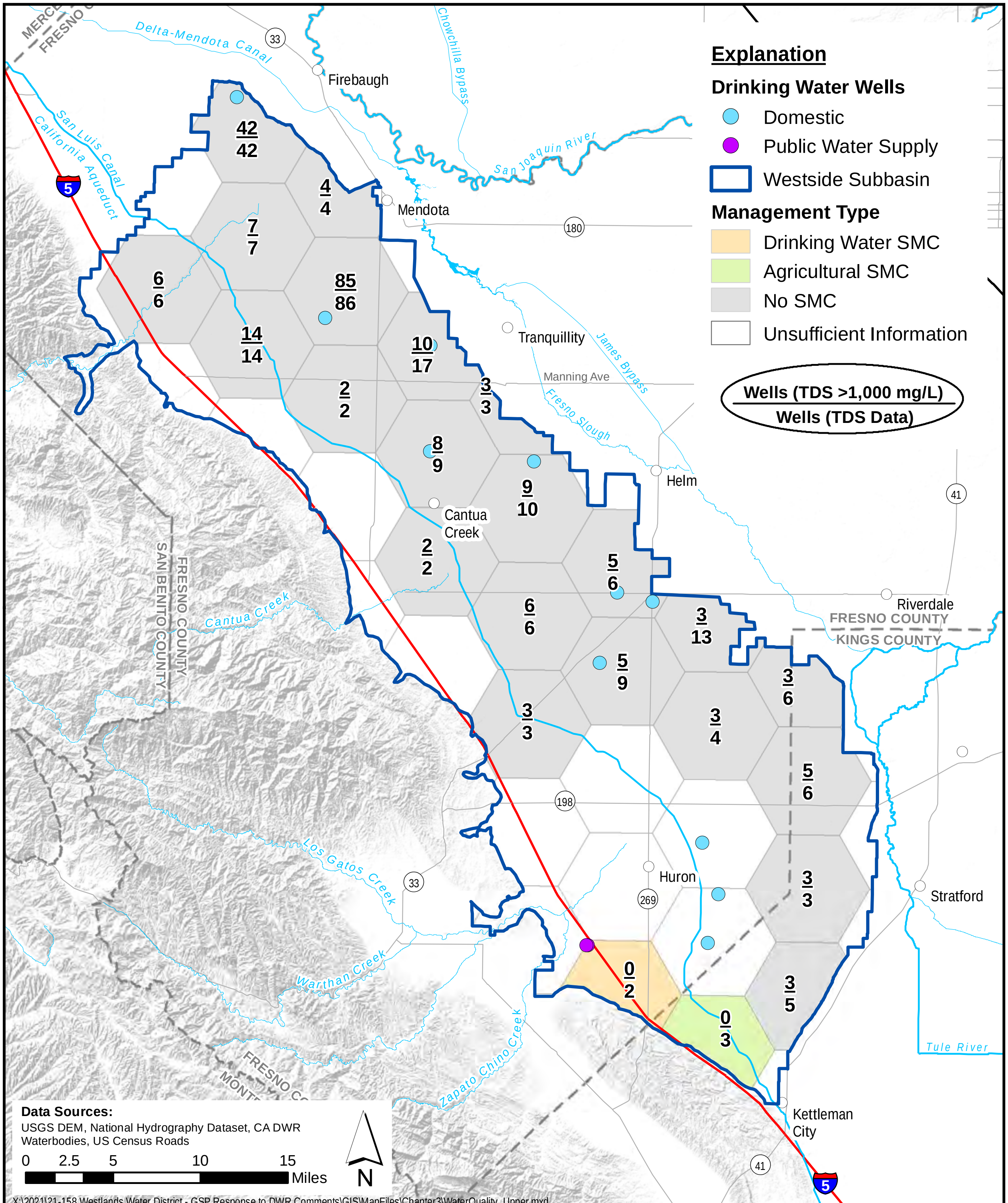


Luhdorff & Scalmanini Consulting Engineers

Representative Monitoring Sites for Land Surface Subsidence

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-3



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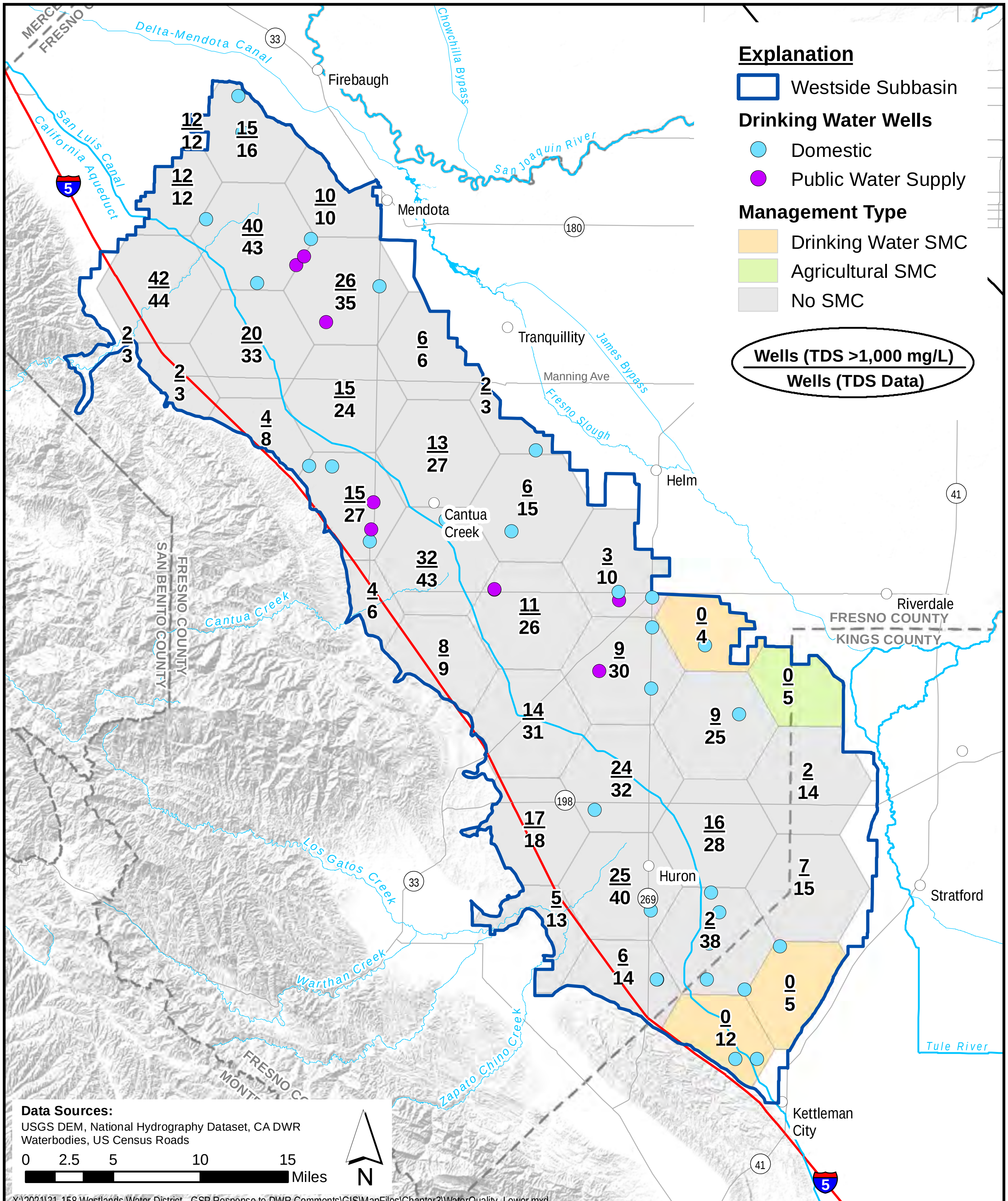
Consulting Engineers

Summary of Measured TDS in Groundwater Wells (Upper Aquifer)

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-4

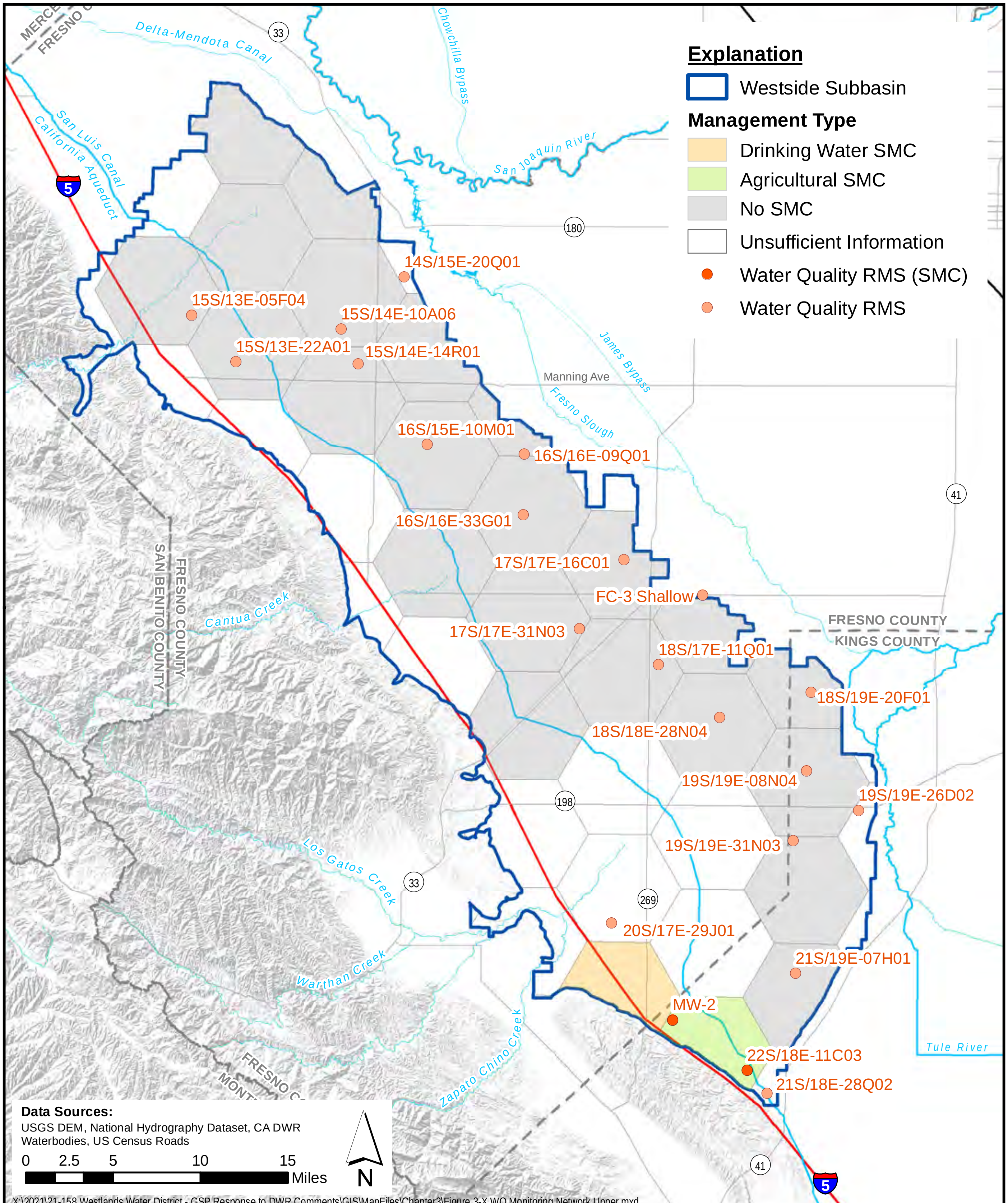


Luhdorff & Scalmanini Consulting Engineers

Summary of Measured TDS in Groundwater Wells (Lower Aquifer)

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-5

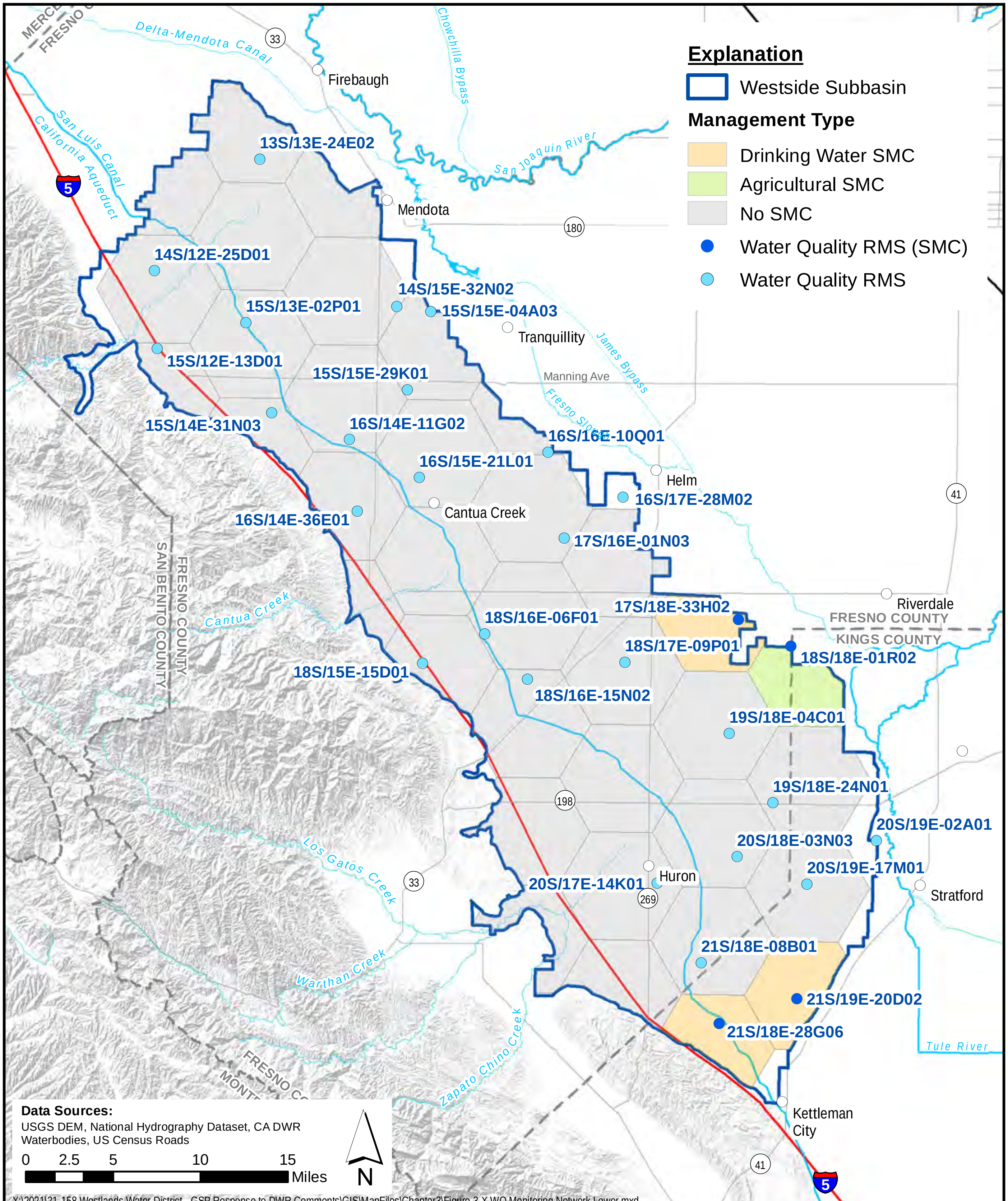


Luhdorff & Scalmanini Consulting Engineers

Representative Monitoring Sites for Groundwater Quality (Upper Aquifer)

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-6

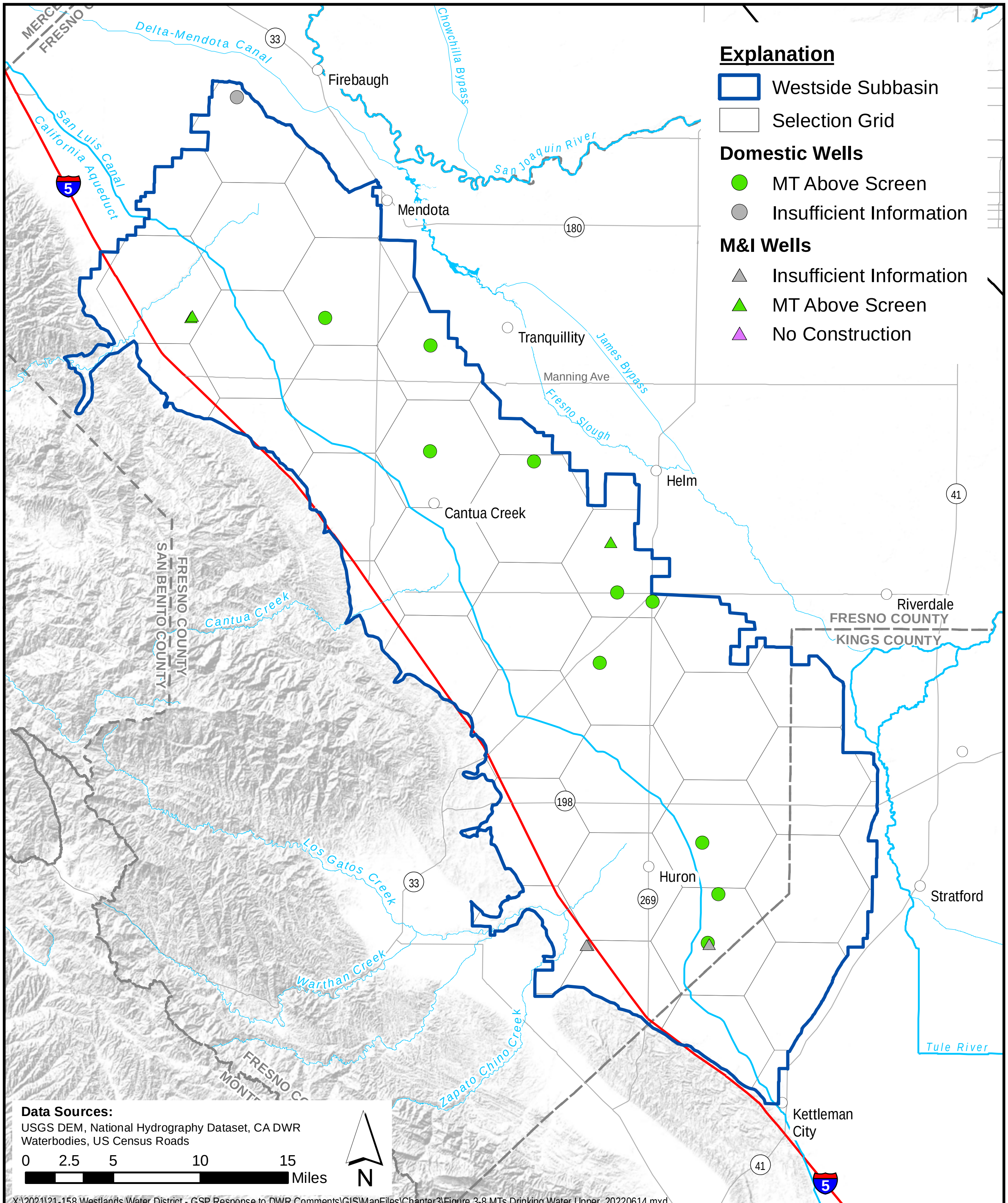


Luhdorff & Scalmanini Consulting Engineers

Representative Monitoring Sites for Groundwater Quality (Lower Aquifer)

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-7

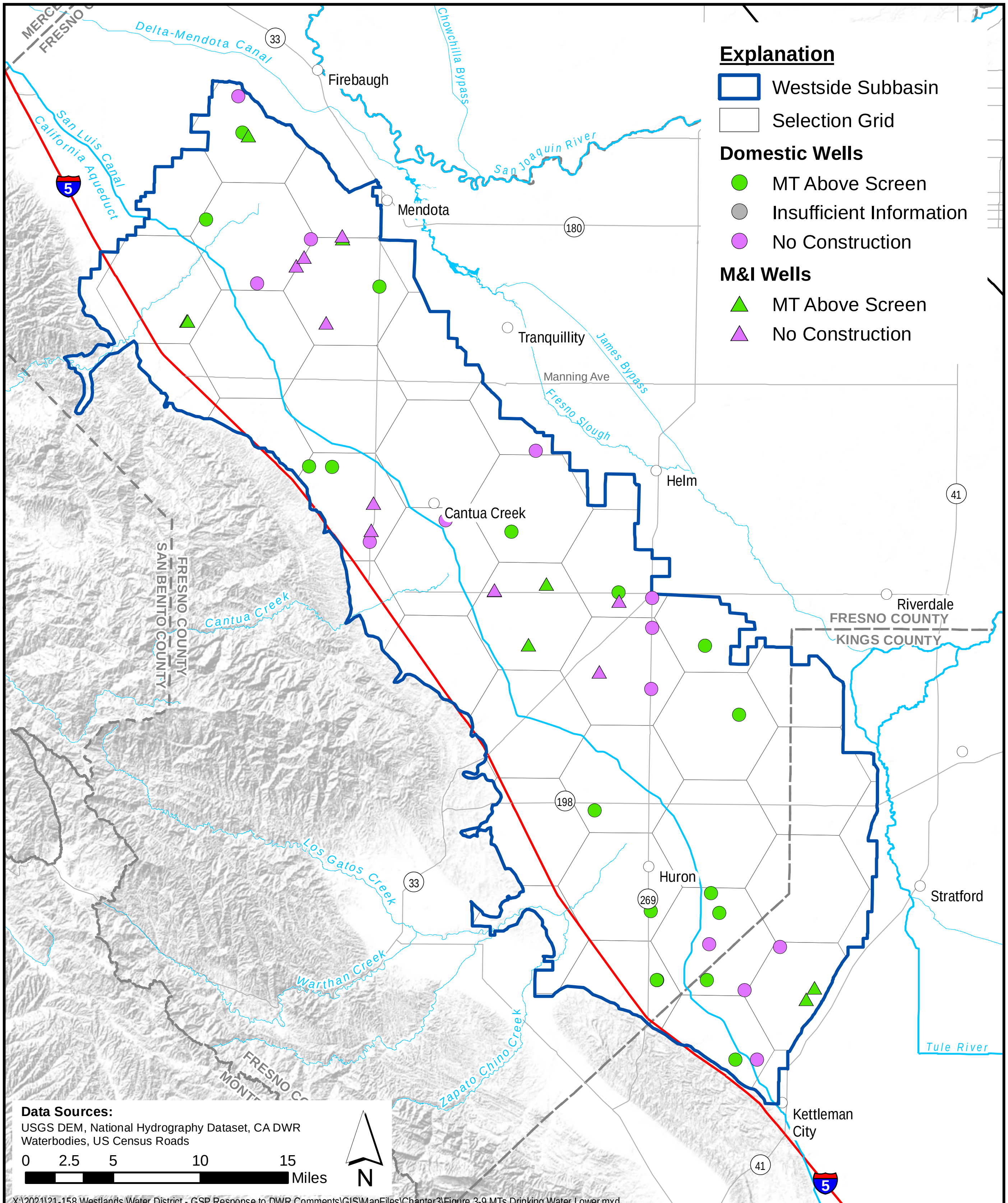


Luhdorff & Scalmanini Consulting Engineers

Comparison of Domestic and M&I Well Construction to Minimum Thresholds (Upper Aquifer)

Figure 3-8

SGMA Sustainability Analyses
Westside Subbasin



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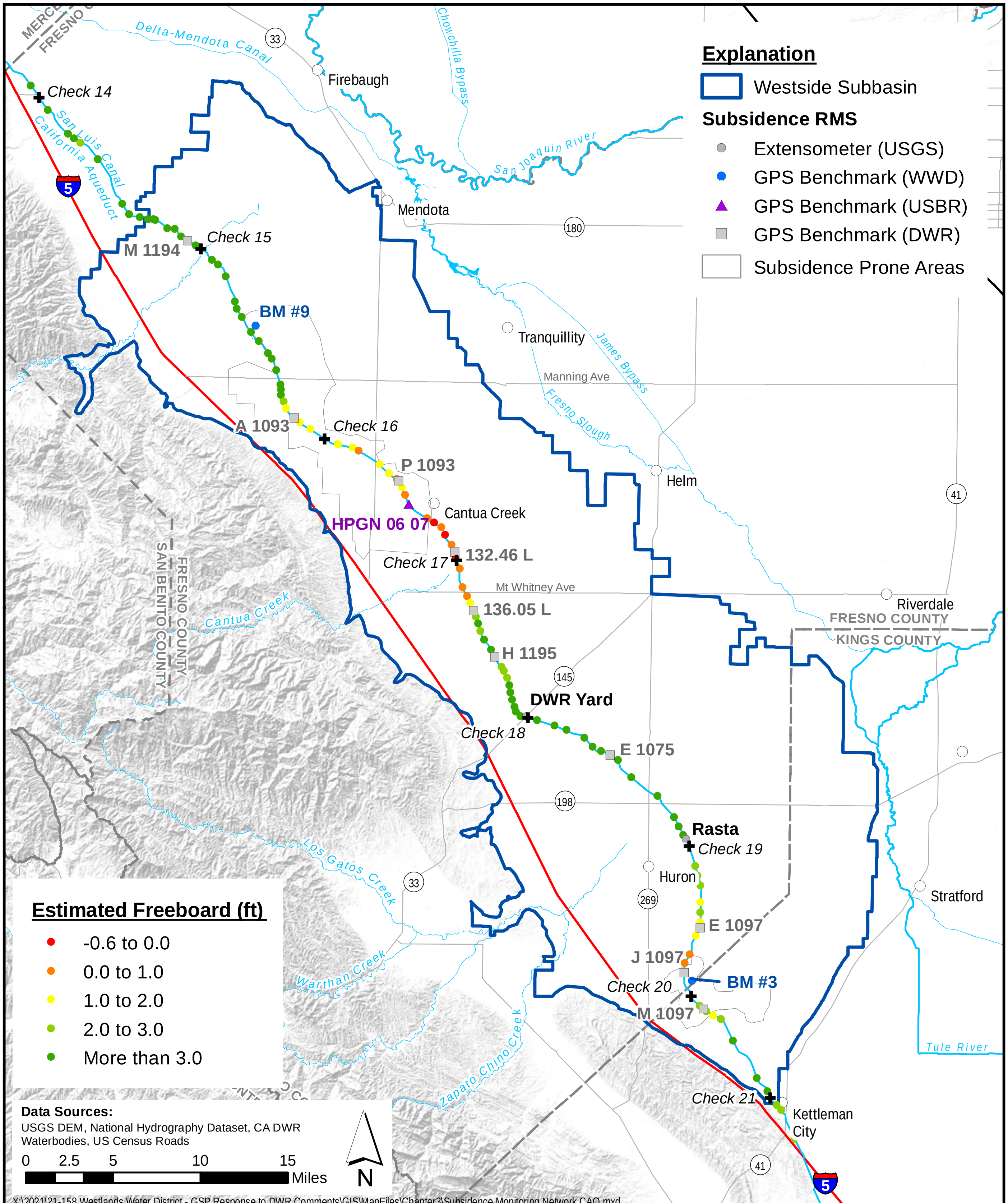
Comparison of Domestic and M&I Well Construction to Specified Minimum Thresholds (Lower Aquifer)

Figure 3-9

SGMA Sustainability Analyses
Westside Subbasin

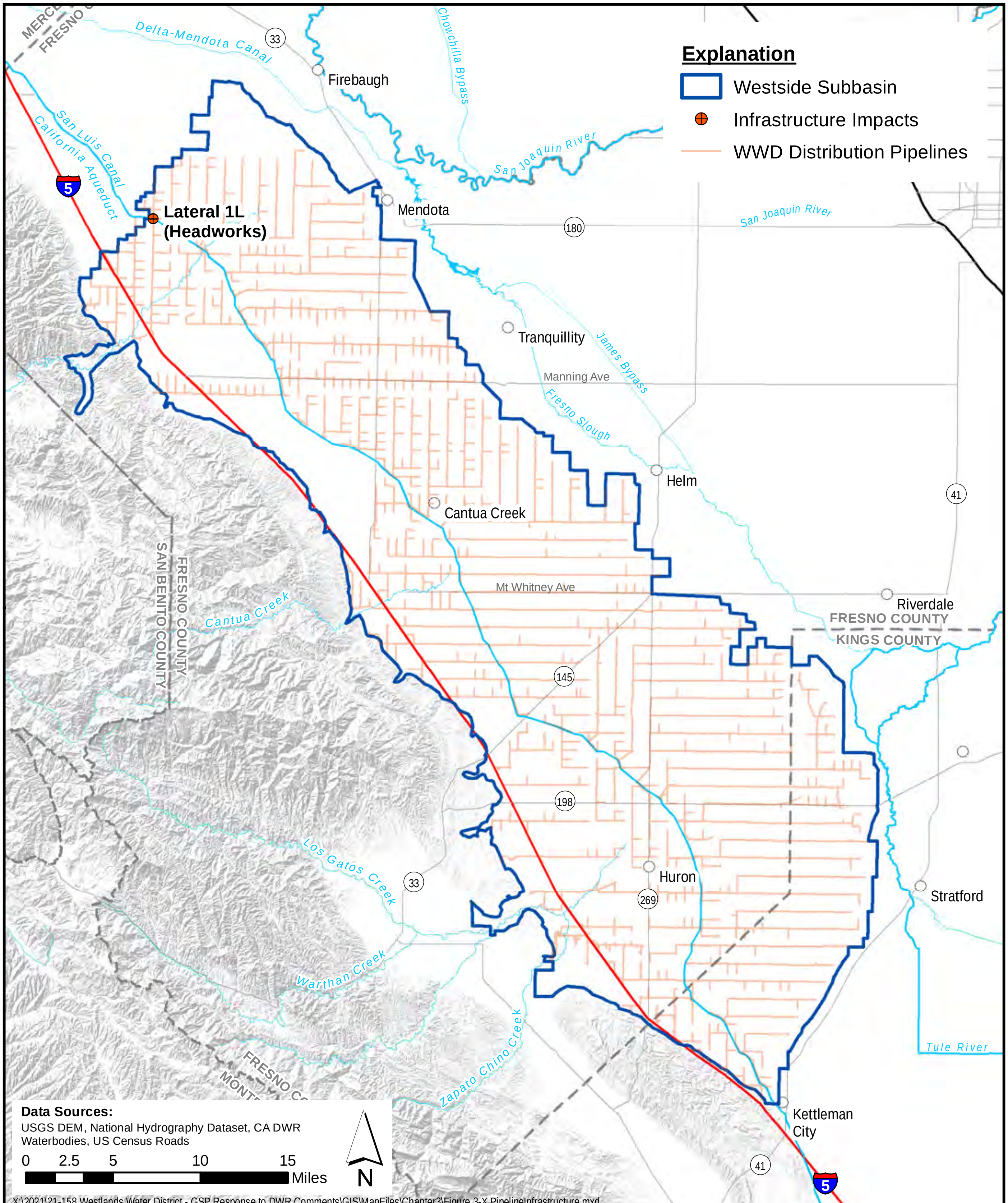


Luhdorff & Scalmanini
Consulting Engineers

Available Freeboard in the San Luis Canal Design Water Surface Elevation (2022)

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-10

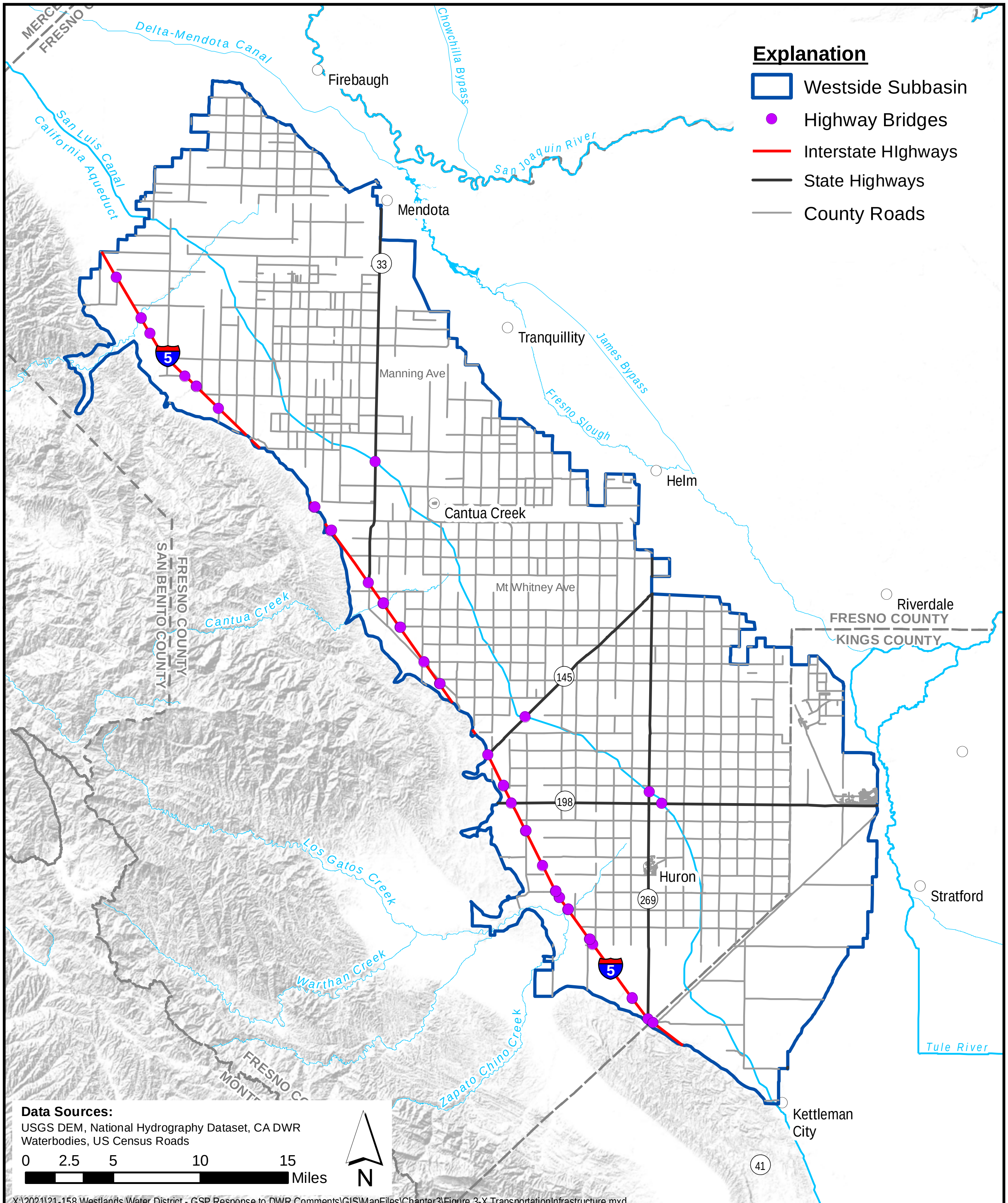


Luhdorff & Scalmanini
Consulting Engineers

Subsidence Impacts to Pipelines and Turnout Structures

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-11

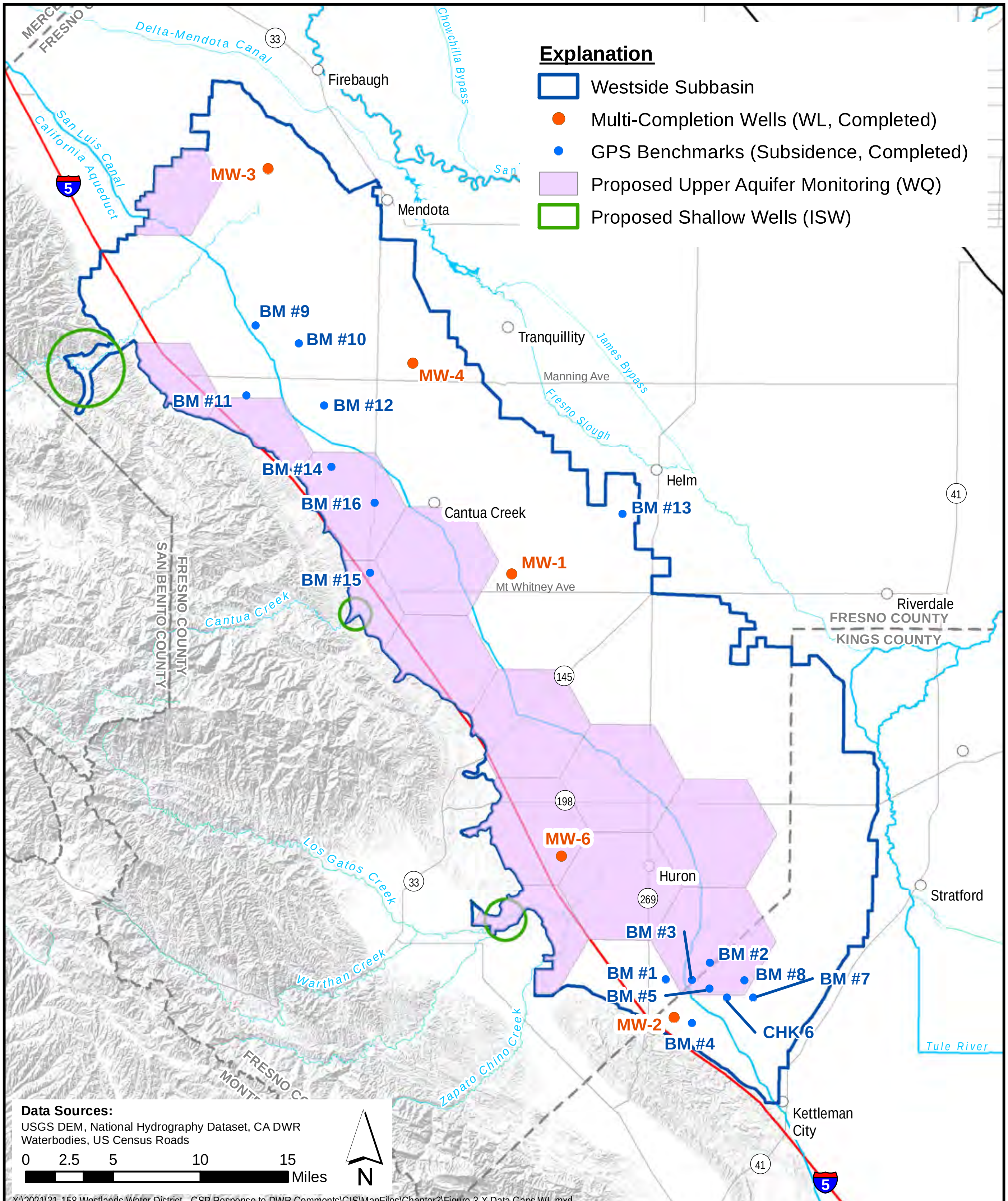


Luhdorff & Scalmanini Consulting Engineers

Transportation Infrastructure that may be Potentially Impacted by Subsidence

SGMA Sustainability Analyses
Westside Subbasin

Figure 3-12



Luhdorff & Scalmanini Consulting Engineers

Sites and Areas to Remedy Monitoring Data Gaps

SGMA Sustainability Analyses Westside Subbasin

Figure 3-13

4 PROJECTS AND MANAGEMENT ACTIONS TO ACHIEVE SUSTAINABILITY GOAL

SGMA defines "sustainable yield" as the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result (Wat. Code §10721(w)). "[S]ustainable groundwater management" is the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results (Wat. Code §10721(v)). This **Chapter 4** sets forth the Projects and management actions (PMAs) that were developed to address sustainability goals, measurable objectives, and avoid causing undesirable results identified in the Subbasin during the planning period and the implementation horizon. When developing the PMAs, efforts were made by the GSA to reduce potential socioeconomic impacts. The potential undesirable results that have been identified for the Subbasin are (i) chronic lowering of groundwater levels, (ii) significant and unreasonable reduction of groundwater storage, (iii) significant and unreasonable land subsidence and (iv) significant and unreasonable degradation of water quality.

The GSP Regulations require that a summary of the PMAs include the following:

a. "Each Plan shall include a description of the projects and management actions the GSA has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.

b. Each Plan shall include a description of the projects and management actions that include the following:

   1. A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:

      A. A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

      B. The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

   2. If overdraft conditions are identified through the analysis required by California Code of Regulations (CCR) Section 354.18 [Water Budget], the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

   3. A summary of the permitting and regulatory process required for each project and management action.

   4. The status of each project and management action, including a timetable for expected

initiation and completion, and the accrual of expected benefits.

5. An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.
6. An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall beincluded.
7. A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.
8. A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.
9. A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

c. Projects and management actions shall be supported by best available information and best available science.

d. "An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions" (GSP Regulations §354.44).

e. The description of minimum thresholds shall describe "[h]ow the minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals. (GSP Regulations §354.28(b)(3); see Water Code §10733(c).)

4.1 Project No. 1 – Surface Water Imports

Historically, surface water imports supplied the majority of agricultural, municipal and industrial water demand the Subbasin. This is expected to continue reducing the demand and reliance on groundwater within the Westside Subbasin during the 50-year GSP planning and implementation horizon. Because Project No. 1 improves both the reliability and availability of surface water it serves to reduce the Subbasin's reliance on groundwater, this helps achieve the sustainability goal. The primary source of imported water will continue to be the Central Valley Project (CVP). The District began importing water in the 1960's and its demand for imported water is not expected to materially change during the implementation and planning horizon as a result of the proposed PMAs. However, as part of the GSP preparation, the amount and reliability of available imported surface water was evaluated to accurately quantify the projected water budget within the Subbasin during the 50-year planning and implementation period. The District expects to benefit from recent regulatory actions increasing the reliability of CVP deliveries and to supplement its CVP water supplies with water made available from willing sellers through water transfer and/or exchange programs as set forth in **Section 4.1.1**.

4.1.1 Project Description

The District's CVP contract entitlement totals approximately 1,197,000 AF, which is delivered through the San Luis Canal or from the Mendota Pool via Laterals 6 and 7. Historically, there has been a direct relationship between the availability of the District's CVP contract for surface water and the amount of groundwater pumped within the Subbasin. The greater the availability of surface water in any year, the less reliance there is upon groundwater in the Subbasin to meet overlying demands in that year. In a given year, CVP deliveries may be stored in the San Luis Reservoir and rescheduled for delivery in subsequent years depending on water demand and operational constraints. Historically, the United States Bureau of Reclamation (USBR) has not provided the full contract amount of project water to the District. From 1988 through 2017, net CVP deliveries averaged approximately 645,000 AF per year, or about 54% of the total 1,197,000 AF contract entitlement amount. Changes in how the CVP is regulated or how the climate may change will likely affect the quantity and reliability of the District's CVP contract entitlement. Current modeling of CVP operations suggests that, with existing regulation of CVP operations, over a longer period of time, and with some change in climate, the District can expect on average approximately 513,000 AFY or about 43% of Westland's 1,197,000 AF CVP contract entitlement (**Figure 4-1, Table 4-1**).

Table 4-1: Projected Surface Water Deliveries by USBR Water Contract Year (2020-2070)

Historic Water Year	Projected Water Year	Water Year Type[1]	CVP Allocation[2] (AF)	COA Benefit[3] (AF)	Total CVP Delivery (AF)	Supplemental WWD & W.U. Transfers[4] (AF)	Total Imported Water (AF)
1965	2020	W	612,000	48,000	660,000	143,000	803,000
1966	2021	BN	653,000	67,000	720,000	143,000	863,000
1967	2022	W	1,159,000	48,000	1,207,000	98,000	1,305,000
1968	2023	BN	465,000	67,000	533,000	143,000	676,000
1969	2024	W	1,190,000	48,000	1,238,000	98,000	1,336,000
1970	2025	W	553,000	48,000	600,000	143,000	743,000
1971	2026	W	380,000	48,000	428,000	196,000	624,000
1972	2027	BN	154,000	67,000	222,000	151,000	373,000
1973	2028	AN	652,000	72,000	724,000	143,000	867,000
1974	2029	W	725,000	48,000	773,000	218,000	991,000
1975	2030	W	692,000	48,000	739,000	143,000	882,000
1976	2031	C	449,000	74,000	523,000	143,000	666,000
1977	2032	C	2,000	74,000	76,000	151,000	227,000
1978	2033	AN	626,000	72,000	698,000	143,000	841,000
1979	2034	BN	531,000	67,000	598,000	143,000	741,000
1980	2035	AN	694,000	72,000	766,000	218,000	984,000
1981	2036	D	528,000	85,000	613,000	143,000	756,000
1982	2037	W	1,040,000	48,000	1,088,000	98,000	1,186,000
1983	2038	W	1,190,000	48,000	1,238,000	98,000	1,336,000
1984	2039	W	693,000	48,000	740,000	143,000	883,000
1985	2040	D	429,000	85,000	514,000	143,000	657,000
1986	2041	W	557,000	48,000	604,000	143,000	747,000
1987	2042	D	93,000	85,000	178,000	151,000	329,000
1988	2043	C	2,000	74,000	76,000	151,000	227,000
1989	2044	D	209,000	85,000	295,000	196,000	491,000
1990	2045	C	2,000	74,000	76,000	151,000	227,000
1991	2046	C	173,000	74,000	247,000	151,000	398,000
1992	2047	C	237,000	74,000	311,000	196,000	507,000
1993	2048	AN	712,000	72,000	784,000	218,000	1,002,000
1994	2049	C	320,000	74,000	394,000	196,000	590,000
1995	2050	W	740,000	48,000	787,000	218,000	1,005,000
1996	2051	W	1,030,000	48,000	1,078,000	98,000	1,176,000
1997	2052	W	560,000	48,000	608,000	143,000	751,000
1998	2053	W	1,190,000	48,000	1,237,000	98,000	1,335,000
1999	2054	W	692,000	48,000	740,000	143,000	883,000
2000	2055	AN	495,000	72,000	567,000	143,000	710,000
2001	2056	D	116,000	85,000	201,000	151,000	352,000
2002	2057	D	328,000	85,000	414,000	196,000	610,000
2003	2058	AN	546,000	72,000	618,000	143,000	761,000
2004	2059	BN	605,000	67,000	672,000	143,000	815,000
2005	2060	AN	456,000	72,000	528,000	143,000	671,000
2006	2061	W	1,190,000	48,000	1,237,000	98,000	1,335,000
2007	2062	D	206,000	85,000	291,000	196,000	487,000
2008	2063	C	2,000	74,000	76,000	151,000	227,000
2009	2064	D	116,000	85,000	201,000	151,000	352,000
2010	2065	BN	425,000	67,000	492,000	196,000	688,000
2011	2066	W	553,000	48,000	600,000	143,000	743,000
2012	2067	BN	573,000	67,000	640,000	143,000	783,000
2013	2068	D	93,000	85,000	178,000	151,000	329,000
2014	2069	C	53,000	74,000	128,000	151,000	279,000
2015	2070	C	237,000	74,000	311,000	196,000	507,000
Annual Average			508,000	66,000	574,000	153,000	727,000
Percent of Allocation			43%	6%	49%	13%	61%

1. Sacramento Valley Water Year Type
2. Projected from Coordinated Long-Term Operation of the Central Valley Project and State Water Project
3. Estimated from 2018 Ammendment to Coordinated Operation Agreement
4. Estimated from Historic Supplemental Water Supply based on CVP Allocation

Operation of the SWP and CVP is coordinated through the Agreement between the United States of America and the State of California for Coordinated Operation of the Central Valley Project and the State Water Project (COA), which was executed in 1986 (USBR, 1986). Due to updates to project facilities and changes to regulatory requirements since 1986, the United States and the State of California agreed to amend the COA (2018 Addendum) (U.S. Department of the Interior, 2018, **Figure 4-2**). With the 2018 Addendum, the District expects the amount of its CVP contract entitlement to increase by between 48,000 AF in wet water years to 85,000 AF in dry years (**Figure 4-3**). On a long-term average, the District can expect that with the 2018 Addendum, the District will receive an additional 65,000 AF of CVP water (**Table 4-1**). The historical experience within the District is that landowners principally rely upon surface water to meet their irrigation needs. This increase in imported water supply availability and reliability will satisfy a portion of the overlying demands within the Subbasin and is expected to reduce groundwater use by a commensurate amount.

Additionally, the District will seek to supplement available CVP contract entitlement with water made available through transfers and exchanges. Historically, imported water as a result of transfers and exchanges is generally delivered through the San Luis Canal or through Laterals 6 and 7 in the Mendota Pool. From 1988 to 2017, supplemental supplies averaged approximately 180,000 AFY (**Table 4-2**).

Table 4-2: Westlands Water District Surface Water Supply (1988 - 2017)

WY	WY Index	CVP Allocation (%)	Net CVP (AF)	Water User Acquired (AF)	Supplemental District Supply (AF)	Total Supplemental Supply (AF)
1988	C	100%	1,150,000	7,657	97,712	105,369
1989	D	100%	1,035,369	20,530	99,549	120,079
1990	C	50%	625,196	18,502	-2,223	16,279
1991	C	27%	229,666	22,943	77,399	100,342
1992	C	27%	208,668	42,623	100,861	143,484
1993	AN	54%	682,833	152,520	82,511	235,031
1994	C	43%	458,281	56,541	108,083	164,624
1995	W	100%	1,021,719	57,840	121,747	179,587
1996	W	95%	994,935	92,953	172,609	265,562
1997	W	90%	968,408	94,908	261,085	355,993
1998	W	100%	945,115	54,205	162,684	216,889
1999	W	70%	806,040	178,632	111,144	289,776
2000	AN	65%	695,693	198,294	133,314	331,608
2001	D	49%	611,267	75,592	135,039	210,631
2002	D	70%	776,526	106,043	64,040	170,083
2003	AN	75%	863,150	107,958	32,518	140,476
2004	BN	70%	800,704	96,872	44,407	141,279
2005	AN	85%	996,147	20,776	98,347	119,123
2006	W	100%	1,076,461	45,936	38,079	84,015
2007	D	50%	647,864	87,554	61,466	149,020
2008	C	40%	347,222	85,421	102,862	188,283

WY	WY Index	CVP Allocation (%)	Net CVP (AF)	Water User Acquired (AF)	Supplemental District Supply (AF)	Total Supplemental Supply (AF)
2009	D	10%	202,991	68,070	70,149	138,219
2010	BN	45%	590,059	71,296	79,242	150,538
2011	W	80%	876,910	60,380	191,686	252,066
2012	BN	40%	405,451	111,154	123,636	234,790
2013	D	20%	188,448	101,413	143,962	245,375
2014	C	0%	98,573	59,714	26,382	86,096
2015	C	0%	82,429	51,134	34,600	85,734
2016	BN	5%	9,204	72,154	174,374	246,528
2017	W	100%	911,307	-50,009	174,490	124,481

Based upon historical experience and expected regulatory and hydrologic conditions, future projections of the total amount of water that would be imported to supplement the District's CVP contract entitlement vary by water year. The quantities of additional imported water supplies are estimated to be 90,000 AF on an average annual basis when the District's allocation of CVP water exceeds 1,000,000 AF and 218,000 AF on an average annual basis when the District's allocation of CVP water is between 750,000 and 1,000,000 AF (**Figure 4-4**). The average annual projected amount of supplemental, imported water is shown in **Table 4-1**. The projected, supplemental water averages 154,000 AFY over the 50-year planning and implementation period. When added to projected CVP deliveries, the total annual surface water deliveries are projected to average 732,000 AF per year (**Figure 4-5**). This PMA encourages water users to utilize imported surface water annually when available, in lieu of groundwater pumping, to provide recharge benefits to the aquifer system and to increase groundwater storage and levels. During periods when surface water supplies are curtailed, water users may utilize stored groundwater to meet water demands. This strategy is intended to improve the opportunities and likelihood of replenishing the Subbasin and reduce the risk of groundwater overdraft.

4.1.2 Implementation

The District will continue to rely on its CVP contacts and acquire supplemental water whenever possible. It is projected that the District and its users will continue to import water during the 50-year GSP horizon.

4.1.2.1 Circumstance for Implementation

It is anticipated that the improvement in the availability and reliability of imported surface water will continue to serve as the primary PMA to avoid undesirable results within the Subbasin. The District and its water users are continually engaged in maintaining existing and developing new sources, infrastructure and regulatory approval to ensure the sustained delivery of surface water to the District. As an ongoing conjunctive use strategy, the criteria for importing surface water through the CVP and other sources are based on the CVP allocation determined by USBR and availability of other non-project water for purchase in combination with economic factors informing individual water users management decisions. If actual results vary from expectations, corresponding adjustments can be made in other management measures to avoid undesirable results during the planning and implementation period.

4.1.2.2 Timeline for Implementation and Accrual of Expected Benefits

CVP deliveries commenced in 1968 and are contracted to continue through the GSP planning and implementation horizon. The District is currently in the process of securing a long-term CVP contract to ensure continued surface water deliveries throughout the planning and implementation horizon. Benefits are continually accrued through the lifespan of the CVP deliveries to the Subbasin. It is expected that these benefits will continue to accrue during GSP implementation and throughout the planning horizon particularly in wet years when groundwater storage increases due to the increased use of imported water and the resulting in lieu recharge.

4.1.2.3 Legal Authority

The GSA has the legal authority to import surface water. Section 10726.2(b) of the California Water Code grants a GSA the authority to "[a]ppropriate and acquire surface water or groundwater and surface water or groundwater rights" as well as "import surface water or groundwater … for any purpose necessary or proper to carry out the provisions of [SGMA]." A GSA also has the power to "[t]ransport, reclaim, purify, desalinate, treat or otherwise manage … waters for subsequent use in a manner that is necessary or proper to carry out the purposes of [SGMA]." (Water Code, § 10726.2(e).) SGMA provides the GSA with the authority to import surface water to manage groundwater resources within the Subbasin.

The legal authority for the District to import surface water is held in a multitude of state and federal codes and statutes. Below are considered key laws providing for and regulating the import and transfer of water into the District.

Federal laws allowing for the import, distribution and transfer of water include:

1. Section 3405(a) of the Central Valley Project Improvement Act, which states that all individuals or districts may "transfer all or a portion of the water subject to such contract to any other California water user or water agency."
2. Warren Act of 1911 (Pub. L. No. 61-406), which allows for the use of federal facilities in the transfer of non-project water.

California State laws allowing for the import and distribution of water by a water district are contained in:

1. Division 13 of the California Water Code which allowed for the formation of Westlands Water District in 1952 and grants the district the power to finance and distribute water.
2. Section 475 of the California Water Code which states that "The Legislature hereby finds and declares that voluntary water transfers between water users can result in a more efficient use of water, benefitting both the buyer and the seller."
3. Water Code section 35401 (Acquisition and Operation of Works) which states: "A district may acquire, plan, construct, maintain, improve, operate, and keep in repair the necessary works for the production, storage, transmission, and distribution of water for irrigation, domestic, industrial, and municipal purposes, and any drainage or reclamation works connected therewith or incidental thereto."

4. Water Code section 35403 (Contracts for Water) which states: "A district may contract to perform and perform any agreement for the transfer or delivery pursuant to Chapter 5 of this part of any irrigation system, canals, rights of way, or other property owned or acquired by the district in exchange for the right to receive and use water or a water supply to be furnished to the district by the other party."
5. Water Code section 35405 (Conveyances of Property) which states: "A district may take conveyances, contracts, leases, or other assurances for property acquired by the district pursuant to this division."

4.1.2.4 Permitting

Various aspects of the District's CVP contracts and supplemental transfers may require permitting to comply with various state and federal statutes and regulations. Supplemental surface water deliveries to the District may require NEPA and CEQA compliance. The District will obtain and maintain all necessary permits to transfer and deliver water supplies into the District.

4.1.2.5 Public Noticing

Public noticing has been ongoing since the formation of WWD, the District and inception of the San Luis Unit of the CVP. The District regularly updates its water users on the status of CVP water allocations and the availability of supplemental water. During the District's interim renewal process, Reclamation prepares an Environmental Assessment which includes at least a 30-day public noticing requirement.

4.1.2.6 Estimated Cost

The estimated annualized cost for Project No. 1 is already incorporated into the District's annual Operations and Maintenance fees paid by landowners in the District on delivered water. Supplemental water is paid by landowners who elect to participate in the program. Additional costs are not anticipated for this project as a result of GSP implementation.

4.1.3 Relation to Groundwater Sustainability

4.1.3.1 Expected Benefits and Metrics

Reductions in available imported water increases landowner reliance on groundwater to meet overlying demands. Consequently, the surface water imports program will serve as a significant, direct physical action to meet the measurable objectives for chronic lowering of groundwater levels, significant and unreasonable reduction in groundwater storage and significant and unreasonable land subsidence. The surface water import program will make more imported water available thereby reducing the reliance on groundwater use and avoiding these undesirable results. Surface water imports are also anticipated to support certain measurable objectives for degradation of water quality most notably for TDS associated with agricultural return flows due to the lower TDS concentrations of surface water supplies when compared to groundwater. Additionally, the project will indirectly contribute to the long-term economic sustainability of the Subbasin by reducing the probability of land fallowing required to meet groundwater sustainability objectives and thereby impacting the local and San Joaquin Valley economy. A summary of expected benefits and metrics for evaluating project effectiveness are summarized in **Table 4-3** and described and quantified in detail in **Appendix I**.

Table 4-3: Expected Benefits and Metrics for Evaluating Project Effectiveness

PMA No.	PMA Name	Expected Benefit	Evaluation
No.1	Surface Water Imports	1. Improved surface water reliability and availability serves to stabilize groundwater Levels generally. Historical trends demonstrate stable levels during periods with average to above average imported water supplies and downward trends when imported water supplies are less than projected averages. 2. Groundwater Storage will vary similarly to groundwater levels described above and will be improved with increased surface water deliveries. 3. Increased surface water availability should assist in slowing the rate of subsidence. 4. Water Quality is expected to remain the same or improve slightly along with increased importation of surface water in lieu of groundwater use. Quantification of benefit will be conducted once groundwater quality data gaps are addressed during GSP implementation.	1. Direct measurement of groundwater levels and comparative analysis[1] 2. Calculation of annual groundwater storage and comparative analysis[1] 3. Direct measurement and analysis of subsidence and compactiondata[1] 4. Direct Measurement of groundwater quality constituents and comparative analysis[1] 5. Computation of irrigation demand and comparative analysis[1] 6. Computation of irrigation demand and comparative analysis[1]

1. Comparative analysis will evaluate project vs. no project annually using a combination of analytical methods and groundwater modeling as part of the 5-year GSP update.

4.2 Project No. 2 – Initial Allocation of Groundwater Extraction

Given the expected variability in imported surface water supplies, effective management of groundwater pumping within the Subbasin is a substantial and necessary strategy to avoid significant and unreasonable levels of the sustainability indicators within the Subbasin. This management action will require the GSA to allocate and manage groundwater pumping among water users to avoid undesirable results. Specifically, the GSA's objective in developing an allocation of groundwater is to enable the continued beneficial use of groundwater for the current and planned uses within the Subbasin in a cumulative quantity that under the identified management actions will avoid the identified undesirable results. Specifically, the allocation plan provides each person with land overlying the Subbasin continued access to groundwater in accordance with the allocation plan.

The proposed allocation does not determine the common law water rights of any person or entity that pumps groundwater. However, any person that pumps groundwater must do so in conformity with the allocation plan. The allocation of groundwater provides an equitable and transparent distribution of pumping across the Subbasin while maximizing each water users' flexibility to manage their water supplies in a manner that is generally more flexible than under common law subject to the regulatory authority of the GSA to establish conditions that avoid undesirable results and prevent material injury to other users and the Subbasin. To that end, with the benefit of technical support and stakeholder involvement, the GSA has developed a framework for groundwater allocation under the GSA's ongoing oversight that maximizes beneficial use without causing undesirable results.

The allocation program will begin with the commencement of an 8-year transition period from 2022-2030 ("transition period") in which a uniform annual allocation is established at 1.3 AF per acre and then subsequently reduced each year by 0.1 AF per acre until 2030 (**Table 4-4**). During this transition period, groundwater withdrawals will be measured and tracked by the GSA.

Table 4-4: Groundwater Allocation Transition Period (2022-2030)

Water Contract Year	Groundwater Allocation
2022	1.3 AF per acre
2023	1.3 AF per acre
2024	1.2 AF per acre
2025	1.1 AF per acre
2026	1.0 AF per acre
2027	0.9 AF per acre
2028	0.8 AF per acre
2029	0.7 AF per acre
2030	0.6 AF per acre

4.2.1 Project Description

A groundwater pumping allocation management action is a means of distributing the total groundwater which can be sustainably extracted from the Subbasin among water users within the GSA. There is no intent to determine common law water rights pursuant to this Allocation. However, as is the case with a "physical solution," a management action, such as an allocation plan can operate to maximize the reasonable beneficial use of water for the shared benefit of all water right holders, regardless of the specific claim of right. The rationale for implementing this groundwater allocation program is to eliminate or reduce long-term and pervasive imbalances in the Subbasin water budget by equitably distributing the total annual pumping within the Subbasin among beneficial users for the benefit of all beneficial uses. Uniform distribution of the total Subbasin pumping among water users will be determined on a per-acre land ownership basis for qualifying agricultural lands (qualifying lands do not include land that has been retired within the Subbasin). The groundwater allocation is estimated based on provisionally allocating the sustainable yield described in **Section 2.3** of the GSP among landowners with land overlying the Subbasin. The groundwater allocation is designed, along with other management actions set forth herein, to manage water levels with the Subbasin consistent with the specified thresholds so as to maintain 2015 baseline conditions, to avoid undesirable results within the Subbasin and to preserve historical boundary flows to and from adjacent basins, thereby avoiding the causation of undesirable results in adjacent basins or the creation of conditions that would impede the efforts of adjacent basins to achieve sustainability.

During the transition period from 2022-2030 landowner allocations will be set at 1.3 AF per acre in 2022 and decrease annually until the groundwater allocation methodology set forth in **Sections 4.2.1.1 and 4.2.1.2** is effective.

4.2.1.1 Groundwater Allocation

Landowners overlying the Subbasin with the ability to make reasonable and beneficial use of groundwater on their lands will be entitled to register for a groundwater allocation based solely on overlying (developed or undeveloped) acreage and irrespective of prior use of groundwater utilization. Land eligible for a groundwater allocation in the Subbasin totals up to approximately 525,000 acres (excludes the District owned land) out of a total basin-wide acreage of about 620,000 acres (**Figure 4-6**). In addition, some portion of the 525,000 acres may have never been farmed and otherwise does not overlie a portion of the Subbasin that has groundwater in sufficient quality and quantity for beneficial use on their land. Where acreage has not been irrigated prior to December 31, 2015 *and* groundwater conditions are unsuitable for beneficial use, the GSA may restrict or further condition the participation of these land in the registration and transfer programs (described below)

Recognizing the current underutilization of the Upper Aquifer in certain areas, the GSA has elected to allow landowners to apply for a gross groundwater allocation or aquifer-specific groundwater allocation as provided in Section 4.2.1.2 below. After the expiration of the transition period, regardless of whether the allocation is made pursuant to this **Section 4.2.1.1 or 4.2.1.2**, the GSA will control and limit cumulative groundwater extractions within the Subbasin in an aggregate amount that will, in combination with other measures, avoid undesirable results.

The GSA will establish an initial groundwater allocation for each acre of agricultural land within the Subbasin Boundary. The GSA has established a provisional initial groundwater allocation of 0.45-acre feet for each acre of agricultural land within the Subbasin that may be subject to change based on the information developed during the transition period (See **Section 4.2.2** below). Eligibility is based on the landowner's ownership of qualifying land and participation in the Registry Program. While the GSA will meter and track all water use annually, implementation of the initial allocation program is expected to vary in the quantity of water made available depending on the condition of the Subbasin. When groundwater levels are in the "green" zone as described in Section 3.4, groundwater pumping is unrestricted, and a user may pump up to 225 percent of their annual maximum allocation. If the GSA determines groundwater levels are or reasonably predicts they will enter the "yellow" zone based on water levels and climatological data, water users will be limited to pumping an amount equal to their initial allocation plus any eligible carry-over or credited water (as described below).

If significant drought or other circumstances cause groundwater levels to drop or the GSA reasonably predicts will drop into the lower to the "red" zone (regardless of whether the this occurs during the transition or once the initial allocation is established), agricultural and M&I groundwater users may be further limited to an allocation amount that ensures – along with other then prevailing measures – the avoidance of undesirable results. **Figure 4-7** projects water levels from a representative well during the SGMA implementation period from 2020-2040, based on the three zones described above and identifies the estimated frequency of each zone: green (75%); yellow (25%) and red (0%) that would likely occur absent management by the GSA. Thus, the GSA predicts that the majority of overlying landowners will be allowed to produce their annual allocation in approximately 96% of the years following the transition period. The GSA will develop regulations to further its groundwater allocation program provided that the allocation program will establish allocations that will, in combination with other measures, ensure the avoidance of undesirable results within the Subbasin and in adjacent basins.

A landowner's groundwater allocation may be augmented through a Groundwater Credit Program which compensates water users that elect to implement groundwater replenishment strategies authorized by the GSA. This will require water users to first estimate and then document the volume of groundwater replenishment which upon verification by the GSA will be added to the water user's allocation. Groundwater crediting will be subject to requirements and limitations outlined in GSA policy. For example, the GSA may establish further limitations on the total quantity of groundwater that may be recovered from a well or wells in close proximity to avoid undesirable results and unreasonable injury to other users and the Subbasin.

Groundwater replenishment alternatives include but are not limited to water conservation, on-farm recharge, sub-lateral over-irrigation, dry well injection, aquifer storage and recovery (ASR) and percolation ponds and basins. The ASR and percolation ponds or basins are further described in **Sections 4.4 and 4.5** of the GSP.

Providing flexibility to water users to meet their individual needs is an important objective of the GSP. Annual variations in the availability of surface water from the CVP is a critical aspect of conjunctive use of groundwater and surface water. Therefore, in those years in which surface water is available, the GSA may seek to encourage and promote the use of surface water over groundwater through new policies and programs.

Groundwater use by landowners will be measured and tracked by the GSA beginning in 2022. During the transition period from 2022 to 2030, water use in excess of 0.6 AF is permissible up to the amount stated in the annual allocation. However, a portion of the landowner's unused allocation may be banked where their annual water use in any year is less than 0.6 AF per acre. For example, in 2022, the annual allocation will be 1.3 AF per acre. If the landowner uses 0.6 AF per acre or greater, no water can be banked during the transition period even though the landowner has used less than the amount authorized by the allocation. The right to bank and potentially transfer groundwater use less than 0.6 AF per acre pre and post transition period will be addressed under rules and regulations adopted by the GSA.

Accordingly, the GSP provides landowners with the ability to pump their allocation or to transfer or bank up to 0.6 AF of their allocation (pre and post transition period) provided that the average groundwater extraction on a per-acre basis for that water user within a rolling five-year period does not exceed 3.0 AF per acre (5 x 0.6 AF) (or other amount established by the GSA from time to time) for that same rolling five-year period. Thus, the flexibility provided individual landowners will be governed by the overall allocation program, in a manner consistent with the objective of managing water levels within the designated thresholds, thereby avoiding undesirable results in the Subbasin and in adjacent basins.

The recovery and transfer of water within the entire basin or within designated areas may be subject to further conditions that limit transferability and the recovery of water, including but not limited to unused allocation and surface water banked under an ASR program, including during the transition period, where the GSA reasonably determines it is necessary to avoid undesirable results and material injury to any user or the Subbasin. For example, limitations my prevent the transfer of some or all of an allocation outside a designated area, the cumulative extraction of water by a specific user or users in any year or portion thereof, or cumulative extraction of water in a particular area experiencing conditions that may cause or contribute to subsidence.

The landowners and water users are subject to the GSA's Rules and Regulations and a registration process for the allocation of groundwater. The registration process is described below:

1. The GSA will send all landowners a registration application, including the transition period and initial groundwater allocations, prior to the start of the contract water year (March 1).
2. Landowners will be required to complete and submit the registration to receive an allocation of groundwater for all eligible acres. Applicants will be required to list Assessor Parcel Number (APN), acreage, well location(s), select gross groundwater or aquifer specific allocation and an estimate of projected extraction volumes.
    a. The failure to register in any year, does not prejudice the right of the landowner (registrations) to participate in future years;
    b. Water provisionally allocated to any property for which no registration is filed is not subject to allocation to others until the end of the water year. At the end of the year, the unpumped water will be released to storage and may be available for pumping by all users in a subsequent year.
3. The GSA will review registration applications and validate the application information. The GSA will determine whether the proposed acreage has been previously irrigated prior to December 31, 2015, overlies the Subbasin and is suitable for reasonable and beneficial use of groundwater. The GSA may require supplemental information from the landowner in cases where these conditions are unclear. A GSA determination that the acreage: (a) has not been previously irrigated prior to December 31, 2015 and either (b) does not overlie the Subbasin or (c) is unsuitable for beneficial use of groundwater shall be subject to the variance procedures set forth in Chapter 6.
4. The GSA will allocate a groundwater credit to registrants' water user account by March 15.
5. The GSA will verify the amount extracted on an annual basis. If the groundwater allocated to the landowner exceeds his/her extracted amount, then the GSA will allocate a carryover credit (bank). If the groundwater extracted exceeds the amount allocated to the landowner, then the GSA shall apply a negative balance in the landowner's account.

6. Allocations generated from recharge projects shall be designated by the GSA to the landowner responsible for the credit at the end of each contract water year.
7. Landowners may pump their groundwater allocation in the year it's allocated or store (bank) the allocation for use at a later date subject to a leave behind percentage established by the GSA.
8. A trading program for unused allocation, banked carryover and recharge credits will be developed.

4.2.1.2 Aquifer-Specific Groundwater Allocation

The GSA will also implement an aquifer-specific groundwater pumping allocation to reduce pumping pressure on the Lower Aquifer and increase the optimum use of groundwater resources in the Subbasin. The provisional initial aquifer specific groundwater pumping allocation is 0.60 acre feet per gross acre year and may be subject to change based upon the information developed during the transition period and thereafter as may be reasonably prudent to avoid undesirable results (see **Section 4.2.2** below). The aquifer-based allocation may increase the gross groundwater allocation but require that groundwater pumped from the Lower Aquifer may not exceed a specified fraction of the total groundwater pumped as outlined in the GSA Rules and Regulations. The GSA retains the discretion to defer, condition and/or refrain from some or all elements of an aquifer-specific groundwater allocation in the Subbasin or certain portions of the Subbasin where the Board concludes there is an unreasonable risk that aquifer-specific pumping may cause or contribute to subsidence. For example, in areas where portions of the Upper Aquifer may be susceptible to compaction, the GSA may not implement the aquifer-specific groundwater allocation program until the data gaps identified in **Section 3.5.4.2.3** are filled. The collected data should ensure that the program does not cause or contribute to significant and unreasonable subsidence until the GSA can adequately monitor for and mitigate potential subsidence risks (see **Section 2.2.8.4.5**). Water users must also coordinate with the GSA to quantify groundwater withdrawals from each aquifer for accounting and reporting processes if they select this option.

Similar to the gross groundwater pumping allocation, aquifer-specific groundwater credits may be banked and reduced in a subsequent year subject to the GSA's Rules and Regulations.

4.2.1.3 Domestic Users

The majority of domestic users likely fall under the SGMA definition of de minimus extractors (pump less than 2 AFY) which are not required to meter groundwater usage (Wat. Code, §§ 10721(e), 10725.8(e).). Domestic groundwater extraction is conservatively estimated at approximately 78 AFY and unlikely to substantially impact groundwater conditions within the Subbasin. Accordingly, there is no current plan on regulating or metering the amount of domestic extraction as part of the current GSP, assuming estimates of domestic use do not appreciably increase. The GSA will continue to provide and update estimates of domestic use during 5-year GSP updates.

4.2.1.4 Municipal and Industrial Users

Data is not readily available to determine whether the municipal and industrial groundwater users will be classified as a de minimis extractor. If it is determined by the GSA that there are some de minimus users, then the GSA does not plan on regulating the amount of extraction as part of the GSP for those users that are de minimus. A few of the municipal and industrial groundwater well locations will be subject to the GSP if the extraction rates exceed 2 AFY. Currently, there are up to 18 locations that may be subject to this GSP. The GSA will continue to evaluate municipal and industrial groundwater use in cooperation with those users during the initial 5-year implementation period and may require these users to comply with GSP pumping and metering provisions during this time. At this time, these users are not subject to the allocation management action.

4.2.1.5 Metering & Reporting

All wells used for agricultural groundwater extraction will be furnished with a water meter provided by the GSA. The GSA plans to install a new flow meter on all groundwater wells subject to the GSP by January 31, 2022. The GSA will continue to read and record quarterly data and summarize in an Annual Groundwater Status Report prepared by the GSA and provided to all groundwater pumpers. Once the GSA's metering project is complete, the meters will be outfitted with data transmission equipment (automatic meter infrastructure) to allow for continuous monitoring and data collection of groundwater extractions.

4.2.2 Implementation

4.2.2.1 Circumstance for Implementation

Information technology systems will need to be developed by the GSA in support of the allocation program. Moreover, implementation and efficacy of the groundwater allocation program is dependent upon reliable information regarding groundwater pumping within the Subbasin. Approximately 60% of the wells in the Subbasin are presently metered. The GSA expects that the technology support and the metering of more than 90% of groundwater production within the Subbasin will be completed by December 31 of 2021. For any remaining unmetered groundwater wells, the GSA may use other reasonable methods, within its discretion, to estimate groundwater production by landowners. Consequently, absent unforeseen delays attributable to technological support or sighting the meters, the GSA will be capable of implementing the groundwater allocation program within the commencement of the transition period no later than January 31, 2022.

All groundwater used for agricultural beneficial uses will be subject to annual allocation. The quantity of the groundwater allocation (either gross allocation or aquifer-specific allocation) will be subject to change based on groundwater conditions and their relation to initial allocations estimates as require to – along with other measures – avoid undesirable results. Groundwater conditions and annual allocations will be determined by the GSA through analysis of groundwater levels, estimated change in groundwater storage and subsidence, informed by monitoring data.

The ability of the GSA to implement the allocation methodology may be impeded by the failure of GSAs in neighboring basins to adopt thresholds that preserve historic inflows into the Subbasin as required by GSP Regulation Section 354.28(b)(3), thereby reducing the sustainable supply of groundwater available, causing undesirable results and impeding the GSA's ability to achieve its sustainability goal. The GSA will monitor and evaluate GSPs for neighboring GSAs and seek a voluntary coordination agreement, as necessary, to implement the sustainable management criteria as set forth in Chapter 3 and if required will pursue administrative and judicial relief to assure that reductions in boundary flows do not impede the GSA's ability to achieve its sustainability goal.

4.2.2.2 Timeline for Implementation and Accrual of Expected Benefits

Groundwater allocations may be pumped at wells that have flow meters. Nearly all supply wells for irrigation are currently metered by the well owner and monitored by the District. Continued extraction of groundwater by any agricultural and M&I water user will require metering by the January 1, 2025 deadline.

Benefits to the aquifer system due to the allocation of groundwater extractions are likely to occur over a period of years following implementation. The benefits will be influenced mostly by future patterns in hydrology and the selection of an allocation option along with the development of strategies by water users to extract groundwater within the allocation framework. Simulation of future conditions using WSGM suggests that the majority of benefits with respect to groundwater overdraft, water levels (and particularly subsidence) will occur during dry periods where allocations will prevent the aquifer system from being overstressed (**Appendix I**). Individual landowner decisions in managing irrigation demand and water supply sources that were not included in the simulation may also influence the short-term timing of anticipated benefits. However, given historic variations in groundwater pumping in the Subbasin, it can be anticipated that there will be one or more periods of heavy groundwater pumping demand between GSP implementation and the 2040 planning horizon during which implementation of groundwater allocation will avoid undesirable results.

The transition period was modeled in Appendix I of **Appendix I**. The modeling evaluated the impacts of enacting a limit on groundwater pumping of 1.25 AF per acre (average of the 3 year stair step transition: 1.3 AF (2022), 1.3 AF (2023), and 1.2 AF (2024)) during the historic drought period experienced from 2013 through 2015. The transitional allocation resulted in a reduction of 165,000 AF of groundwater pumped during the three-year baseline period. The projection showed a relative change in groundwater levels increasing by up to five feet in the Upper Aquifer and Lower Aquifer. The projection reduced the projected amount of land subsidence by up to 0 feet in some areas of the Subbasin. Modeling this temporary stress on the Subbasin and projected benefits provide the technical support to implement the transitional groundwater allocation program in 2022. The GSA recognizes the success of this program is based on the GSAs ability to continue to monitor the Subbasin and engage in adaptive management. The GSA retains the authority to reduce allocations during the transition period as necessary and to implement other PMAs to address any undesirable results that may arise during the transition period.

While beneficial to the basis as a whole, general groundwater pumping allocations are insufficient to avoid undesirable results which may occur over short time periods over a small geographic extent during the planning and implementation horizon. Such impacts will likely require targeted and adaptive management actions taken based on future conditions and thresholds outlined in **Chapter 3** of the GSP. These management actions are described in **Section 4.5** of the GSP.

In addition, the need to protect the maintenance of historical boundary inflows and outflows as described in **Section 4.2.2.1** above, the variability of hydrologic conditions and the availability of surface water in the initial years of the allocation program may adversely impact the feasibility of implementing the allocation measure within the Subbasin. Total surface water availability below the projected average of 732,000 acre feet per year and groundwater levels that are below the measurable objectives set forth in Chapter 3 represent conditions of shortage that *may* impair the initial efficacy of the proactive measures specified in this GSP, including but not limited to conservation, banking, trading of credits, ASR and percolation management measures. To ensure that the allocation program is reasonably likely to achieve its intended objectives, the GSA reserves its discretion to defer, temporarily, the allocation program start date if it reasonably finds that: (a) adjacent basin(s) are impairing the ability of the GSA to achieve its sustainability goal by their failure to maintain historic inflows into the Subbasin or (b) shortage conditions exist (as evidenced by either total surface water deliveries in the preceding water year falling below 732,000 acre feet and/or groundwater levels are at or below the measurable objectives set forth in Chapter 3) and undesirable results within the Subbasin and adjacent areas can be avoided by the imposition of other projects and management measures during the deferral period. Moreover, information developed during the transition period may assist the GSA in the refinement of its management measures without increasing the risk of undesirable results. The GSA expressly reserves the right to impose the initial allocation program at an earlier date as well as more stringent measures if required.

4.2.2.3 Legal Authority

Section 10726.4(a)(2) of the California Water Code grants the GSA the authority to "control groundwater extractions by regulating, limiting, or suspending extractions from individual groundwater wells or extractions from groundwater wells in the aggregate … or otherwise establishing groundwater extraction allocations." To monitor groundwater extractions, a "[GSA] may require through its [GSP] that the use of every groundwater extraction facility within the management area of the groundwater sustainability agency be measured by a water-measuring device satisfactory to the [GSA]." (Water Code, § 10725.8(a).) This SGMA authority is in addition to, and not a limitation on the authority granted to the District under any other law (Water Code, §§ 10725(a), 10726.8(a)).

Although the GSA has the authority to regulate groundwater extractions, an initial allocation of groundwater extraction or any other limitation on groundwater extraction by the GSA "shall not be construed to be a final determination of the rights to extract groundwater from the basin or any portion of the basin." (Water Code, § 10726.4(a)(2).) In this instance, similar to a physical solution, the management strategy pays due regard to common law and competing water right claims. (See *City of Santa Maria v. Adam*, (2012) 211 Cal.App.4th 266, 288; *California Am. Water Co. v. City of Seaside*, (2010) 183 Cal.App.4th 471, 480.) No person has the common law or statutory right to engage in an unreasonable use of water, causing or materially contributing to undesirable results. (See GSP Regulations § 354.26; *Pasadena v. Alhambra* (1949) 33 Cal.2d 908, 924; Cal. Const. art. X, §2.)

4.2.2.4 Permitting

The determination, implementation and enforcement of groundwater allocations will require no permits from any county, state or federal agency. However, subsequent to the adoption of the GSP, every person or entity that produces groundwater for irrigation must have an allocation from the GSA as provided herein.

4.2.2.5 Public Noticing

To date, public notice regarding the intent to adopt a pumping allocation has occurred through public workshops provided by the GSA as part of the Stakeholder Communication and Engagement Plan. These have occurred on the following dates:

- April 3, 2019
- February 19, 2019
- September 18, 2018
- October 16, 2018
- August 14, 2018
- July 16, 2018

Meeting material is also posted on the website. The GSA will also email and/or mail groundwater allocation applications to all landowner users to complete in 2019.

4.2.2.6 Estimated Cost

Funding for implementation includes the cost of meter installation, calibration and maintenance, meter reading by GSA personnel and data collection, management and reporting. Historically, the District provided well owners the opportunity to have their groundwater meter(s) serviced by the District. Meter replacement will be funded by Public Purpose funds and by water user fees. Quarterly meter reading, maintenance and calibration is initially estimated to cost $65,000 per year. This budget estimate will be refined as part of the 2025 update after the program is fully implemented. GSA Administration and accounting staff will also provide support to implement the project. Funding for data collection, management and reporting is included in costs associated with development and maintenance of the data management system (described in **Table 5-1**) and not explicitly evaluated. Aside from the meter related costs and administrative support described above, no other costs are associated with this management action.

4.2.3 Relation to Groundwater Sustainability

4.2.3.1 Expected Benefits and Metrics

The groundwater pumping allocation will directly contribute to achieving measurable objectives relating to water levels and groundwater storage by promoting groundwater pumping distributions in the Subbasin that minimizes the occurrence of large amounts of groundwater extraction that result in undesirable results. Groundwater allocations are also expected to substantially minimize and prevent undesirable results of chronic lowering of groundwater levels, significant and unreasonable reduction in groundwater storage and significant and unreasonable land subsidence. Under aquifer specific allocations, sustainable utilization of the Upper Aquifer will reduce groundwater user's reliance on the Lower Aquifer to meet their pumping demand and provide additional benefits with respect to subsidence within certain areas. Pumping allocations may also provide additional indirect benefits to groundwater quality by limiting the migration of poor quality water derived from marine sediments to other portions of the aquifer system due to Upper Aquifer groundwater pumping that results in a reduction in the downward vertical gradient between the Upper and Lower Aquifers. A summary of expected benefits and metrics for evaluating project effectiveness are summarized in **Table 4-5** described and quantified in detail in **Appendix I**.

Table 4-5: Expected Benefits and Metrics for Evaluating Project Effectiveness

PMA No.	PMA Name	Expected Benefit	Evaluation
No. 2	Groundwater Pumping Allocation	1. Stable groundwater levels 2. Reduced depletion in groundwater storage 3. Avoid and minimize subsidence 4. Maintenance of water quality	1. Direct measurement of groundwater levels and comparative analysis[1] 2. Calculation of annual groundwater storage and comparative analysis[1] 3. Direct measurement of subsidence and compaction and comparative analysis[1] 4. Direct Measurement of water quality constituents and comparative analysis[1]

1. Comparative analysis will evaluate project vs. no project annually using a combination of analytical methods and groundwater modeling as part of the 5-year GSP update.

4.3 Project No. 3 – Aquifer Storage and Recovery

Aquifer Storage and Recovery (ASR) is being investigated as a conjunctive use strategy to improve water supply reliability within the Subbasin. Due to the predominance of fine-grained soils combined with the occurrence of the Corcoran Clay throughout the majority of the Subbasin, there are limited opportunities for surface recharge within the Subbasin to benefit Lower Aquifer groundwater conditions (KDSA, 2009; Wood, 2019). As a result, the GSA has proposed implementing a large-scale agricultural ASR program, through artificial injection wells, as a more pragmatic alternative to enhance subsurface recharge in the Subbasin. The program feasibility was demonstrated in a 2018 pilot study on a retrofitted District-owned well (Brown and Caldwell, 2018; **Appendix K**). The report favored the development of a District-wide ASR program as an augmentation strategy for conjunctive use in the Subbasin.

4.3.1 Project Description

The proposed agricultural ASR program will include direct injection and storage of imported water supplies into retrofitted production wells as part of the GSA's Groundwater Pilot Credit Program. An ASR well is an eligible project in the District's Groundwater Credit Pilot Program. The ASR program would be voluntarily adopted by landowners within the District. Accordingly, well modifications, rehabilitation, equipment and filtration or treatment required for injection of agricultural water will be the responsibility of the landowner. Injected water will only receive filtration and treatment to the extent needed for operational requirements and may only be withdrawn and used for agricultural purposes. Injected water would contribute to a landowner's groundwater allocation and may be withdrawn within 5 years. GSA Administration and accounting staff will also provide support to implement the project. Injection may also be subject to a leave-behind quantity (which accounts for losses attributed to a portion of the injected water remaining in the aquifer system). The District is currently pursuing programmatic compliance through a Report of Waste Discharge (ROWD) with the Central Valley Regional Water Quality Control Board (CVRWQCB or Regional Board) and California Division of Drinking Water (DDW) to inject water in up to 400 Ag-ASR wells within the Subbasin.

Aquifer storage is anticipated to occur during periods where there is available water for injection. Sources of injected water are anticipated to be a combination of Section 215 non-storable water, at-risk carryover water from the San Luis Reservoir and flood flows. Water used for injection will be delivered to injection wells using the existing distribution system in the Subbasin. Results from the pilot study demonstrated sustained injection rates that ranged from 400 to 550 gpm with a maximum injection rate of 650 gpm for up to 6 months. The total amount of water potentially available from implementation of ASR in 400 wells averages approximately 12,300 AFY (**Figure 4-8**). In conjunction with carry over storage in the San Luis Reservoir and Section 215 water contracts, it is anticipated that water stored in the GSA's ASR program could average as much as 28,000 AFY annually.

The ASR program will incorporate any monitoring and reporting conditions required by the regulating State agencies as part of the project operation. Those requirements are under development with the Regional Board and DDW as part of the Pilot Groundwater Credit Program feasibility analysis and ROWD permit preparation. Subsequent GSP submittals in 2025 and 2030 will provide updated information on the monitoring and reporting requirements for this project.

The GSA will expressly condition the right to recover surface water banked in accordance with the ASR program so as to avoid material injury to other users and the Subbasin. This means that limits may be placed upon the recovery of banked water within areas identified by the GSA. These conditions may limit the total quantity of all water and banked water by year or any part thereof.

4.3.2 Implementation

4.3.2.1 Circumstance for Implementation

Implementation of the Ag-ASR program is contingent on the approval of the ROWD by California DDW and Regional Board. Upon approval, landowners on accepted Ag-ASR locations have the opportunity to store water and generate groundwater credit. Actual injection and recovery volume and timing will be at the discretion of individual landowners. Continued participation by landowners may be subject to the initial success of the program, availability of water for injection along with other considerations. As a result, the timeline for implementation is expected to occur over a period of years and full adoption of the program by 2030. If the GSA determines that this project is required to achieve sustainability, the GSA may consider developing ASR projects on wells owned by the District.

4.3.2.2 Timeline for Implementation and Accrual of Expected Benefits

On receipt of regulatory approvals and adoption of the GSP, landowners within the Subbasin will be eligible to participate in the GSA's ASR program as early as 2020. Since participation in the Ag-ASR program is voluntary, it is difficult to predict the timeline for full project implementation (400 irrigation wells). The timeline for full implementation will be re-evaluated based on the program's initial success, which is largely dependent on surface water availability and rate of adoption by well owners. However, it is estimated that the ASR program will be fully implemented by 2030.

Since water will be directly injected into the aquifer system, benefits to the aquifer system should be immediate and commensurate with the amount of water injected and level of landowner participation in the program.

4.3.2.3 Legal Authority

The policy of the State of California is to encourage the conjunctive use of surface and groundwater. (Water Code, § 1011.5). Toward that end, the GSA can implement the ASR Program through its authority to regulate extractions outlined in Sections 10726, 10726.2 and 10726.4 of the California Water Code. SGMA also authorizes a GSA to engage independently in activities related to the "spreading, storing, retaining, or percolating into the soil [] waters for subsequent use or in a manner consistent with a [GSP]." (Water Code, § 10726.2(b).) Further, Section 10726.5 of the California Water Code grants the GSA the authority to enter into agreements with private parties to facilitate the implementation of a GSP. Under this authority, the GSA can contract with individual landowners to implement the ASR Program.

Subject to the GSA's coordination and administration to avoid undesirable results and material injury to other users and to the Subbasin, the use of the aquifer to store surface water underground for subsequent beneficial use is recognized by the California Water Code. Section 1242 of the California Water Code defines a beneficial use with regard to underground storage "if the water so stored is thereafter applied to the beneficial purposes for which the appropriation for storage was made," provided that appropriate regulatory approvals have been granted and that common law rights to native water and storage are not impaired. The GSA will coordinate the ASR program to ensure that both the storage and recovery of banked water does not cause or contribute to undesirable results or material injury to other users.

4.3.2.4 Permitting

California Water Code section 13260 requires a ROWD be submitted to the Regional Board for injection wells used as part of an ASR program. The District submitted a ROWD with the Central Valley Regional Board allowing for the approval of up to 400 Ag-ASR wells within the District. The goal of this ROWD is to demonstrate compliance with the State Board's Water Quality Order 2012-0010 as well as the Antidegradation Policy 68-16. The programmatic ROWD includes results from a pilot study conducted in 2017 and numerical model results used to establish adequate safeguards and protections for water quality in drinking water wells (Brown and Caldwell, 2018; Brown and Caldwell, 2019).

Delivery of 215 non-storable water and flood flows to well owners through the San Luis Canal is allowable under the Warren Act. Under a 2017 Finding of No Significant Impact (FONSI) filed by the USBR in 2017, up to 50,000 AFY are permitted to be delivered through the SLC to WWD until 2022 (FONSI-17-023). Historically, the District has renewed the Warren Act contract every 5-years since 1992. It is expected that this Warren Act contract and accompanying environmental review will be continually renewed every 5 years.

4.3.2.5 Public Noticing

To date, public notice regarding the ASR projects has occurred through public workshops provided by the District as part of the Stakeholder Communication and Engagement Plan. These have occurred on the following dates:

- December 15, 2015, Board Meeting
- March 21, 2017, Water Users Workshop
- May 3, 2018, Workshop
- June 19, 2018, Board Meeting

- July 16, 2018, GSA Workshop
- March 19, 2019, Water User Workshop
- April 3, 2019, GSA Workshop

The District circulated the 2019 Groundwater Credit Pilot Program Terms and Conditions for public comment on April 17th, 2019 on the District's SGMA website listing the ASR as viable alternative for developing Groundwater Credits (WWD, 2019). Eligible project participants will be notified of approval of the ROWD and will be sent applications for Ag-ASR project participation via direct mail and email upon approval from the DDW and Regional Board.

4.3.2.6 Estimated Cost & Funding

The Ag-ASR program will require funding for administration and infrastructure. District administration costs include the development and implementation of the pilot program in 2017/2018 and preparation and submittal of the programmatic ROWD. In addition, the District will manage the Ag-ASR program and review landowner ASR operations as part of ensuring compliance with the ASR project conditions and monitoring requirements.

The metering of both injection and recovery amounts adds a level of complexity to the quarterly monitoring of groundwater pumping that needs to include meters that can accurately record the injected and recovered volumes. Program implementation and management costs are included in the GSP implementation.

In addition, permitting requirements by the Regional Board may include additional groundwater quality monitoring that is separate from the regular GSP monitoring for the groundwater quality sustainability indicator. Equipment required at each ASR well will be funded directly by the participating well owner. Absent grant funding, equipment/infrastructure costs will be borne by the individual landowner and not the GSA.

Annual operations and maintenance costs will likely increase for those wells that are utilized in the ASR program. These costs may include well rehabilitation to address any chemical buildup to maintain injection and recovery rates. The costs associated with implementing the ASR program are dependent on landowner participation, level of financial assistance from the District, and permitting and monitoring requirements by the Regional Board. A preliminary estimate of District participation is approximately $1,000 per well per year which is approximately $400,000 per year for 400 wells (**Table 5-4**).

Infrastructure enhancements are anticipated to fall on individual water users choosing to participate in the Ag-ASR program. Wells used for the Ag-ASR program will require some level of retrofitting to enable injection of surface water. Each location required modification will vary based on site conditions. Modification may include well modifications, rehabilitation, wellhead equipment and operation of the well motor. The initial cost per well for equipment, rehabilitation and modifications is estimated at $50,000. Average annualized costs for operations and maintenance involving rehabilitation, equipment and treatment costs are estimated at $10,000. The cost associated from acquiring water for injection will be paid by the individual well owners.

4.3.3 Relation to Groundwater Sustainability

4.3.3.1 Expected Benefits and Metrics

The Ag-ASR program is anticipated to directly contribute to meeting measurable objectives of chronic lowering of groundwater levels, reduction in groundwater storage, and land subsidence through aquifer replenishment via injected water. The benefits include storage of surplus surface water and ensures protection of the Subbasin via leave-behind quantities, which contribute additional water to the groundwater aquifer. Unlike recharge through percolation basins or on-farm recharge approaches the Ag-ASR program is able to target recharge at a particular depth interval providing a significant advantage in providing recharge to the Lower Aquifer. The project will also directly improve water quality through the injection of water with lower TDS and other constituents than native groundwater. The Ag-ASR program is also anticipated to indirectly contribute to the economic sustainability of the region by increasing the reliability of water resources during dry periods. By the end of the sustainability period, we anticipate approximately 400 Ag-ASR locations in the Subbasin. A summary of expected benefits and metrics for evaluating project effectiveness are summarized in **Table 4-6** and described and quantified in detail in **Appendix I**.

Table 4-6: Expected Benefits and Metrics for Evaluating Project Effectiveness

PMA No.	PMA Name	Expected Benefit	Evaluation
No.3	Agricultural-ASR Program	1. Stable groundwater levels 2. Reduce depletion of groundwater storage 3. Reduce subsidence 4. Improve water quality	1. Direct measurement of groundwater levels and comparative analysis[1] 2. Calculation of annual groundwater storage and comparative analysis[1] 3. Direct measurement subsidence and compaction and comparative analysis[1] 4. Direct measurement of water quality constituents and comparative analysis[1]

1. Comparative analysis will evaluate project vs. no project annually using a combination of analytical methods and groundwater modeling as part of the 5-year GSP update.

4.4 Project No. 4 – Targeted Pumping Reductions

Land subsidence near Checks 16, 17 and 20 of the San Luis Canal/California Aqueduct during the 2013-2016 drought highlighted the necessity to develop a mechanism for the GSA to reduce groundwater pumping to avoid or mitigate undesirable results. With respect to the San Luis Canal at Checks 16, 17, and 20, any amount of additional land subsidence, according to DWR operations staff (DWR personal communication, 2018), will significantly and adversely impact the ability for the USBR and DWR to convey water without implementing new design and construction measures to mitigate the impacts to aqueduct operations from subsidence. Accordingly, the GSA has developed a process to require groundwater pumping reductions in portions of the Subbasin and when necessary to immediately and directly relieve the groundwater pumping stress when continued pumping would produce significant undesirable results.

In June 2017, DWR published a study on the impacts of subsidence on the operations of the California Aqueduct/SLC. In the report, DWR identified two areas within the Subbasin where subsidence has impacted the Aqueduct in the form of reduced flow capacity, reduced storage capacity, and reduction in freeboard. A subsequent study is in preparation by DWR to achieve the following objectives as described in the 2017 DWR Study:

1. Develop future operational conditions for the SLC. Obtain cost and operational impacts for all reasonable conditions.
2. Identify all project alternatives options to meet the operational conditions. Develop, in more detail, an alternative matrix of the top few alternatives for each condition. The alternatives could include raising a canal liner, building a storage facility, or adding a new Aqueduct segment.
3. Collect information on groundwater wells near the Aqueduct from DWR's groundwater well database. Analyze the distribution of the wells to aid in future subsidence predictions.
4. Collect right of way boundary information and canal structure elevation data. Data will be used to evaluate impacts and costs for proposed project alternatives.

This management action by WWD will complement current efforts by DWR in DWR's current investigations on identifying projects to meet the objectives DWR identified in the 2017 Study.

4.4.1 Project Description

The GSA will provide landowners with incentives to reduce pumping in a given water year to prevent water level declines in sensitive portions of the aquifer system (around Checks 16, 17 and 20 of the San Luis Canal). Pumping reductions will be commensurate to the relation of current conditions to the minimum threshold, rate of water level decline and severity of the undesirable results caused by continued water level declines. The GSA will provide supplemental water supplies to subsidence sensitive areas of the Subbasin as may be required – along with other measures – to avoid undesirable results. The pumping reduction may target specific areas and specific aquifer zones (e.g., Lower Aquifer) for specific water years.

The pumping reduction program will provide a regional benefit to the Subbasin and ensure all interested parties have access to water. The amount participants can extract from wells will be a fixed proportion of each water user's annual groundwater allocation (e.g., 50%). In the case where incentives target a specific aquifer (e.g., Lower Aquifer only) agricultural water users may only pump the reduced allocation from the specific aquifer. For users who elect an aquifer-specific allocation, reductions only apply to the targeted aquifer. Aquifer specific allocations will be further detailed, modified or amended in GSA Rules and Regulations as may be required to avoid undesirable results.

In order to avoid material injury and substantial expense, agricultural water users in a subsidence sensitive area that participate in the program will be provided a substitute source of water to reduce pumping in a given year. Water users who elect to curtail pumping in a specific area may first elect to pump all, or part of their groundwater allocation from an unaffected part of the aquifer or Subbasin. This includes groundwater credits banked from previous years. As an incentive, the GSA will allow the groundwater user to pump an additional fixed percentage of their groundwater allocation (including credits) if extracted from a non-affected area. This allocation adjustment incentive may be subject to revision from time to time in the GSA's Rules and Regulations as may be required to contribute towards the avoidance of undesirable results. Alternatively, groundwater users may request that the District supply water to meet their water demand up to the amount of their remaining groundwater pumping allocation and carried over credits. Water supplied by the GSA will be provided at the same cost as the fees and costs incurred by the water user when pumping groundwater. The process for documenting pumping costs will be provided in the GSA's Rules and Regulations.

The GSA reserves its discretion, to require landowner compliance with the Targeted Pumping Reductions Program if it concludes that the measure is reasonably necessary to avoid undesirable results, provided that no landowner that is compelled to accept substitute supplies will bear a material expense in accepting the substitute supply when compared to the full cost of withdrawing groundwater. The GSA further reserves its discretion to compel the delivery and acceptance of substitute supplies in coordination with or independent of the groundwater allocation program and may be required at any time as may be reasonably required to mitigate the risk of undesirable results.

4.4.2 Implementation

4.4.2.1 Circumstance for Implementation

Subsidence concerns near Checks 16, 17 and 20 of the San Luis Canal require the District to develop a framework to provide incentives for groundwater pumpers in this region during critical periods to reduce pumping. While the program retains flexibility to enable implementation in other circumstances, the GSA currently anticipates that the program will only be warranted in subsidence prone areas during critical periods where the operation of infrastructure will be compromised by continued subsidence resulting from groundwater extractions (**Figure 4-9**).

The San Luis Canal may be impacted by additional subsidence, requiring adaptive implementation of pumping restrictions. Accordingly, the requirement for enacting this management action will be determined by the relation of groundwater levels (particularly in the Lower Aquifer) and subsidence to minimum thresholds and amount of anticipated groundwater pumping. This determination will be informed by regular monitoring of water levels, groundwater storage and compaction and subsidence outlined in **Section 3.5** of the GSP. Modeling described in **Appendix I** was used to inform the spatial extent and amount of pumping reduction required to avoid undesirable results near Checks 16, 17 and 20 of the San Luis Canal. These results indicate the need for up to a one-mile buffer around these subsidence prone areas. Groundwater modeling indicated there was a substantially reduced benefit to extending the buffer zone further. Groundwater withdrawals from wells within the defined area may be limited to between 0 to 50% of the initial allocation depending on circumstances, subject to the provision of a substitute supply as provided above.

4.4.2.2 Timeline for Implementation and Accrual of Expected Benefits

Depending on water levels, the GSA is prepared to implement a targeted pumping reduction incentive program (Targeted Pumping Reductions Program) in conjunction with in-lieu surface water deliveries as soon as January 31, 2020. All wells used for supplying irrigation water within the Subbasin will be metered by January 2025. Infrastructure required to deliver replacement supplemental surface water in place of groundwater pumping is currently available district-wide via the distribution system and privately-owned temporary divisions. However, participants in the pumping reduction program may elect to offset those reductions by pumping more groundwater from another portion of the Subbasin, from another portion of the Upper Aquifer, or from an unaffected portion of the aquifer in place of receiving supplemental surface water supplies. As a result, implementation of this alternative is dependent on the availability of

Upper Aquifer wells with sufficient capacity to meet the additional demand and the installation of groundwater meter as well as further monitoring of potential impacts associated with increased production from the Upper Aquifer. Otherwise, it is assumed that affected landowners will be able to utilize that option by January 31, 2020.

Pumping reductions are expected to provide an accrued benefit to the aquifer system, substantially mitigating localized undesirable results particularly with respect to groundwater levels and aquifer system compaction and land subsidence. Implementation will only occur when the management action is necessary. Consequently, the timeline for the accrual of expected benefits is specifically tied to avoidance of land subsidence generally and impacts to infrastructure in targeted locations while allowing continued access to groundwater in unaffected areas of the Subbasin.

4.4.2.3 Legal Authority

The authority to implement mandatory pumping reductions in sensitive areas is provided to the GSA under Section 10726.4(a)(2) of the California Water Code, which grants the GSA the authority to "control groundwater extractions by regulating, limiting, or suspending extractions from individual groundwater wells or extractions from groundwater wells in the aggregate[.]"

The authority to provide surface water in lieu of groundwater extractions is provided in Section 10726.2(d) which states that a GSA may:

> "Perform any acts necessary or proper to enable the agency to purchase, transfer, deliver, or exchange water or water rights of any type with any person that may be necessary or proper to carry out any of the purposes of this part, including, but not limited to, providing surface water in exchange for a groundwater extractor's agreement to reduce or cease groundwater extractions."

Implementation of mandatory pumping reductions in sensitive areas "shall not be construed to be a final determination of the rights to extract groundwater from the basin or any portion of the basin." (Water Code, § 10726.4(a)(2).) However, this management strategy is undertaken with due regard to common law water rights and in a manner consistent with the doctrine of "physical solution" that maximizes the reasonable and beneficial use of water without causing undesirable results. Overlying landowners that are selected to receive a substitute supply of water to off-set a required curtailment under this measure will not be required to incur a material economic expense as a result of the substitution. (*City of Lodi v. East Bay Municipal Utility Dist.* (1936) 7 Cal.2d 320). Further, no person is authorized to make an unreasonable use of water that causes or materially contributes to undesirable results. (See GSP Regulations § 354.26; *Pasadena v. Alhambra* (1949) 33 Cal.2d 908, 924; Cal. Const. art. X, §2.)

4.4.2.4 Permitting

Targeted pumping reductions will require no permits from any county, state or federal agency.
Imported water transfers and Warren Act contracts for conveyance and storage of any new sources of non-project water supplied to water users by the GSA may require CEQA and/or NEPA and compliance. The level NEPA or CEQA compliance could delay the implementation time frame of this management action.

4.4.2.5 Public Noticing

To date, public notice regarding the Targeted Pumping Reductions Program occurred through public workshops provided by the District as part of the Stakeholder Communication and Engagement Plan. These have occurred on the following dates:

- April 3, 2019
- October 16,2018
- September 18, 2018

In years when the Targeted Pumping Reductions Program is offered, the GSA will contact the landowners in the affected area and notify them that program is available.

4.4.2.6 Estimated Cost & Proposed Funding

The primary cost associated with this management action is attributed to the District's obligation to provide supplemental surface water to water users in-lieu of extracted groundwater at the same cost per acre-foot as groundwater extraction, should it be required. Excluding infrastructure costs, the economic burden of providing an alternate surface water supply is largely dependent on the quantity of Supplemental surface water required, the per acre-foot cost to extract groundwater and the per acre-foot cost to secure and furnish surface water. The demand, availability and cost of water can fluctuate widely depending on hydrologic conditions. For planning purposes, it is estimated that additional water will cost on average $2,750,000 per year. The program would provide approximately 17,500 AF of water to the subsidence areas near Checks 16, 17 and 20.

4.4.3 Relation to Groundwater Sustainability

4.4.3.1 Expected Benefits and Metrics

Under the current context of developing a means to provide direct relief to the aquifer system near Checks 16, 17 and 20 near the San Luis Canal, pumping reductions are expected to directly contribute to avoiding undesirable results of land subsidence, groundwater storage and water levels. The management action may prevent water level declines and increase storage in the Subbasin. However, pumping reductions are expected to increase water levels and mitigate overdraft locally. A summary of expected benefits and metrics for evaluating project effectiveness are summarized in **Table 4-7** and described and quantified in detail in **Appendix I**.

Table 4-7: Expected Benefits and Metrics for Evaluating Project Effectiveness

PMA No.	PMA Name	Expected Benefit	Evaluation
No.4	Targeted Pumping Reductions Program	1. Maintain water levels 2. Reduce localized depletions in groundwater storage	1. Direct measurement of groundwater levels and comparative analysis[1] 2. Calculation of annual groundwater storage and comparative analysis[1] 3. Direct measurement subsidence and compaction and comparative analysis[1]

		3. Focused protection against subsidence in targeted areas	

1. Comparative analysis will evaluate project vs. no project annually using a combination of analytical methods and groundwater modeling as part of the 5-year GSP update.

4.5 Project No. 5 – Percolation Basins

Managed aquifer recharge through percolation basins is being considered by the GSA as an additional groundwater replenishment strategy within the Subbasin. Soils within six feet of the ground surface in many areas of the Subbasin are predominantly composed of fine-grained material which greatly reduce the volume of water that can infiltrate and recharge the aquifer system (Carollo and LSCE, 2015). However, there are areas where soil properties are suitable for possible recharge basins. The GSA is currently investigating and the use of dry wells within percolation basins to enhance groundwater recharge.

4.5.1 Project Description

The GSA is proposing to construct and operate percolation basins on District-owned lands located along the western margin of the Subbasin where the Corcoran clay is not present (**Figure 4-10**). Percolation basins are a conjunctive use strategy where surface water is retained and infiltrated through permeable surficial deposits to recharge the Upper Aquifer. The District would utilize these basins to store and recharge supplemental surface water in the aquifer to enhance groundwater conditions within the Subbasin.

At this time, the District has conducted geophysical investigations at sites located at Cantua Creek and Arroyo Pasajero using cone penetration tests (CPT) (Wood, 2019). Findings from this study do not recommend continued investigation at the Cantua Creek location due to the presence of low permeability soils and the likely presence of consolidated Diablo Range deposits which “present a significant barrier to surface water percolation to the water table” (Wood, 2019). Conditions at the Arroyo Pasajero site were more favorable but would likely require enhancement through the construction of dry wells due to the presence of low permeability soils encountered in the upper 35 feet below the ground surface.

Preliminary findings suggest that the development of surface recharge facilities at proposed locations will require further investigation to demonstrate feasibility. As a result, the GSA has been unable to develop estimates of cost or quantity of water stored in future facilities. However, the GSA will continue to evaluate additional sites and augmentation strategies to develop percolation basin facilities.

4.5.2 Implementation

4.5.2.1 Circumstance for Implementation

Percolation ponds were proposed as part of a suite of long-term conjunctive use enhancement strategies proposed by the District/GSA to address undesirable results. If a suitable site is found, recharge in future ponds is anticipated to occur in the winter and spring months particularly in wet years when water is available.

4.5.2.2 Timeline for Implementation and Accrual of Expected Benefits

Further development and implementation of recharge facilities are contingent on demonstrating preliminary feasibility at current or future sites. The District is currently conducting investigations to locate suitable sites and/or augmentation strategies. The District acquired three properties with recharge potential. If the District identifies other sites suitable for groundwater recharge and there is a need for additional projects to achieve sustainability, the information will be provided in the following five-year update.

4.5.2.3 Legal Authority

The policy of the State of California is to encourage the conjunctive use of surface and groundwater. (Water Code § 1011.5). The GSA has the legal authority to conduct a feasibility study for suitable locations for percolation basins (Water Code, § 10725.4.). Once the feasibility study identifies a suitable location, the percolation basin project would be implemented by the GSA or the District. Both the GSA and District have the authority to acquire property for percolation basins (Water Code, §§ 10726.2(a), 35600).

In addition to powers granted to the District in Division 13 of the California Water Code to construct percolation basins, Section 10726.2 (b) grants a GSA authority to:

> "Appropriate and acquire surface water or groundwater and surface water or groundwater rights, import surface water or groundwater into the agency, and conserve and store within or outside the agency that water for any purpose necessary or proper to carry out the provisions of this part, including, but not limited to, the spreading, storing, retaining, or percolating into the soil of the waters for subsequent use[.]"

As a result, both the GSA and the District have the authority to investigate and construct percolation basins to support sustainable groundwater management.

4.5.2.4 Permitting

Water sources used for recharge may require additional permitting, depending on source and duration of availability/use. Recharge facilities will need to comply with CEQA through preparation of environmental documentation such as a Mitigated Negative Declaration or, if deemed necessary, an EIR. Preparation of NEPA would be required when a federal action is taken that may have impacts on the environment. Federal action includes federal funding, permits, policy decisions, or facilities. An EA/FONSI would be developed as the environmental document unless the impact(s) from the construction and operations of the percolation facility are significant, then an EIS would be required.

In general, the construction of the percolation facilities will require a General National Pollutant Discharge Elimination System (NPDES) Permit for Low Threat Discharges filed with the Regional Board, grading permits and land use approval from respective counties, and applicable air quality permits. An EPA Class V Injection permit would be required if recharge is through dry wells. Continuing future site investigations and feasibility will require the submission and approval of drilling permits from the respective counties'

Public Health Department in order to conduct further CPT/geotechnical investigations, and the construction of monitoring wells. Public Noticing

To date, public notice regarding groundwater recharge projects occurred through public workshops provided by the GSA as part of the Stakeholder Communication and Engagement Plan. These have occurred on the following dates:

- April 16, 2019
- April 3, 2019
- October 16,2018
- September 18, 2018

The GSA will continue to provide updates to members of the GSA through continued public workshops as part of the Stakeholder Communication and Engagement Plan to provide updates on investigations. The public will have the opportunity to provide comment prior to the adoption of the District's CEQA and/or NEPA filings.

4.5.2.5 Estimated Cost

The estimated cost to implement recharge projects are related to the following:

- Feasibility investigations and pilot studies
- Environmental Documentation
- Design and construction
- Permitting and water rights
- Monitoring and data collection
- Operations and maintenance

The estimated cost of implementing this project has a high level of uncertainty and is initially estimated at approximately $145,000 annually. Source of water for the project includes flood flows and CVP water risk of spill. The availability of these water supplies occurs about each once every three to five years.

The determination of feasibility for recharge project requires a pilot test to find issues with the design of the dry wells, such as infiltration rate and clogging factor, at a smaller scale since there are few studies of implementing a network of dry wells as the method for groundwater recharge. A dry well pilot test will be conducted in the winter of 2019. Once the pilot test is completed and moving forward with the full-scale project is deemed feasible, design of the project will begin.

If the project is feasible, the project is estimated at $9,900,000. The GSA will continue to investigate the project and update the project's status during 5-year GSP updates.

4.5.3 Relation to Groundwater Sustainability

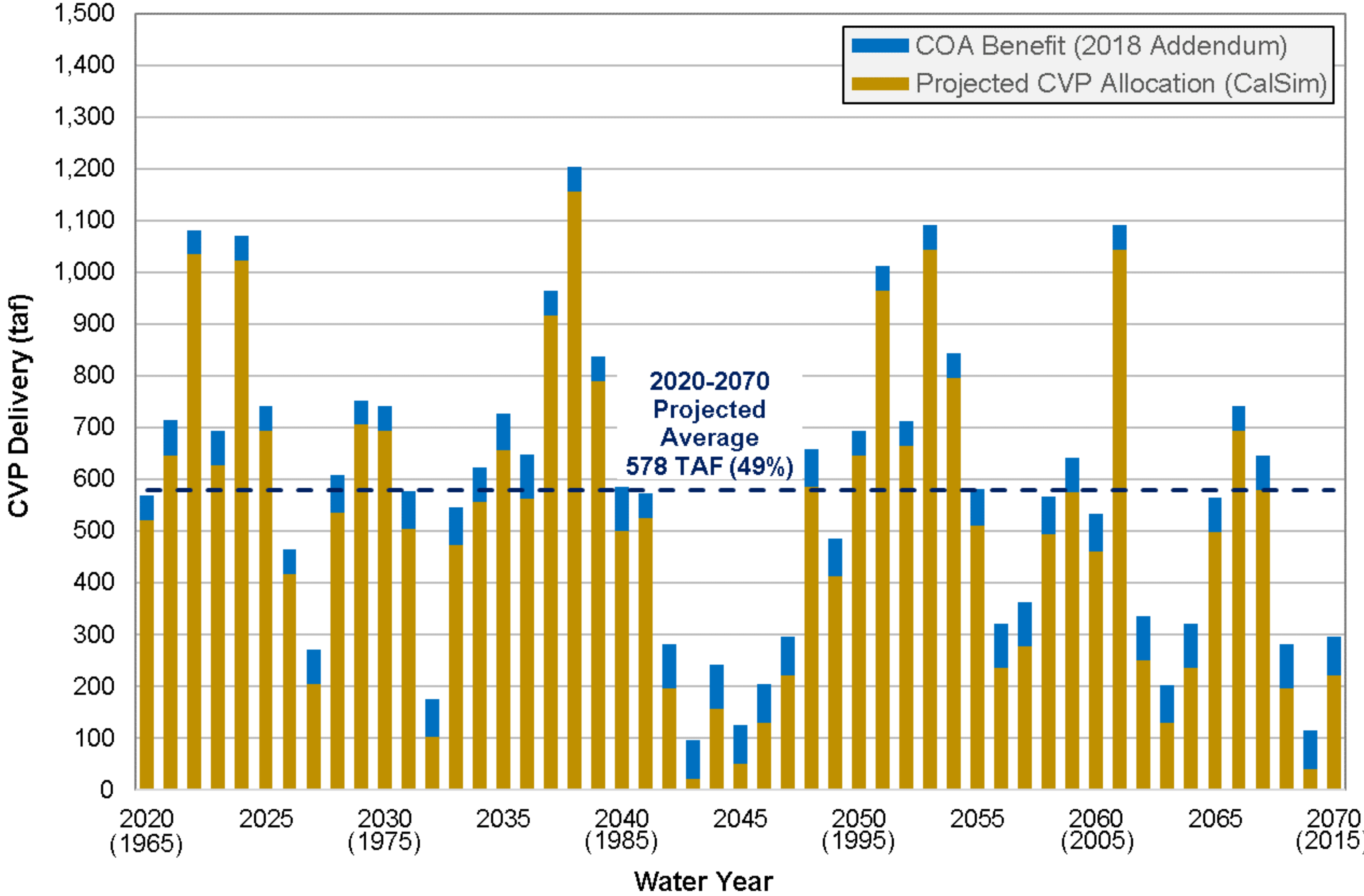
4.5.3.1 Expected Benefits and Metrics

Recharge ponds are expected to directly contribute achieving measurable objectives with respect to land subsidence, groundwater storage and chronic lowering of groundwater levels during periods of higher water demand by increasing groundwater storage in the aquifer system during wet periods. There are anticipated benefits to local water quality particularly in the Upper Aquifer due to recharge of surface water. The site investigations will further quantify and develop a strategy to monitor the expected benefits of potential percolation basins through installation of groundwater monitoring wells. The expected benefits and metrics for evaluating project effectiveness are summarized in **Table 4-8**. A quantitative assessment of expected benefits has not been conducted as estimates of projected recharge rates, timing and location have not been determined at the time of GSP preparation.

Table 4-8: Expected Benefits and Metrics for Evaluating Project Effectiveness

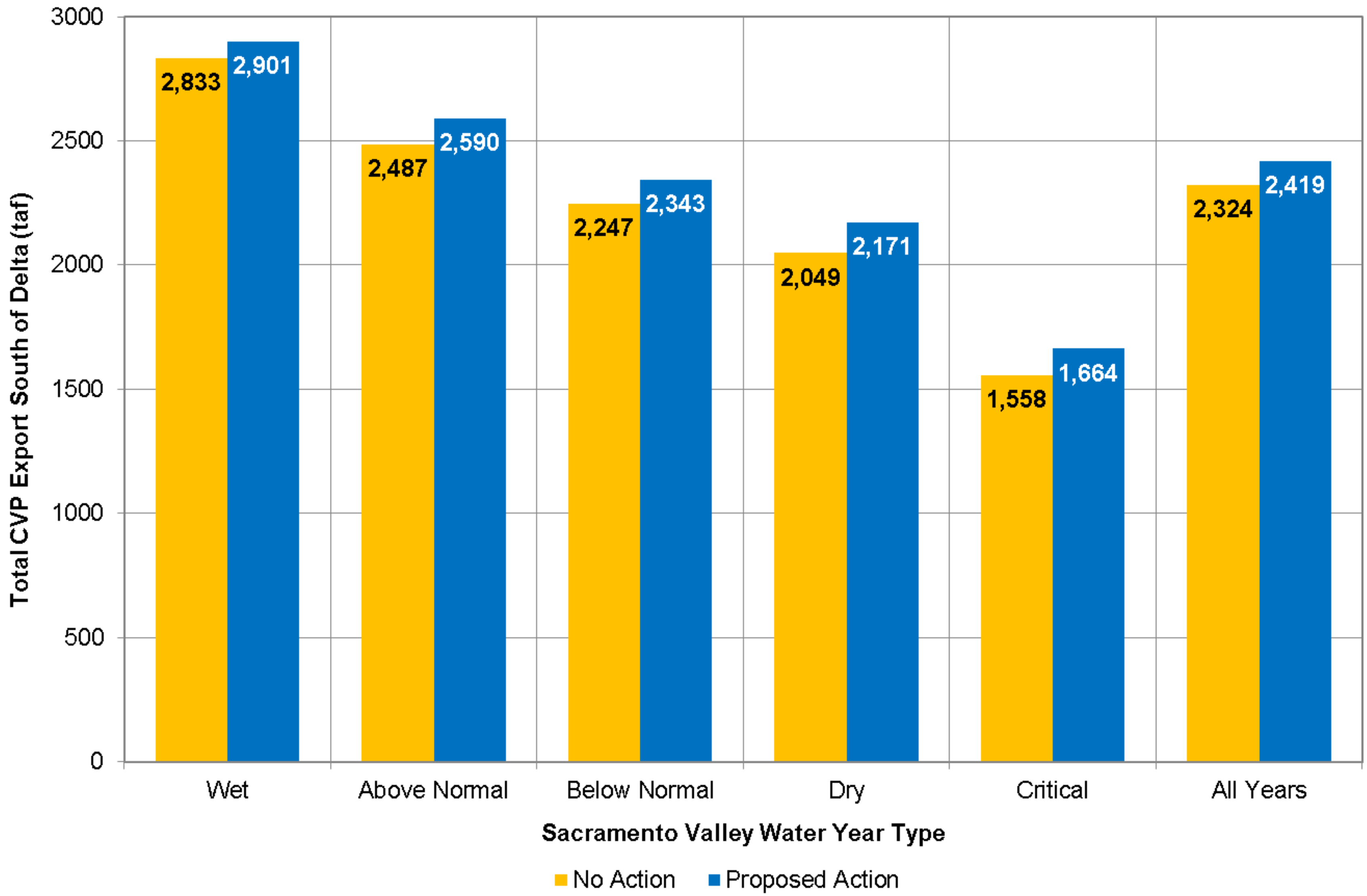
PMA No.	PMA Name	Expected Benefit	Evaluation
No.5	Percolation Basins	1. Stabilize groundwater levels 2. Reduce depletion in groundwater storage 3. Avoid subsidence 4. Avoid degradation of water quality	1. Direct measurement of groundwater levels and comparative analysis[1] 2. Calculation of annual groundwater storage and comparative analysis[1] 3. Direct measurement subsidence and compaction and comparative analysis[1] 4. Direct measurement of water quality constituents and comparative analysis[1]

1. Comparative analysis will evaluate project vs. no project annually using a combination of analytical methods and groundwater modeling as part of the 5-year GSP update.



Luhdorff & Scalmanini Consulting Engineers

Figure 4-1
Projected Central Valley Project Delivery to WWD With 2030 Climate Change Factor (2020-2070)



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Consulting Engineers

Figure 4-2
Total CVP Export South of the Delta from Addendum to the Coordinated Operation Agreement (2018)

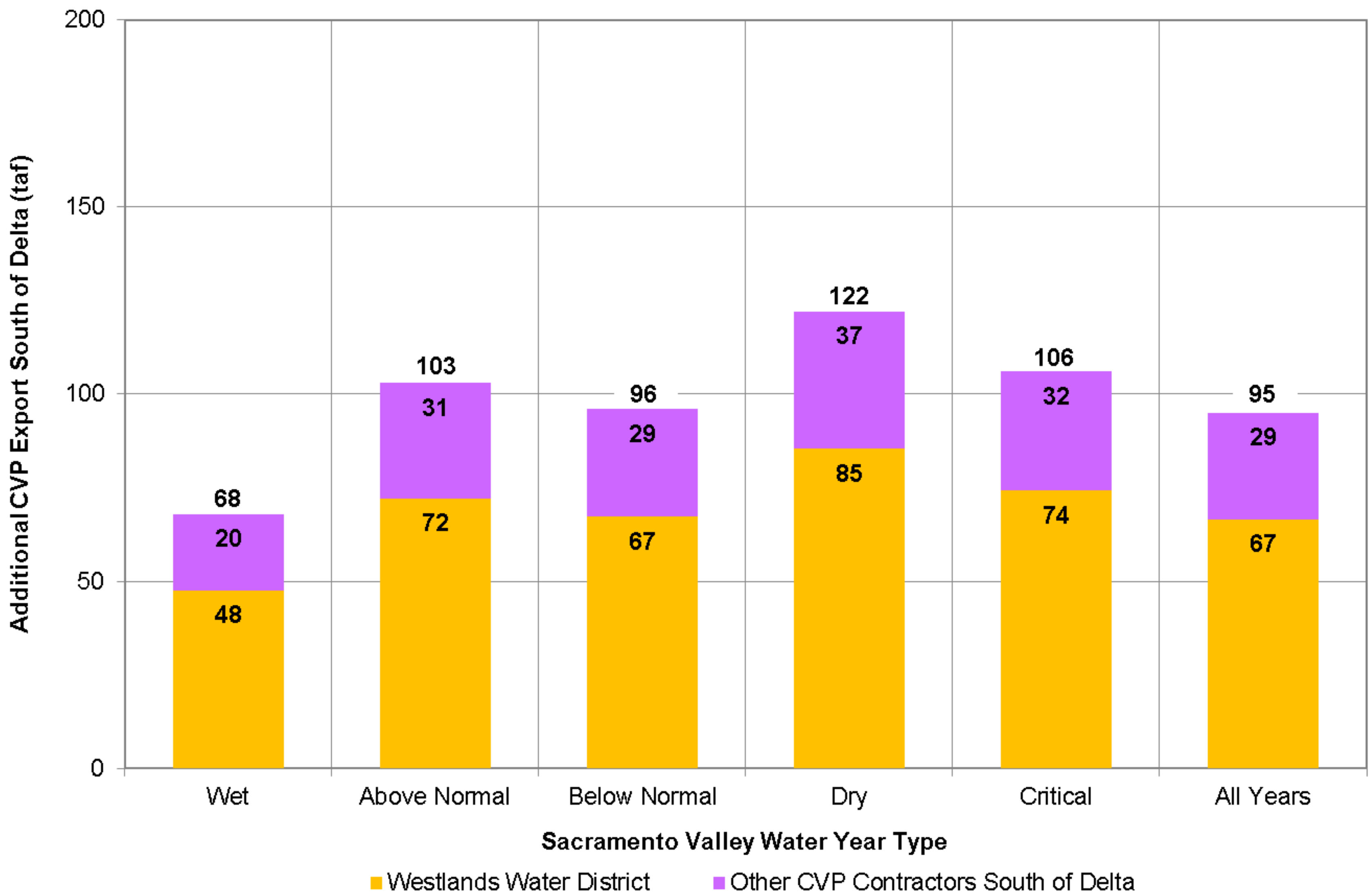

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Figure 4-3
Increase in CVP Export South of the Delta from Addendum to the Coordinated Operation Agreement (2018)

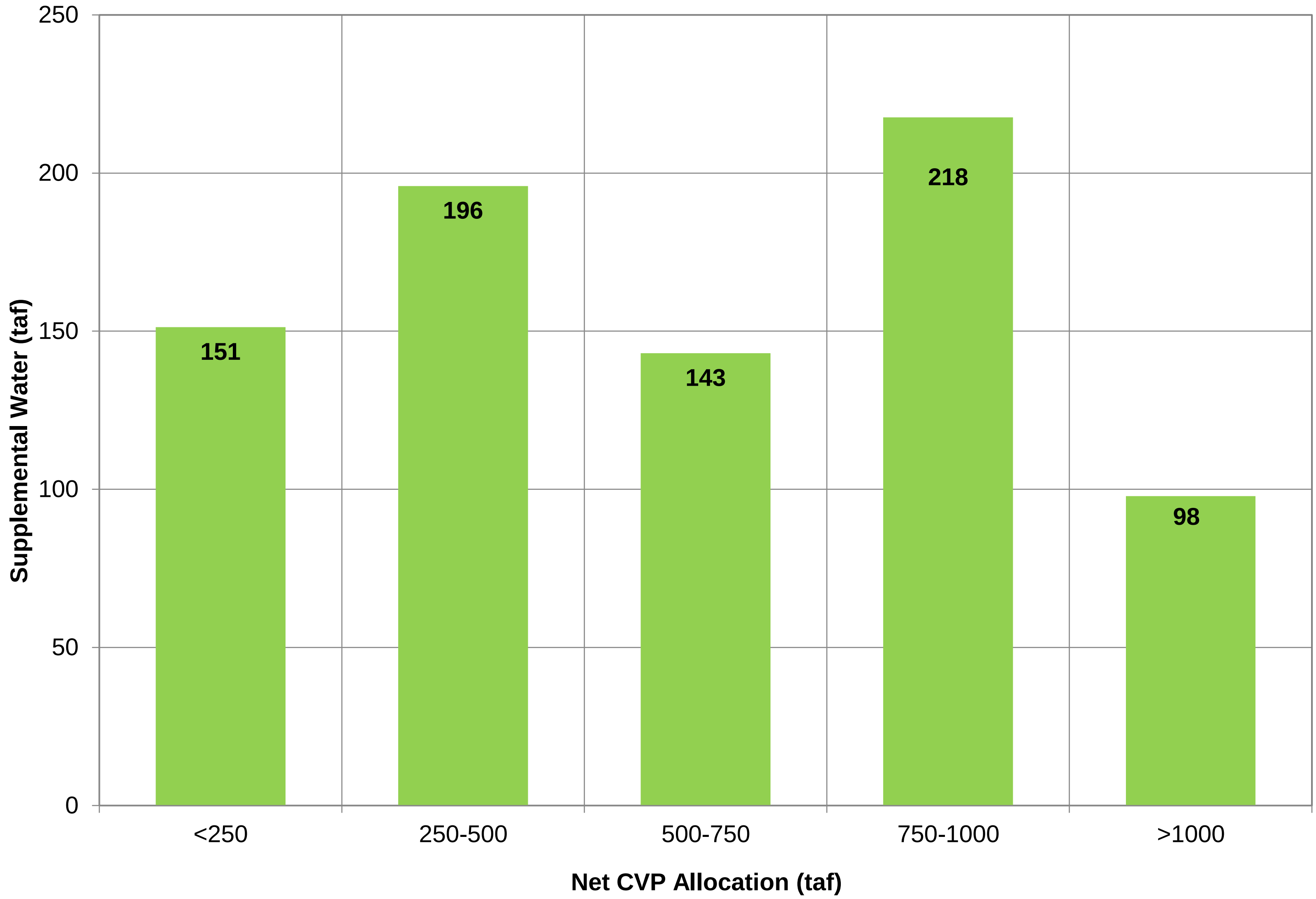

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Figure 4-4
Average Supplemental Surface Water Imports Based on Net CVP Allocation (1988-2017)

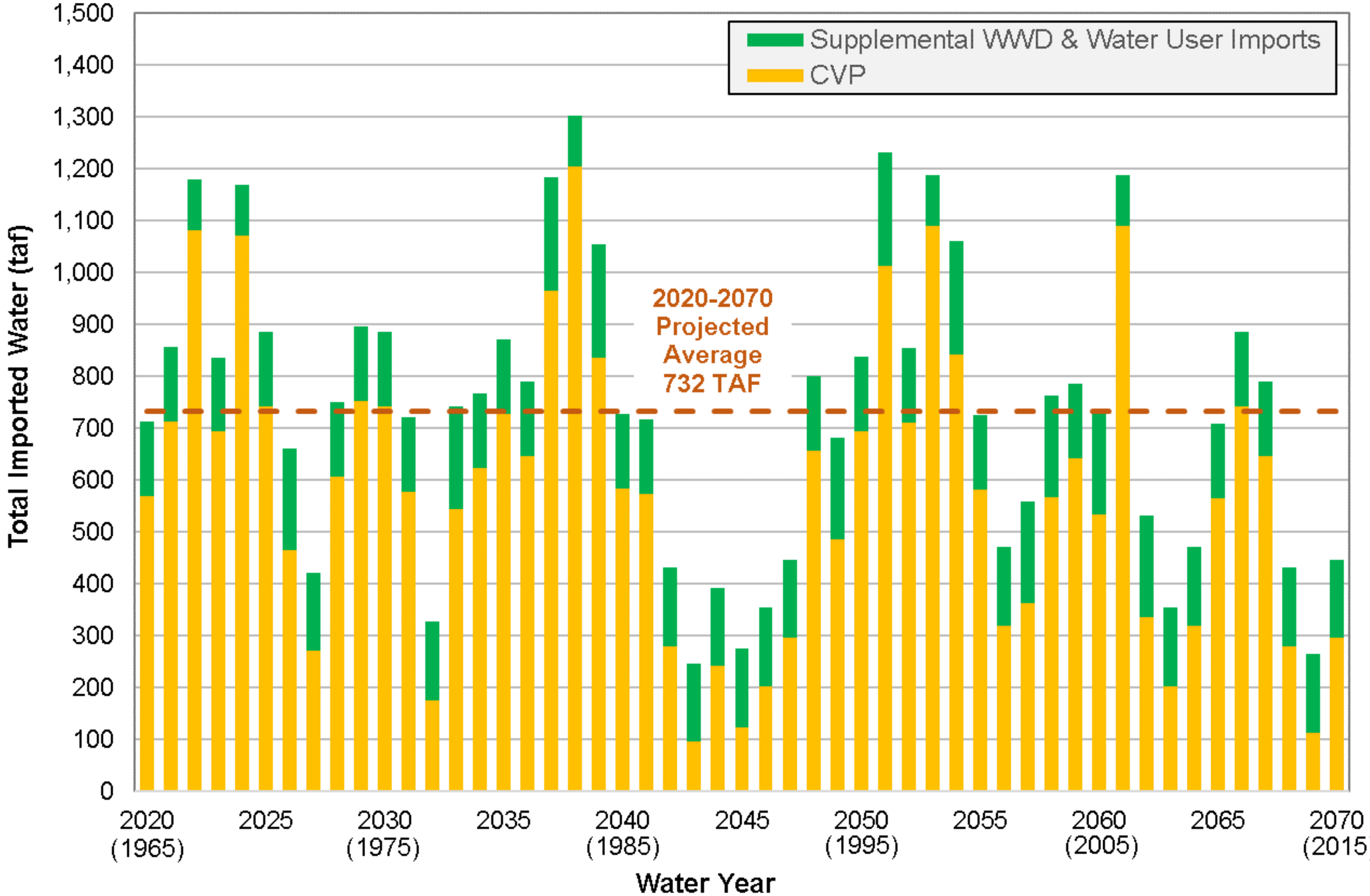

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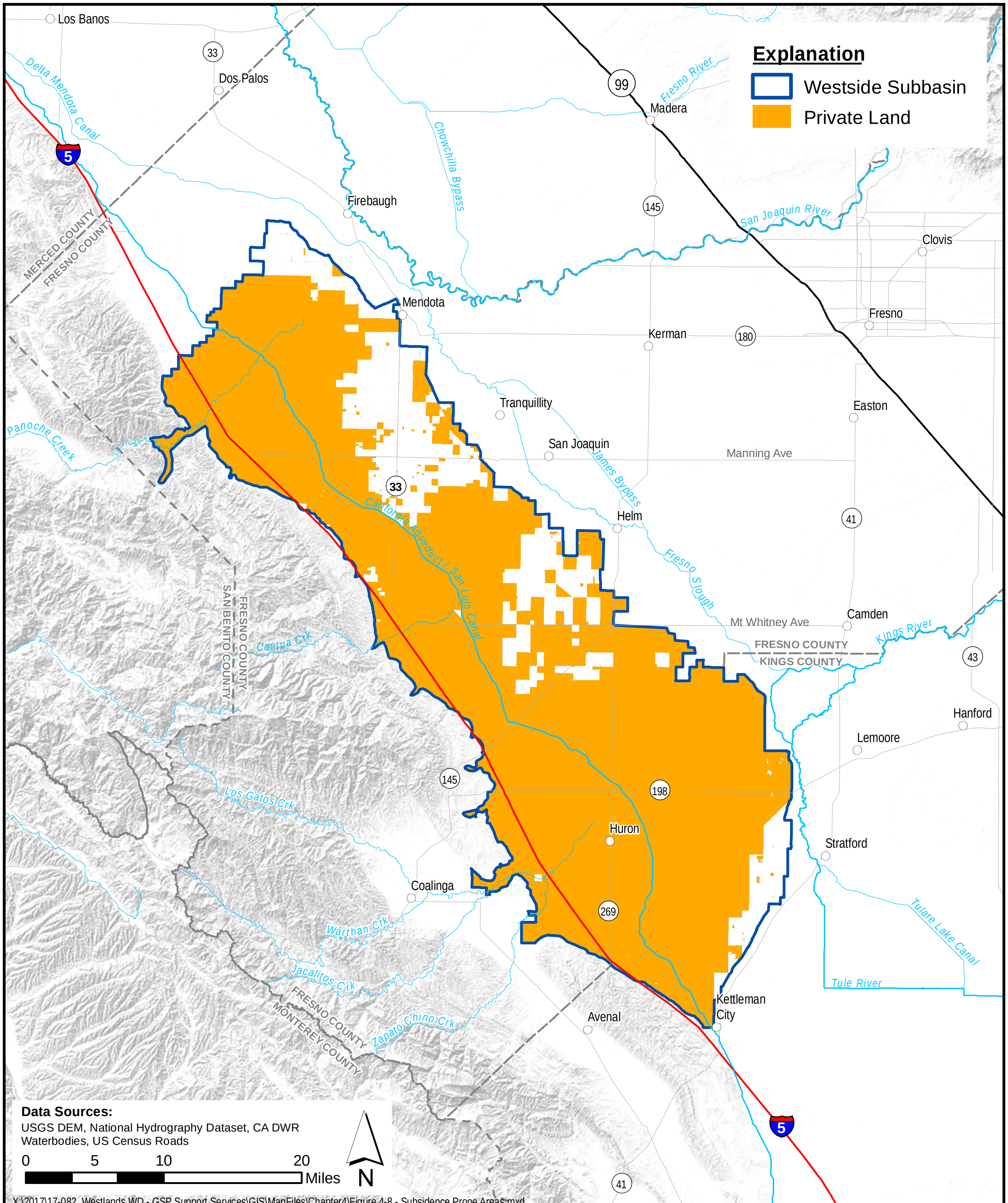
Figure 4-5
Total Projected Surface Water Imports
2020-2070



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Privately Owned Land Within WWD as of 2019

SGMA Sustainability Analyses
Westside Subbasin

Figure 4-6

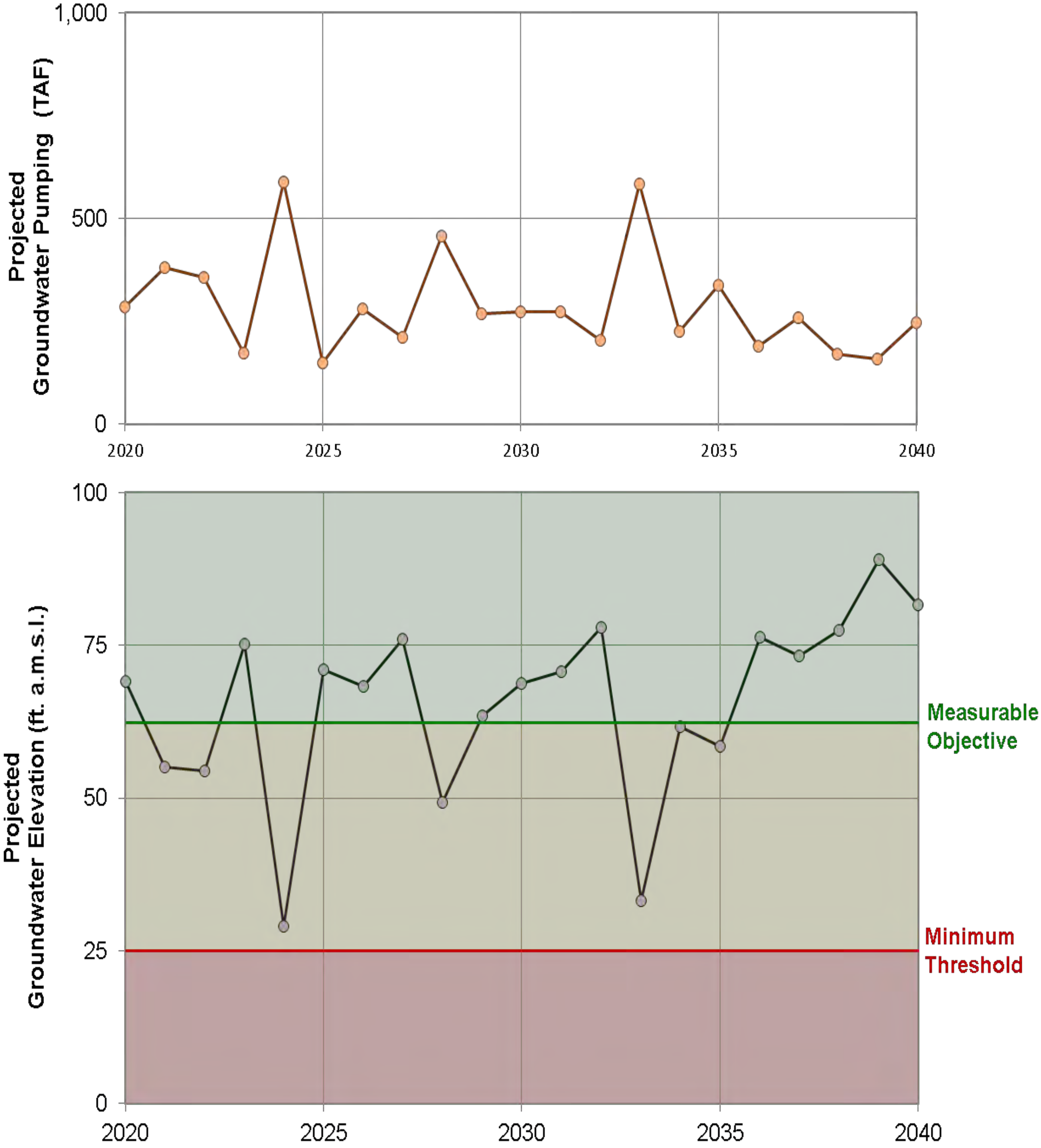

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Figure 4-7
Groundwater Management Levels

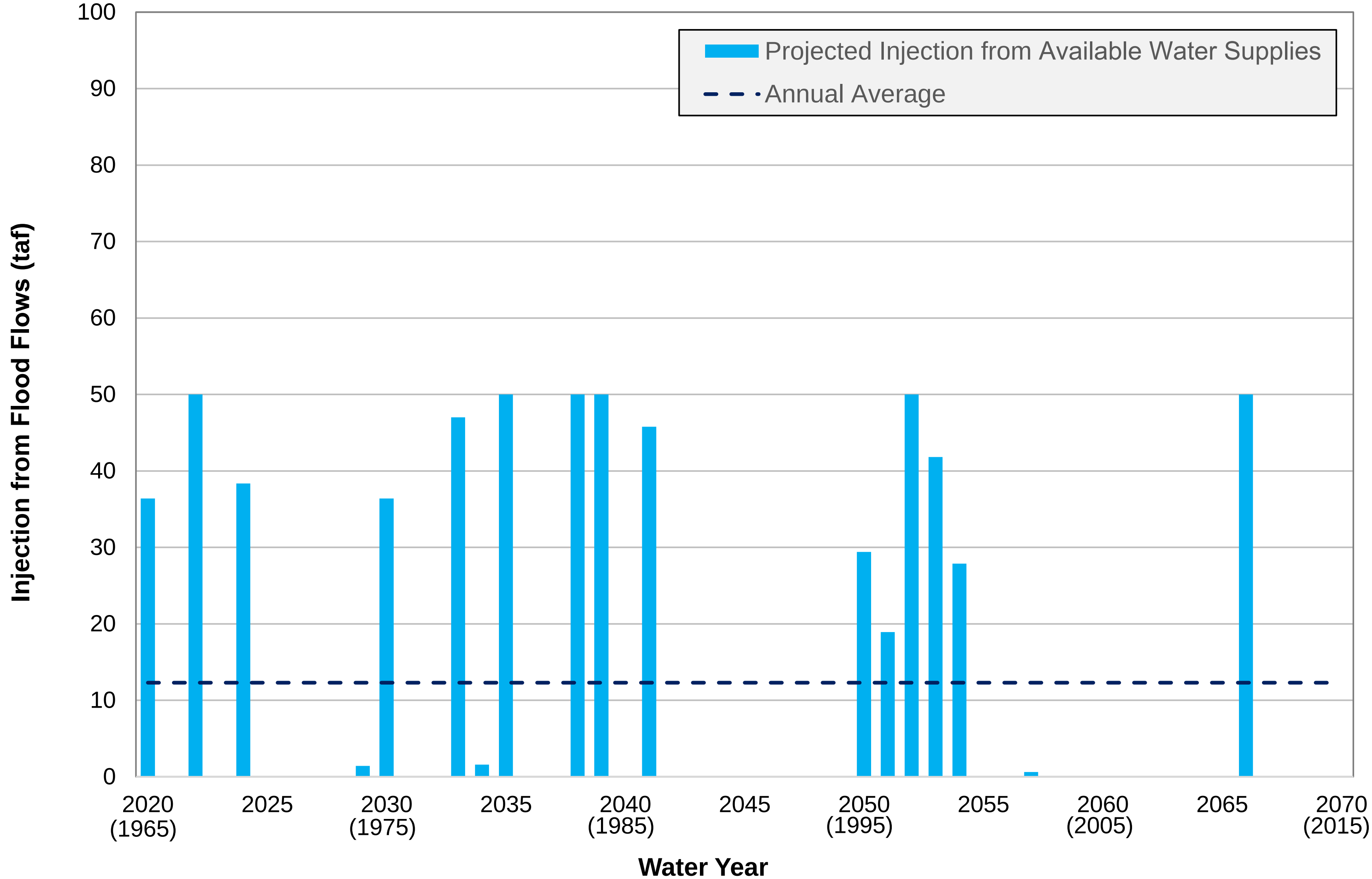

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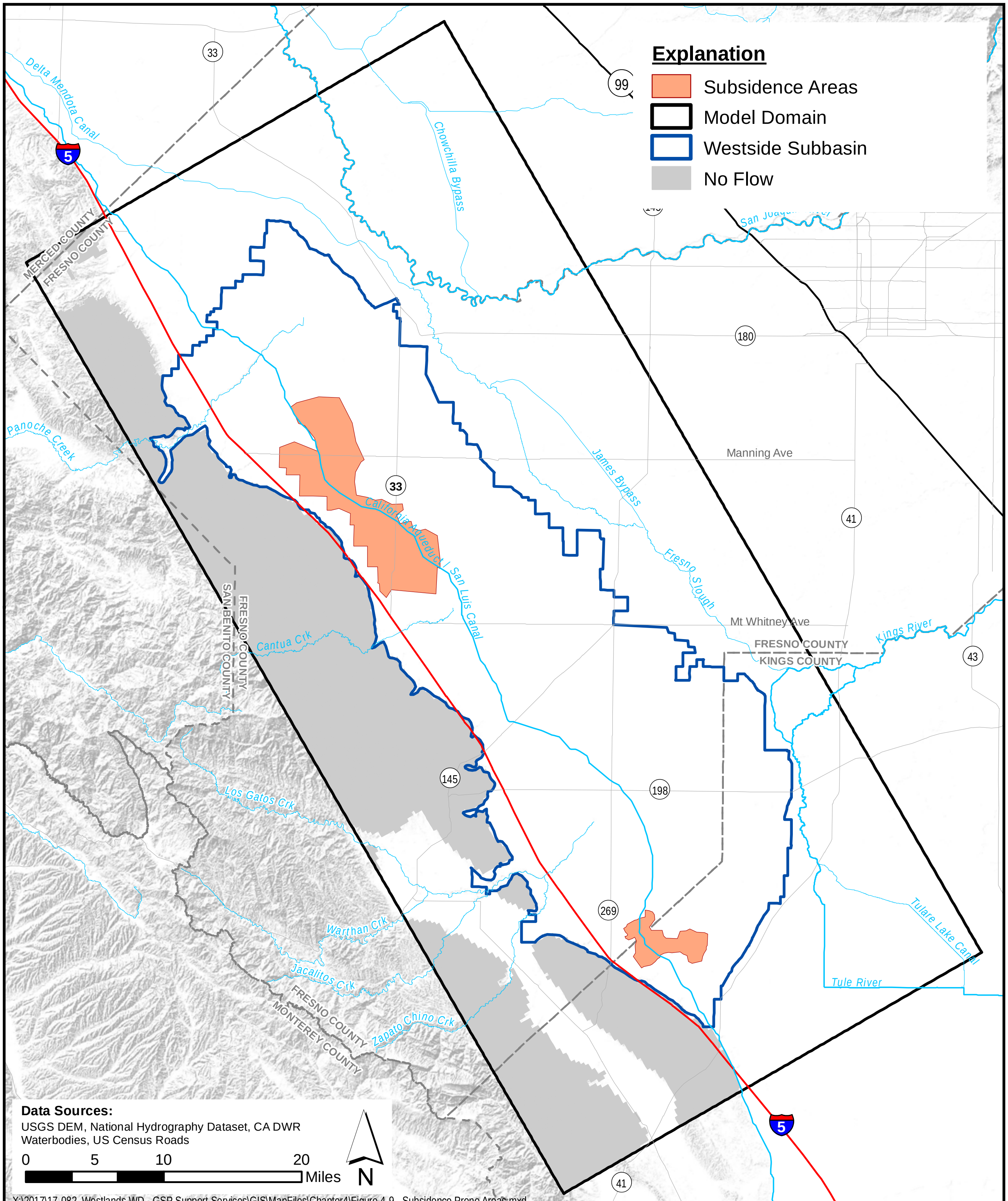
Figure 4-8
Projected ASR Injection from Available Water Supply
2020-2070



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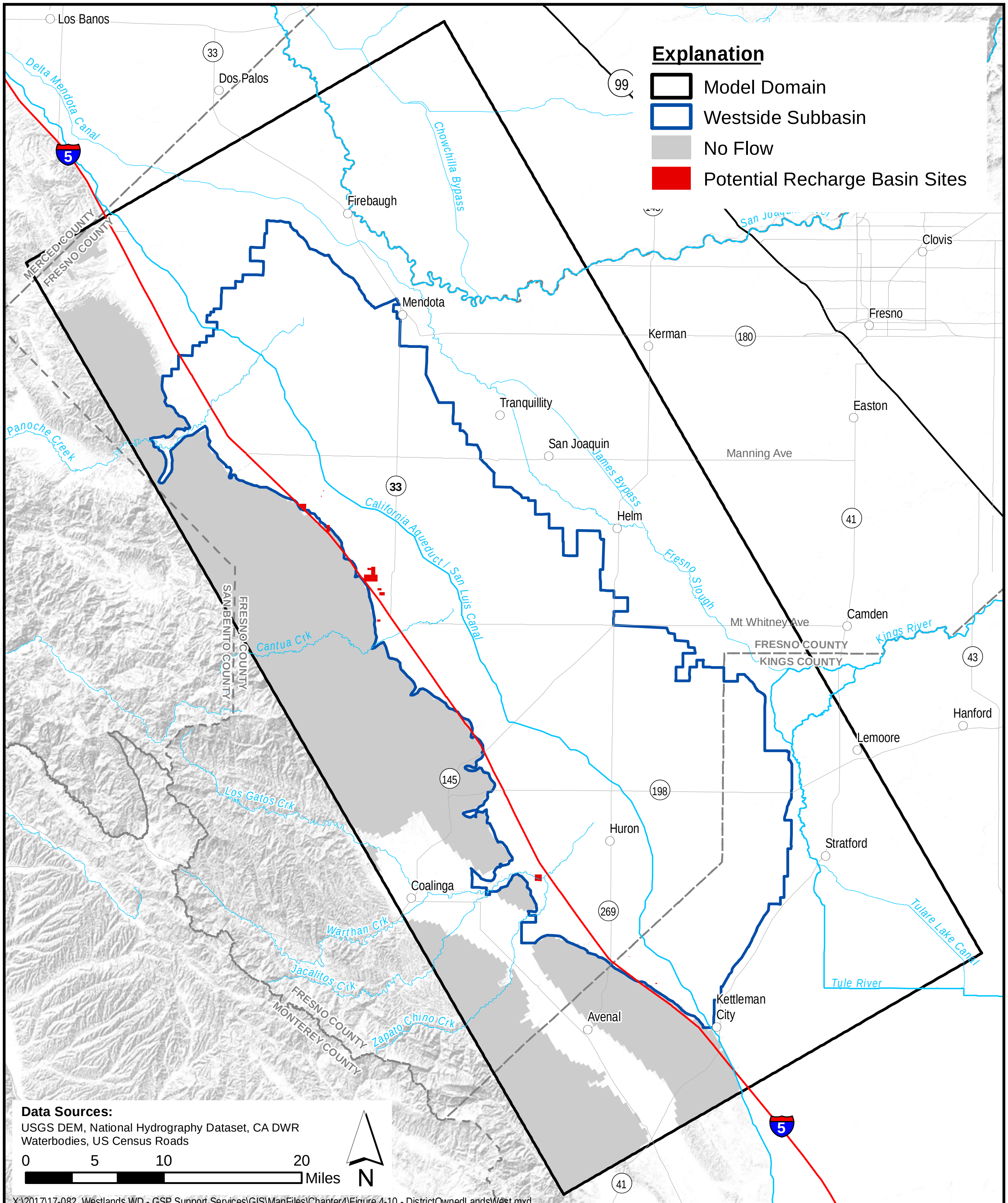
Subsidence Prone Areas

SGMA Sustainability Analyses
Westside Subbasin

Figure 4-9



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Location of District Owned Lands in Western Portion of Subbasin

Figure 4-10

SGMA Sustainability Analyses
Westside Subbasin

5 GROUNDWATER SUSTAINABILITY PLAN IMPLEMENTATION

As discussed in previous chapters, there are several activities and management actions that will be implemented under this Groundwater Sustainability Plan (GSP). Implementation of the GSP includes implementation of the projects and management actions included in Chapter 4, as well as the following:

- WWD GSP implementation program management
- WWD GSA administration
- Public Outreach
- Implementation of the monitoring programs
- Development of annual reports
- Development of 5-year updates and reports

Chapter 5 provides a description of the above, including contents of the annual and five-year reports that will be provided to the Department of Water Resources (DWR) as required under GSP regulations.

5.1 Estimate of GSP Implementation Costs

GSP implementation cost and GSA support costs are estimated on an annual basis and include: operations, monitoring, reporting, management, administration, and the development and implementation of the Project and Management Actions (PMAs) described in Chapter 4. GSP updates will incur additional costs throughout the 20-year implementation period for the GSP. These costs and the associated funding sources are all discussed in further detail below.

5.1.1 Monitoring Costs

Annual monitoring includes monitoring of groundwater levels, water quality, and annual review of land subsidence data, as necessary, in accordance with the Monitoring Plan (see Chapter 3 for more details). Other related tasks include data analysis, management, and system maintenance, monitoring equipment maintenance, pump metering, updates to the groundwater model, and annual reporting. Operations and monitoring tasks are described in detail below. The total estimated monitoring cost is $264,000 as displayed by the tasks in **Table 5-1** below.

Table 5-1: Monitoring Costs

Task No.	Description	Estimated Annual Cost
1	Groundwater Level Monitoring	$10,000
2	Water Quality Monitoring	$20,000
3	Land Subsidence Monitoring	$14,000
4	Administrative Personal (1.1 FTE)	$170,000
5	Annual Comprehensive DWR Reporting	$50,000
Total		**$264,000**

Each task can be described as follows:

1. **Groundwater Level Monitoring:** Professionals trained in collecting groundwater level monitoring data will collect depth to groundwater data, either manually or from transducers, from the Subbasin monitoring network wells as described in Chapter 3. This task includes data management and preparation of an annual report/summary. Groundwater level data will be collected on a semi-annual basis.
2. **Water Quality Monitoring:** Water quality data will be collected on an annual basis. Professionals trained in collecting groundwater samples will obtain water quality samples from designated monitoring wells in the monitoring well network as described in Chapter 3. Samples will be sent to a certified analytical laboratory for analysis. Staff will review and manage laboratory results and prepare an annual report/summary.
3. **Land Subsidence Monitoring**: The network of WWD benchmarks will be monitored on a bi-annual basis by the District Consultant. Staff will review results and prepare an annual report/summary.
4. **Administrative Personal (1.1 FTE):** Professionals trained in database structure, maintenance and organization of the data management system (DMS) will process monitoring data into formats for input into the DMS. The DMS will be updated and the collected data will be checked for accuracy prior to input into the DMS.
5. **Annual Comprehensive DWR Reporting:** Both a "Draft" and "Final" Annual Report will be prepared. The draft will be prepared by the GSA and a final version will be submitted to DWR each year by April 1st. Annual reports must include three key sections: 1) General Information, 2) Basin Conditions, and 3) Plan Implementation Progress. Annual reporting would be completed in a manner and format consistent with Section 356.2 of the GSP regulations. As annual reporting continues, it is possible that this outline will change to reflect basin conditions, the priorities of WWD and applicable requirements from DWR.

5.1.2 Management, Administration, Operations and Other Costs

The implementation of this GSP will result in additional costs accrued by WWD staff. These costs include 1.2 full time employees (Groundwater Master, Accounting Technician, Informational Technology, and Management), with a full time equivalent (FTE) of approximately $170,000. The FTE includes the following fringe benefits, office supplies, vehicles utilities, insurance, and office space for such administration and management. WWD may also incur costs associated with the potential repair and replacement of capital assets such as well meters, monitoring equipment (excludes the transducers and dataloggers already accounted for above), supplies, billing and potential well abandonment costs.

Legal fees are estimated to be $50,000 per year. Other additional expenses include audit services, insurance, engineering services, permits and fees, land management expenses, and public outreach. Many of these costs will vary and be dependent on numerous factors such as the implementation schedule and unforeseen needs during the implementation of the GSP. Therefore, additional cost evaluation will be necessary throughout the GSP implementation period. The estimated costs are summarized in **Table 5-2** below.

Table 5-2: Management, Administration, and Other Costs

No.	Description	Estimated Annual Cost
1	Pump Metering	$15,000
2	Operation and Maintenance	$45,000
3	Project Management and Coordination (0.5 FTE)	$100,000
4	Administrative Personnel (0.7 FTE)	$70,000
5	Engineering & Consulting Services	$20,000
6	Legal Expenses	$50,000
7	Public Outreach	$15,000
	Total	**$315,000**

Each task can be described as follows:

1. **Pump Metering:** Groundwater pumping data will be obtained from wells that have already been equipped with meters for all pumped wells within the Subbasin, and an annual groundwater extraction report/summary will be prepared. Meter calibrations, validation, maintenance, and replacements will occur as needed.
2. **Operation and Maintenance:** Maintenance and repairs to monitoring instruments such as transducers, dataloggers, etc. will be addressed as necessary.
3. **Project Management and Coordination:** Interbasin correspondence between GSA and adjacent GSAs and other consultants and parties. GSA and GSP management and implementation update meetings will occur as necessary. This task will also include outreach in the form of an annual workshop.
4. **Administrative Personal:** Interested parties outreach, accounting system support, public outreach support.
5. **Engineering & Consulting Services:** Provide additional "as needed" technical support.
6. **Legal Expense:** Facilitate and support water rights, water transfer programs and provide legal review of project components and implementation.
7. **Public Outreach:** During GSP development, the WWD GSP Program used multiple forms of outreach to communicate SGMA-related information and solicit input. The GSA intends to continue public outreach and provide opportunities for engagement during GSP implementation. This will include providing opportunities for public participation, especially from beneficial users, at public meetings, providing access to GSP information online, and continued coordination with entities conducting outreach to disadvantaged communities (DAC) in the Subbasin. Announcements will continue to be distributed via email prior to public meetings (e.g., public workshops and GSA Board meetings). Emails will also be distributed as specific deliverables are finalized, when opportunities are available for public input and when this input is requested, or when items of interest to the stakeholder group arise, such as relevant funding opportunities. The WWD SGMA website, managed as part of GSP Administration, will be updated a minimum of quarterly, and with information related to the

program. The website may be updated to add new pages as the program continues and additional activities are implemented. Additionally, the GSA will host public workshops to provide an opportunity for stakeholders and members of the public to learn about, discuss, and provide input on GSP activities, progress towards meeting the Sustainability Goals of this GSP, and the SGMA program.

5.1.3 Plan Update Costs

Every fifth year of the GSP implementation, and with GSP amendments, the GSA will update the GSP and submit the GSP for DWR's review. An evaluation must also be made whenever the GSP is amended. The GSP five-year updates will include revisions to the existing GSP document deemed necessary along with additional information topics described below and would be prepared in a manner consistent with §356.4 of the GSP Regulations.

5.1.3.1 Sustainability Evaluation

This section will contain a description of current groundwater conditions for each applicable sustainability indicator and will include a discussion of overall Subbasin sustainability. Progress towards achieving interim milestones and measurable objectives will be included, along with an evaluation of groundwater elevations (being used as direct measure for water level and proxy measure surface water depletions), groundwater quality, and subsidence in relation to minimum thresholds.

5.1.4 Plan Implementation Progress

This section will describe the current status of project and management actions since the previous five-year report. An updated project implementation schedule will be included, along with any new projects that were developed to support the goals of the GSP and identification of any projects that are no longer included in the GSP. The benefits of projects that have been implemented will be included, and updates on projects and management actions that are underway at the time of the five-year report will be reported.

5.1.5 Reconsideration of GSP Elements

Part of the five-year report will include a reconsideration of GSP elements. As additional monitoring data is collected during GSP implementation, land uses and community characteristics change over time, and PMAs are implemented, it may become necessary to revise the GSP. This section of the five-year report will reconsider the Subbasin setting, management areas, undesirable results, minimum thresholds, and measurable objectives. If appropriate, the five-year report will recommend revisions to the GSP. Revisions will be informed by the outcomes of the monitoring network, and changes in the Subbasin, including but not limited to, changes to groundwater uses or supplies and outcomes of PMA implementation.

5.1.6 Monitoring Network Description

A description of the monitoring network will be provided in the five-year report. Data gaps will be identified consistent with Sections 352.4 and 354.34(c) of the regulations. An assessment of the monitoring network's function will be provided, along with an analysis of data collected to-date.

5.1.7 New Information

New information available since the last five-year evaluation or GSP amendment will be described and the GSP evaluated in light of this new information.

5.1.8 Regulations or Ordinances

The five-year report will include a summary of the regulations or ordinances related to the GSP that have been implemented since the previous report and address how these may require updates to the GSP.

5.1.9 Legal or Enforcement Actions

Enforcement or legal actions taken by the GSA in relation to the GSP will be summarized in this section along with how such actions support sustainability in the Subbasin.

5.1.9.1 Plan Amendments

A description of amendments to the GSP will be provided in the five-year report, including adopted amendments, recommended amendments for future updates, and amendments that are underway during development of the five-year report.

The five-year update will incur additional costs for that year. These costs include the professional services necessary for reviewing and updating the Water Budget, Groundwater Model, Sustainable Yield, Pumping Allocations, and the preparation of the Plan Evaluation and Assessment Report. A summary of these estimated costs is provided in **Table 5-3** below.

Table 5-3: Plan Update Costs

Task No.	Description	Estimated Cost for 5-Year Plan Update
1	Updates to Water Budget, Analysis of Effectiveness of PMA's, Revise MO/MT, Groundwater Model, and Sustainable Yield	$240,000
2	Updates to Management Strategies	$18,000
3	Public Outreach	$10,000
4	5-Year Plan Evaluation and Assessment Report	$32,000
	Total	**$300,000**

5.1.9.2 Project and Management Actions Development and Implementation Costs

Project and Management Actions (PMAs) are presented in Chapter 4. The estimated costs associated with these plans and programs are presented in **Table 5-4** below. Cost summarized in **Table 5-4** are the responsibility of the program participates. Proposed PMAs are presented at the planning level and additional costs will be incurred with feasibility studies and full implementation.

Table 5-4: Project Management Actions Development Costs

PMA	Description	Estimated Cost	Level of Project Development
1	Surface Water Imports	$0	Planning
2	Initial Allocation of Groundwater Extraction	$30,000	Planning and trading/storage system development
3	Aquifer Storage and Recovery	$400,000	Program implementation
4	Targeted Pumping Reductions (reduce pumping near Check 16, 17 and 20)	$1,250,000	Planning and engineering
5	Percolation Basins	$100,000	Planning

5.1.10 Environmental Impact Report Cost

The California Environmental Quality Act (CEQA) is not applicable to GSP preparation, but CEQA is applicable to new projects listed in **Table 5-4**. If the project is not CEQA exempt, then an Initial Study Reports (IS) will be prepared for GSP implementation of projects and management actions. Cost will vary by project depending on the required environmental documentation. It is estimated that environmental costs could increase by approximately $200,000 to $500,000. If a project requires National Environmental Policy Act (NEPA) compliance, costs could increase by approximately $500,000 to $750,000.

5.1.11 Total Costs

Annual implementation costs of this GSP are expected to vary from year to year due to PMA implementation status and needs, significance of data, updates to data management and modeling systems, other management needs, potential increased reporting requirements during the 5-year milestone review period. There will also be unknown equipment replacement and maintenance needs, professional services, and various other sources that could affect the annual cost. The cost will be updated as necessary during the milestone review periods. Since this GSP provides planning and cost estimates until 2040, an annual inflation value of 3% was assumed for planning and budgeting purposes. The total implementation cost also assumes a 10% contingency over the 20-year implementation period. The total estimated GSP implementation cost is $16,124,894 as displayed in **Table 5-5**.

Table 5-5: GSP Estimated Implementation Cost Through 2040

Fiscal Year	Monitoring Costs	Management, Admin., Operations, & Other Costs	5-Year Annual Reviews & Updates	10% Contingency	Total
2020	$264,000	$310,000	$0	$57,400	$631,400
2021	$164,000	$319,300	$0	$48,330	$531,630
2022	$168,920	$328,879	$0	$49,780	$547,579
2023	$173,988	$338,745	$0	$51,273	$564,006
2024	$179,207	$348,908	$0	$52,811	$580,926
2025	$184,583	$359,375	$300,000	$84,396	$928,354
2026	$190,121	$370,156	$0	$56,028	$616,305
2027	$195,825	$381,261	$0	$57,709	$634,794
2028	$201,699	$392,699	$0	$59,440	$653,838
2029	$207,750	$404,480	$0	$61,223	$673,453
2030	$213,983	$416,614	$345,000	$97,560	$1,073,157
2031	$220,402	$429,112	$0	$64,951	$714,466
2032	$227,014	$441,986	$0	$66,900	$735,900
2033	$233,825	$455,245	$0	$68,907	$757,977
2034	$240,840	$468,903	$0	$70,974	$780,717
2035	$248,065	$482,970	$396,750	$112,778	$1,240,563
2036	$255,507	$497,459	$0	$75,297	$828,262
2037	$263,172	$512,383	$0	$77,555	$853,110
2038	$271,067	$527,754	$0	$79,882	$878,703
2039	$279,199	$543,587	$0	$82,279	$905,064
2040	$287,575	$559,894	$456,263	$130,373	$1,434,105
Total	**$4,670,741**	**$8,889,711**	**$1,498,013**	**$1,505,846**	**$16,564,311**

5.1.12 Funding Sources

The implementation of the GSPs and SGMA compliance will likely require GSAs to collect fees as well as seek additional outside funding. The GSA will develop a financing plan for the overall implementation of the GSP. SGMA grants a GSA the authority to impose fees on the extraction of groundwater to fund costs of groundwater management under a GSP. (Wat. Code, §§ 10730, 10730.2(a).) These fees can cover groundwater management costs, including but not limited to, administrative, operations and maintenance; acquisition of property, facilities and services; supply, production, treatment or distribution of water; or other activities necessary or convenient to implement the GSP. (Wat. Code, §§ 10730, 10730.2(a).) Fees imposed under SGMA may include fixed fees and fees charged on a volumetric basis. (Wat. Code, §§ 10730(a), 10730.2(d).)

In addition to the fee authority granted by SGMA, a GSA retains any separate fee authority granted to it by any other laws. (Wat. Code, § 10730.8.) The District thus may also elect to adopt a charge or assessment under its water district fee authority pursuant to Water Code section 35470 *et seq*.

Pursuant to this authority, the GSA shall adopt a fee in accordance with SGMA and the California law. The amount and type of the GSA fee will be developed through a comprehensive fee study. The GSA will then adopt a fee, in accordance with California law, to cover the costs of GSP implementation. Prior to implementing any fee, the GSA will comply with the regulatory requirements.

5.2 Implementation Schedule

The GSP will be completed and submitted to DWR by January 31, 2020. Implementation will begin thereafter. **Figure 5-1** and **Figure 5-2** provide a preliminary schedule for implementation. The schedules are subject to change as implementation proceeds and will be evaluated and updated during each annual or periodic review as necessary based on implementation progress, the sustainability goal, and other factors.

Annual Reporting of GSP implementation progress will occur in accordance with SGMA and will include semi-annual measurements of groundwater levels, water quality, streamflow measurements, and annual, continuous, or as-needed reporting of meters, meter calibration, subsidence, and model and data system updates, all of which are discussed in further detail in Section 5.3 below. Annual Reports will be prepared and submitted to DWR by April 1st of each year. Periodic Reporting will occur every 5 years and as needed changes to the GSP are due to DWR by April 1st.

The five (5) PMAs and their associated implementation schedules are presented in **Figure 5-3** below. These actions need to undergo CEQA review to determine if action is needed to reduce, mitigate, or minimize potential environmental impacts. An environmental document, such as a Negative Declaration (ND) or Environmental Impact Report (EIR) may need to be prepared and developed in addition to NEPA compliance for some of these PMAs. Following certification of the environmental review processes, the PMAs will be implemented with milestone goals over the 20-year implementation period to achieve sustainability by 2040.

5.3 Annual Reporting

Pursuant to GSP Regulations section 356.2, the GSA will submit an Annual Report to DWR each year following the adoption of the GSP with information from the preceding water year, shown in **Table 5-6** below, with the following information:

Table 5-6: Annual Reporting Requirements

Description	Occurrence	Reported As
General Information	Reporting Period	Executive Summary, Basin Map
Groundwater Elevation Data	Semi-Annual Measurements	Groundwater Elevation Contour Maps, Hydrographs
Groundwater Extraction Data	Annual Measurements	Tables, Maps, Accuracy, Summary
Surface Water Supply	Annual Measurements	Tables, Summary
Total Water Use	Reporting Period	Table, Summary
Changes in Groundwater Storage	Reporting Period	Aquifer Maps, Graphs, Summary
Implementation Progress	Reporting Period	Summary

1. **General Information:** The GSA will prepare an executive summary to report any significant findings or key recommendations from the reporting period and provide a map highlighting the basin covered by the report.
2. **Groundwater Elevation Data:** Groundwater elevation data will be collected on a semi-annual basis as described in Chapter 3. The collected data will be organized in a data management system and groundwater elevation contour maps by aquifer will be developed for the Annual Report. Each aquifer's contour maps will depict the groundwater conditions' seasonal high and seasonal low. Historical hydrographs from January 1, 2015, to present will be submitted annually to DWR. The Annual Report will include a written interpretation of this data with references to past data and any observed data gaps and recommendations going forward, if needed.
3. **Groundwater Extraction Data:** Groundwater extraction data for the preceding water year will be presented in the Annual Report in the form of tables, a map, and a written description. This data will be obtained from WWD pumping records from metered extractions and presented in a table that summarizes groundwater extractions by water use sector, the measurement method (direct or estimated), and accuracy of the measurements. This section will be accompanied by map showing the general location and volume of groundwater extractions.
4. **Surface Water Supply:** Surface water quantities supplied or available for use, for recharge or in-lieu use, will be presented in the Annual Report and measured through annual surface water diversion reporting.
5. **Total Water Use:** Total water use within the GSP boundary will be evaluated through direct methods such as WWD production and delivery records and metered well use where applicable and indirect methods such as recent Urban Water Management Plans and Agricultural Water Management Plans and other sources of estimation where necessary. A table showing the total

water use by sector, the method of measurement (direct or estimated), and accuracy of measurements will be provided to summarize the annual water use data.

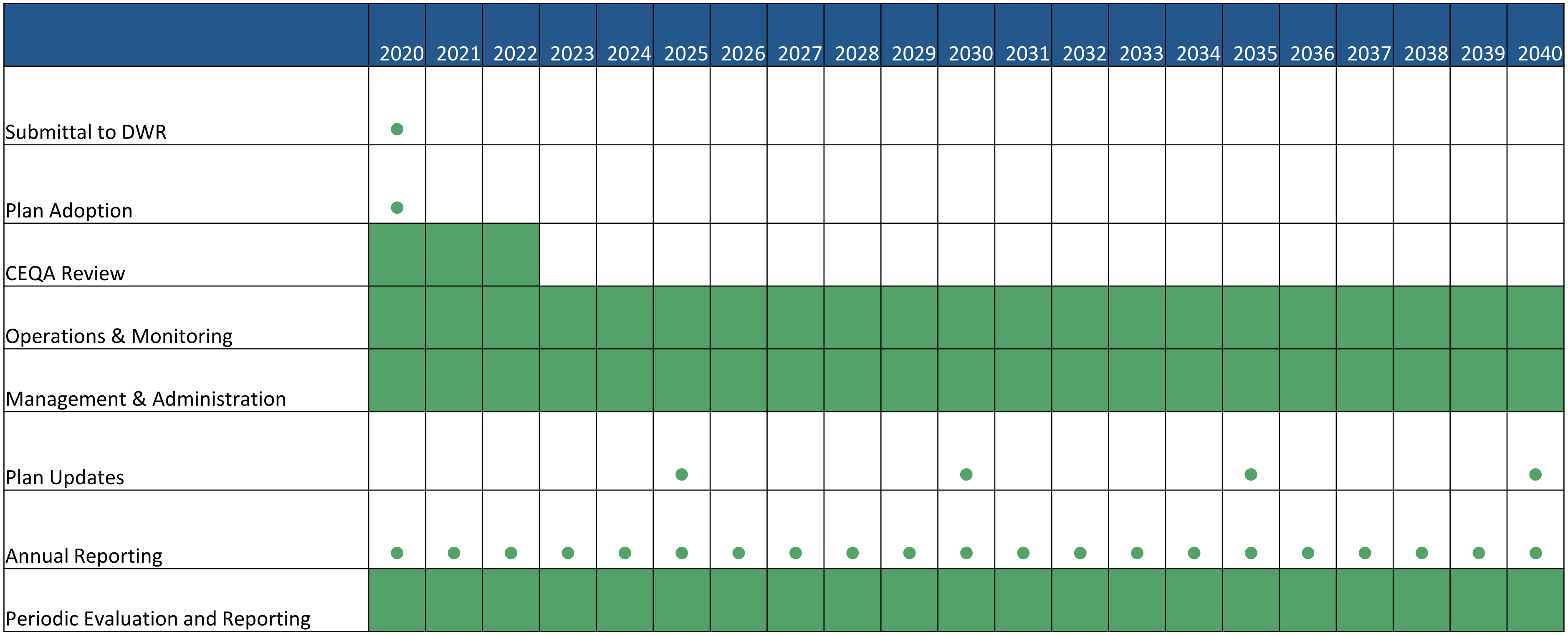
6. **Changes in Groundwater Storage:** The estimated change in groundwater storage for each principal aquifer for the preceding water year will be determined using observed changes in groundwater levels over a time period. This information will be presented on a map for each aquifer and on graphs showing the water year type (wet, dry, or normal), groundwater use, annual change in groundwater storage, and the cumulative change in groundwater storage based on historical data and information from the reporting period.
7. **Implementation Progress:** The Annual Report will include a summary of the progress of the GSP implementation. Milestones, significant updates or changes, implementation schedule, and implementation tasks and costs will be reviewed, discussed, and updated as necessary.

5.4 Periodic Evaluation and Reporting

The GSA will evaluate its GSP every five-years at a minimum with additional evaluation as required. A written assessment of the evaluation will be provided to DWR which will include the elements of the Annual Reports, as described above, implementation progress, and progress toward meeting the sustainability goal of the Westside Subbasin. The GSA will also make these periodic evaluations available to interested parties and the public through WWD's SGMA website, https://wwd.ca.gov/sgma and via email to the interested persons list. Periodic evaluations will also include the following:

1. **Current Groundwater Conditions:** An evaluation and description of current groundwater conditions will be included for each applicable sustainability indicator relative to the measurable objectives, interim milestones, minimum thresholds, and undesirable results as provided in Chapter 3. Graphs, figures and a written description will be prepared as needed to depict groundwater elevations for the evaluation period in key wells in relation to the goals and thresholds established in this GSP.
2. **Implementation of Project Management Actions:** PMAs will be evaluated to determine their implementation status, success, and progress toward reaching the GSP sustainability goal. This will include an evaluation of the effect of the PMA on groundwater conditions and other factors, as necessary. Adaptive management processes will be incorporated and if it is determined that the PMA is not meeting the sustainability goal or implementation timeline, it will be re-evaluated and potentially placed on an accelerated implementation path.
3. **Plan Elements:** Elements of this Plan, such as the basin setting and management areas, as discussed in previous chapters, will be evaluated for any potential reconsiderations or revisions. Updates and revisions will be proposed as necessary in the evaluation. The sustainability indicators will be evaluated for undesirable results and minimum thresholds and measurable objectives will be reconsidered with revisions proposed, if necessary. Evaluation will include the progress of the Plan toward meeting the sustainability goal and interim milestones.
4. **Basin Evaluation:** Each periodic evaluation will include an assessment of the basin setting in relation to any significant or unanticipated changes or new information that may have developed during the evaluation period. This will include significant changes in water use with special attention to potential overdraft conditions. If warranted, the report will describe the specific impact of revised sustainability yield value on pumping allowances, measurable objectives, interim milestones and other relevant components of the GSP.

5. **Monitoring Network:** A description of the established Monitoring Network, as described in Chapter 3, will be provided in the periodic evaluation and will include a description of potential data gaps, areas within the basin that are represented by data that does not meet the Data and Reporting Standards set by SGMA, and an assessment of the Monitoring Network's functionality. If necessary, the evaluation will include actions necessary to improve the monitoring network, identification of data gaps and a program to acquire additional data sources and the timing of such, and a plan to install new data collection facilities.
6. **New Information:** Any significant, new information that has been developed since the Plan adoption or amendment or the last periodic evaluation will be discussed.
7. **Relevant Actions:** The evaluation will include a description of any relevant actions taken by the GSA since the preceding periodic or 5-year assessment including any regulations or ordinances related to the Plan, development of new Project Management Actions, and other actions impacting the implementation of the GSP.
8. **Enforcement or Legal Actions:** A description of any enforcement or legal actions taken by the GSA during the evaluation period will be included.
9. **Plan Amendments:** The evaluation will include a description of any completed or proposed Amendments to the Plan.
10. **Summary of Coordination:** If necessary, a description of the coordination of GSAs within the basin, coordination between hydrologically connected basins, and land use agencies will be presented.
11. **Other Information:** The Periodic Evaluation will include any other appropriate and relevant information pursuant to SGMA, the Plan Implementation, and DWR review.



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Schedule for Implementation - Overview

Groundwater Sustainability Plan – Westside Subbasin

Figure 5-1

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Reporting																					
Groundwater Level Monitoring	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Water Quality Reporting	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pump Metering	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Land Subsidence Monitoring	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Operations & Maintenance																					
Data Management System	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Groundwater Model Update	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DWR Reporting	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Project Management & Coordination																					

● Occurs once a year

● Occurs twice a year

● Occurs monthly

Ongoing

*All monitoring is reported on an annual basis

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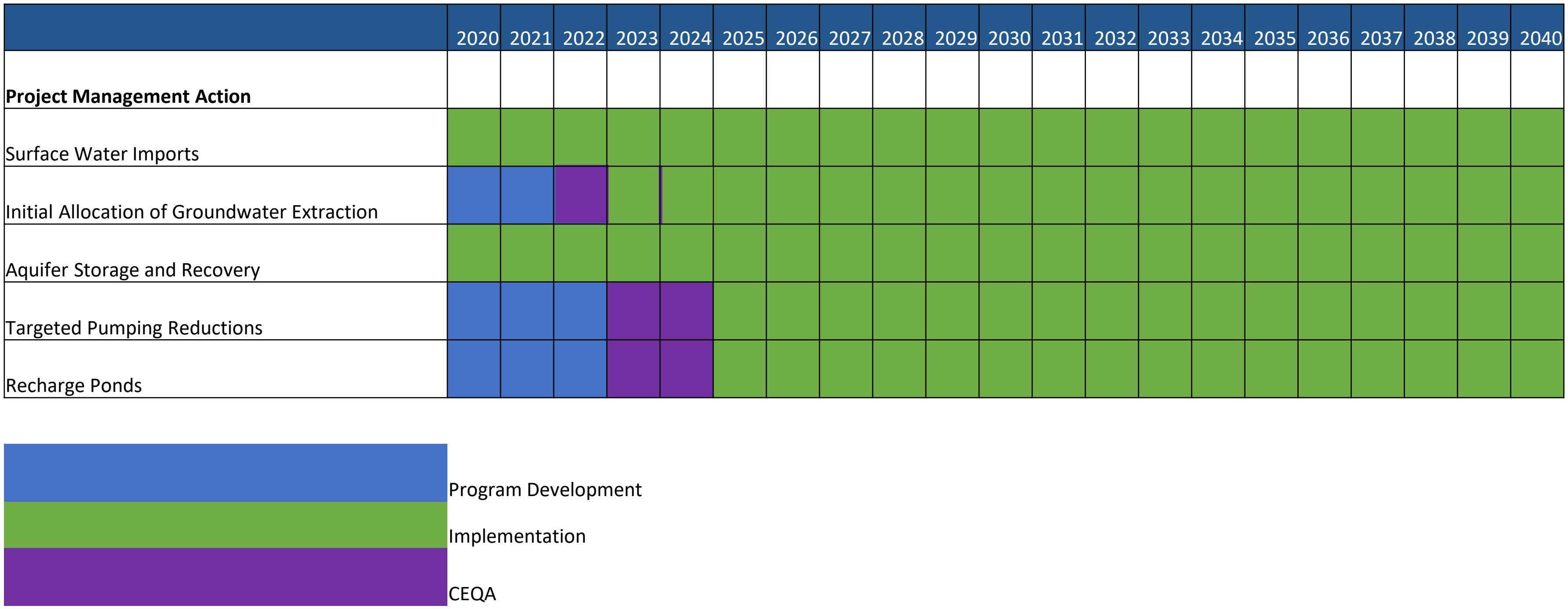
Schedule for Implementation – Operation and Monitoring Costs

Groundwater Sustainability Plan – Westside Subbasin

Figure 5-2



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Schedule for Implementation – Projects and Management Actions

Groundwater Sustainability Plan – Westside Subbasin

Figure 5-3

6 GOVERNANCE

6.1 Overview

In adopting the Sustainable Groundwater Management Act (''SGMA"), the Legislature made clear that nothing in SGMA "determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights."[1] In other words, the Legislature intended that actions undertaken in accordance with SGMA respect common law water rights.

Water rights are property rights, protected as such under the California Constitution.[2] The right to use groundwater, including groundwater from the Westside Subbasin, is limited to the amount that can be beneficially used and not wasted.[3] Article X, section 2 of the California Constitution declares that the "general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable . . . The right to water or to the use or flow of water . . . shall be limited to such water as shall be reasonably required for the beneficial use to be served . . . . "

The groundwater within the Westside Subbasin is overlain by vast acreage with appurtenant, overlying water rights, which allow owners of land overlying a groundwater basin to extract groundwater for use on their overlying land. The groundwater is also subject to appropriations; use of groundwater on non-overlying land, such as for domestic and off-basin uses. Collectively, groundwater withdrawals over the past 50 plus years, within the Subbasin and contiguous adjacent areas, reflect a cycle of depletion and recovery dependent upon the quantity of available surface water supplies. However, recovery in groundwater levels has not been complete and over time, undesirable results have occurred, primarily in the form of land subsidence.

Under California common law, groundwater users, neither individually nor collectively, have the right to lower groundwater levels in a manner that causes undesirable results, including land subsidence. Prior to the adoption of SGMA and in the absence of regulatory oversight, where there has been overdraft, the courts have adjudicated water rights, approved and, in some cases, imposed physical solutions to provide for the coordinated management of all groundwater rights in a common supply and to avoid undesirable results.[4] These physical solutions establish management regimes that enable the expression and use of water rights in a manner that enhances the efficient use of water in accordance with the California Constitution.[5]

[1] Wat. Code, § 10720.5(a).
[2] *State of California v. Riverside Superior Court* (2000) 78 Cal.App.4th 1019, 1025.
[3] *Peabody v. City of Vallejo* (1935) 2 Cal.2d 351, 372; *City of Barstow v. Mojave Water Agency* (2000) 23 Cal. 4th 1224, 1242.
[4] See *City of Santa Maria v. Adam* (2012) 211 Cal.App.4th 266, 287-88.
[5] The courts have sustained groundwater management strategies that establish physical solutions which concurrently maximize beneficial use, respect common law water rights and avoid causing undesirable results.

While SGMA did not modify common law water rights, it vested the principal responsibility for developing and administering a management plan for groundwater basins to Groundwater Sustainability Agencies (GSA), each of which is either an agency or comprised of agencies local to the subject groundwater basin.[6]

The question of how a GSA's authority is wielded is of critical importance to the efficacy of the GSP. In the end, groundwater management under SGMA must be consistent with Article X, section 2 of the California Constitution and it must be sufficiently adaptive to respond to the challenges and opportunities that may arise over time.

This GSP establishes the objective of maximizing the beneficial use of water within the Westside Subbasin, without causing undesirable results. The powers of a GSA are set forth in SGMA. This GSP meets the requirements of SGMA and vests the management authority in a GSA as provided in this Chapter.

6.2 Powers of the GSAs

1. **In General.** WWD serves as the GSA for the portion of the Westside Subbasin that is within WWD's jurisdictional boundary. The County of Fresno (Fresno County) serves as the GSA for the portion of the Westside Subbasin that is within Fresno County but outside WWD's jurisdictional boundary. Each GSA shall have and may exercise the express powers set forth under SGMA and shall perform the duties as provided in this GSP as it may be amended by the GSA, in accordance with applicable law. It is essential that this GSP allow each GSA the maximum flexibility and adaptability, so that the GSP can be amended and improved to address changes in circumstances and to account for advances in data gathering, analysis, technology, as well as emerging institutional and economic opportunities. Toward this end, each GSA expressly reserves all power and authority to implement and amend the GSP as a physical solution as may be necessary, proper and convenient over time to achieve its objective of maximizing the reasonable and beneficial use of water without causing undesirable results. The enumeration of the powers and authorities set forth herein is not a limitation on any power or authority of each GSA arising under applicable law.
2. **Coordination**. WWD and Fresno County shall coordinate to implement the GSP pursuant to a Memorandum of Understanding (MOU) or as amended in a subsequent Memorandum with respect to implementation of the Sustainable Groundwater Management Act in the Westside Subbasin.
3. **Rules and Regulations**. Each GSA may make, adopt and amend, after public hearing, appropriate rules and regulations for conducting its affairs, including but not limited to, meeting schedules and procedures. Copies shall be maintained on each GSA's website.
4. **Committees.** In addition to the formation of the Advisory Committee and Technical Advisory Committee expressly authorized below, WWD and Fresno County may, periodically and at their discretion, coordinate to establish committees to act solely in an advisory role by providing advice, and recommendations. Any committee established under this GSP shall be chaired by a representative from one of the GSAs.

[6] The declared legislative intent in the adoption of SGMA is set forth in Water Code section 10720.1 and includes the directive to provide local management of groundwater.

5. Specific Powers

(a) Allocation. In close coordination, the GSAs may establish an allocation program and establish terms and conditions on the use of that allocation from time to time, including but not limited to, eligibility, quantity of allocation, method of delivery, banking, transfer, reporting and monitoring.

(b) Replenishment. Each GSA may arrange for, conduct, authorize and control replenishment by any reasonable means in accordance with applicable law including but not limited to spreading, percolation injection and in-lieu recharge of non-native, imported, foreign and developed water ("supplemental water").

(c) Groundwater Storage. The Westside Subbasin has a substantial amount of available groundwater storage capacity that may be used for storage and conjunctive use of supplemental water in coordination with native groundwater and return flows from foreign, non-native and imported water. It is essential that the use of this groundwater storage capacity be undertaken only under the control and regulation of a GSA, to protect the integrity of all water held in storage and the sustainable yield of the Westside Subbasin.

  i. Use of Available Groundwater Storage Capacity. No person may make use of the groundwater storage capacity in the Westside Subbasin for the storage and conjunctive use of supplemental water except pursuant to written agreement with a GSA or as may be authorized by a GSA through the adoption of duly authorized rules and regulations.

  ii. Uniform Rules and Regulations. In close coordination, the GSAs may adopt uniformly applicable rules and a standard form of agreement for storage of supplemental water provided that the performance of any agreement will not cause undesirable results.

  iii. Abandonment. Any supplemental water recharged or stored in the Westside Subbasin done without a GSA storage agreement or as authorized by adopted rules and regulations, shall be deemed abandoned and not classified as stored water.

  iv. Priority in Allocation. In the allocation of storage capacity, the needs, use and requirements of the lands overlying the Westside Subbasin shall have priority and preference over storage for the purpose of export for use on non-overlying lands.

(d) Transfers. The right of persons or entities to transfer water, credits, allocations, stored water and any other entitlement authorized by or arising under this GSP, including any rules, regulations and conditions thereon, is subject to prior approval of one or both GSA(s) as may be provided under the GSP and adopted rules and regulations.[7]

(e) Conjunctive Use. In close coordination, the GSAs may adopt specific incentives and mandates, pursuant to adopted rules and regulations that encourage and, where necessary, require the use of surface water in-lieu of groundwater to avoid undesirable results and to optimize the beneficial use of groundwater.

[7] Overlying water rights are generally not transferable under common law and overlying owners do not have the right to store unpumped groundwater for use in future years. The allocations arising under this GSP are only as authorized hereunder in furtherance of the physical solution as embodied in the GSP.

(f) Accounting. WWD shall calculate additions, extractions and losses to the Westside Subbasin and maintain an annual account of all replenished water, stored water, transferred water allocations and produced groundwater. WWD shall provide annually a summary of the annual account information to Fresno County.

(g) Federal Reserved Rights. Nothing herein, express or implied, shall be construed as a limitation on the origin, scope or exercise of federal reserved rights to groundwater in the Westside Subbasin, whatever they may be.

6. **Variances.** Any person or entity desiring relief (excuse from compliance) from any portion of the GSP, program, policy, rule, regulation or project (collectively "measure") may request a variance from the GSA implementing the GSP for their portion of the Westside Subbasin. In close coordination, the GSAs will prepare a form for the submittal of a request for a variance and make it available to the public following the adoption of the GSP. Any request for variance filed must be submitted in writing to the appropriate GSA and shall (1) identify the specific GSP measure that is the subject of the request, (2) the reason(s) for the requested variance, (3) whether the requested variance is necessary to avoid substantial physical or economic harm and an explanation thereof, and (4) a statement of the requested relief. Except in the event of an emergency,[8] any technical request for a variance will be considered by the Technical Advisory Committee ("TAC") prior to consideration by the appropriate GSA. Non-technical requests will be considered directly by the appropriate GSA. Each GSA must consult with the other GSA representative for the Westside Subbasin prior to its consideration of a variance. Either GSA will not grant a variance if it finds that to do so would (1) be a substantial factor in causing or contributing to undesirable results in any portion of the Westside Subbasin, (2) not undermine effective implementation of the GSP, (3) cause material harm to others who have rights to use groundwater within the Westside Subbasin, and (4) only authorize actions that are reasonable necessary and narrowly tailored to avoid unreasonable physical and economic harm to the groundwater user.

7. **Appeals.** Within WWD's portion of the Westside Subbasin, any person aggrieved by an action of WWD staff to implement the GSP and/or pursuant to an implementing measures may submit a written appeal to the WWD Board. An appeal must include each of the following: (i) name and address of the appellant, (ii) Brief description of the project (if applicable), (iii) the specific decision which appellant appeals, (iv) the date on which the decision was made, (v) the basis or bases for the appeal, (vi) the specific action which appellant requests be taken on appeal, and (vii) all information appellant relies upon to support appellant's appeal. Except in the event of an emergency,[9] any technical request for a variance will be considered by the Technical Advisory Committee (TAC) prior to consideration by the appropriate GSA. Non-technical requests will be considered directly by the appropriate GSA. WWD may reconsider a prior decision, if there is new material information that was not reasonably available to the appellant at the time of the decision. Decision of the WWD Board shall be final.

[8] Sudden, unexpected perilous condition.

[9] Sudden, unexpected perilous condition.

6.2.1 Advisory Committee

The WWD Board will establish an Advisory Committee (AC) that in the discretion of the WWD Board will be comprised of between eight and eleven representatives from stakeholder groups within the Westside Subbasin, which shall include one representative from the County of Fresno Department of Public Works and Planning, as designated by their Director. The purpose of the AC is to increase effective collaboration and communication between and among stakeholders by: providing advice and recommendations to the GSAs, including but not limited to, advice as to methods in which the GSAs may improve the GSP or its implementation. The AC will be chaired by a member of the WWD Board and subject to the Brown Act.

(a) Appointment. The WWD Board in its discretion will appoint and the AC will maintain from eight to 11 members, with the exception of the County of Fresno appointment, which shall be designated by the Director of the Department of Public Works and Planning

(b) Qualifications. A minimum of 60 percent of its members shall be active agricultural groundwater producers with at least one each from domestic groundwater users, Fresno County GSA representative, disadvantaged communities and non-governmental organizations.

(c) Scope and Authority. The AC's duties and authority shall be limited to that expressly set forth in this herein. The AC's recommendations, if any, shall be transmitted to the appropriate GSA(s) for consideration and potential action.

(d) Offices and Records. The AC's records shall be maintained at the WWD's Fresno office. The AC's records shall be available for inspection by any person during regular business hours.

(e) Meetings. Regular meetings of the AC shall be held when needed, at a convenient time and location, as determined by the chair of the AC or resolution of WWD Board. The Agenda and all available materials pertaining to agenda items shall be posted and made available in compliance with the Brown Act and WWD standard procedures. The AC members shall be provided an opportunity to propose and comment on agenda items.

(f) Special Meetings. Special meetings of the AC may be called at any time at the discretion of the Chair, by written notice in compliance with the Brown Act.

(g) Adjournment. Any meeting of the AC may be adjourned to a time and place specified in the Order of Adjournment.

(h) Open Meetings. All AC meetings shall be open to all members of the public.

6.2.2 Technical Advisory Committee

The WWD Board will establish a TAC. The TAC shall function *solely* in an advisory role. The TAC shall function as an *independent* body of experts that can provide transparent, credible, and timely advice to the GSAs, as the GSAs may deem appropriate, in their discretion, from time to time. The TAC will meet as required to perform the following actions: (i) review of proposed and existing GSP programs and projects; (ii) requests arising from persons seeking specific approvals pursuant to the GSP or relief from its requirements (i.e., variances), including the rules and regulations adopted by the GSAs; (iii) appeals regarding WWD staff actions in support of GSP implementation or complaints regarding the actions of third parties authorized thereunder; and (iv) evaluating the boundary condition and potential impacts of groundwater use in contiguous basins on inflow into the Westside Subbasin. The TAC will be chaired by a member of the WWD Board and subject to the Brown Act.

(a) Appointment. The WWD Board in its discretion will appoint five to nine members to the TAC, including at least one representative from the County of Fresno Department of Public Works and Planning, as designated by their Director.

(b) Qualifications. Each member shall hold a bachelors or advanced degree or higher in a field related to groundwater, engineering, hydrology and/ or at least five years of relevant professional experience.

(c) Scope and Authority. The TAC's duties and authority shall be limited to that expressly set forth in this herein. Upon completing its evaluation of any subject matter within the scope of its authority, the TAC's recommendations shall be transmitted to the appropriate GSA(s) for consideration and potential action.

(d) Offices and Records. The TAC's records shall be maintained at it the WWD's Fresno office. The TAC's records shall be available for inspection by any person during regular business hours.

(e) Meetings. Regular meetings of the TAC shall be scheduled when needed, at a convenient time and location, as may be determined by the chair of the TAC or resolution of the WWD Board. The Agenda and all available materials pertaining to agenda items shall be posted and made available in compliance with the Brown Act and WWD standard procedures. The AC members shall be provided an opportunity to propose and comment on agenda items.

(f) Special Meetings. Special meetings of the TAC may be called at any time at the discretion of the Chair, by written notice in compliance with the Brown Act.

(g) Adjournment. Any meeting of the TAC may be adjourned to a time and place specified in the Order of Adjournment.

(h) Open Meetings. All TAC meetings shall be open to all members of the public.

(i) Variance. An application for a variance generally will be reviewed at the first regularly scheduled TAC meeting if the variance is technical. The Board of Directors will consider the variance within ninety (90) days from the date the appropriate GSA determines the application is complete and provides notice thereof, provided that staff and/or TAC members may for reasonable cause continue consideration of the application to a future date to ensure a fair evaluation of the application. The TAC's consideration of a variance application is *advisory* only.

(j) Appeals. Except in the event of an emergency, an appeal will be reviewed at the first regularly scheduled TAC meeting and the Board within ninety (90) days from the date of a GSA's receipt of an appeal. The TAC's consideration of an appeal is *advisory* only.

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APPENDIX A

California Water District Act

46831

BEFORE THE BOARD OF SUPERVISORS

OF THE COUNTY OF FRESNO, STATE OF CALIFORNIA

--oOo--

In the Matter of the Petition of The Holders of Title to Land in the Counties of Fresno and Kings, State of California, for the formation, under the provisions of Division 13 of the Water Code of the State of California, of a Water District to be known as the Westlands Water District.

RESOLUTION AND ORDER DECLARING RESULTS OF ELECTION, DECLARING DISTRICT FORMED, AND FOR ISSUANCE OF CERTIFICATES OF ELECTION AND RECORDING.

The Board of Supervisors of the County of Fresno, State of California, being duly convened on this 8th day of September, the second Monday following August 26, 1952, pursuant to law and Section 34425 of the California Water District Law, for the purpose of canvassing the vote at the election ordered to be held on August 26, 1952, by the prior order of this Board, entered at a regular meeting thereof held on July 29, 1952, to vote upon the proposition of whether or not the proposed Westlands Water District shall be formed and electing the officers thereof if it be formed, and each of the members of the Board of Election appointed by this Board at said regular meeting held on July 29, 1952, to hold and conduct said election having on said August 26, 1952, prior to the opening of the polls taken and subscribed his oath of office as a member of said Board of Election, and the same being on file with this Board, and said Board of Election having on August 26, 1952, before the opening of the polls posted in a conspicuous place at the polling place designated by this Board in its said

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SECURITY BANK BLDG.
FRESNO, CALIFORNIA
TELEPHONE 3-3131

order of July 29, 1952, a list of the voters eligible to vote at said election, and the number of votes entitled to be cast by each voter, which said list of voters so posted is attached hereto and made a part hereof and immediately follows:

363
267
96

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& AVERY
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FRESNO, CALIFORNIA
TELEPHONE 3-6151

which said voting list sets forth the names of all holders of title to land within said proposed Westlands Water District, and gives and allows each holder of title one vote for each dollar's worth of land located in Fresno County and within said proposed district to which he holds title as fixed by the last equalized assessment roll of the County of Fresno, State of California, and one vote for each dollar's worth of land in Kings County, State of California, within said proposed district, to which he holds title as fixed by the last equalized assessment roll of the County of Kings, State of California; and said Board of Election upon the closing of the polls at 5:00 o'clock P. M. on said August 26, 1952, having canvassed the votes cast at said election, and having declared the result of the election that 6,467,361 votes were cast favoring the formation of said Westlands Water District, and that NO votes were cast against the formation of the same; and that Ralph D. Carr received 6,467,361 votes for the office of Director; that A. L. Fourchy received 6,467,129 votes for the office of Director; that C. W. Goodwin, received 6,467,129 votes for the office of Director; that Frank Diener received 6,467,361 votes for the office of Director; and that J. E. O'Neill received 6,467,361 votes for the office of Director; and that Louis Telesco received 6,467,361 votes for the office of Assessor; that George D. Helvey received 6,467,361 votes for the office of Treasurer; and that Earl A. Harnish received 6,467,361 votes for the office of Tax Collector; and that said Board of Election following the closing of the polls having forwarded to and filed with this Board the returns of said election and all ballots cast thereat, with all proxies and authorizations of legal representatives to vote at said election, together with a list of ballots cast at said election prepared by said Board of Election pursuant to Section 35110 of the California Water District

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FRESNO, CALIFORNIA
TELEPHONE 3-3191

Law showing the name of each voter by or for whom the ballot was cast; the name of any proxy or legal representative casting the ballot; the number of votes cast by each voter and how the person casting each ballot voted on each matter and each office and candidate presented at the election; and it further satisfactorily appearing to the Board from the records and files in this proceeding and from other evidence and proofs produced, all precedent legal steps in the filing of the petition for the formation of said proposed district signed by the holders of title or evidence of title to more than a majority in area of the lands within the exterior boundaries of said proposed district, in the call for and notice of the hearing of said petition before this Board of Supervisors, and in the hearing thereof before this Board, in this Board's resolution and order establishing proposed district boundaries and naming the proposed district following the hearing of said petition by this Board, in this Board's resolution and order of July 29, 1952, calling an election to vote upon the proposition of whether or not said proposed Westlands Water District shall be formed and electing the officers thereof if it be formed, have all heretofore been regularly, legally and duly taken, all in accordance with law and the provisions of the California Water District Law, and that due and legal notice of the call for and notice of the time and place fixed for the holding of said election has been given in accordance with the prior order of this Board entered herein on said July 29, 1952, and in accordance with the requirements of the California Water District Law, by publication in The Fresno Bee-The Republican, a newspaper of general circulation printed and published in the County of Fresno, State of California, in the issues of said newspaper published on August 1st, August 8th, August 15th, and August 22nd, 1952, a notice of the holding of said election and of the

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TELEPHONE 3-3191

time and place fixed and appointed therefor, and containing and setting forth in said published notice of said election all matters and things required by said California Water District Law relating to the district formation and the election of officers thereof if said district be formed; and this Board having examined all ballots cast and all proxies and authorizations of legal representatives to vote at said election on file with this Board, and this Board having canvassed, ballot by ballot, the ballots cast at said election has determined, and does hereby determine the results of said election to be as hereinafter set forth,

NOW, THEREFORE, on motion of Supervisor Malm, seconded by Supervisor Rudkopf, the following resolution and order is hereby unanimously adopted by said Board of Supervisors, County of Fresno, State of California,

RESOLVED: That upon the canvass of the election returns, ballots cast, proxies and authorizations of legal representatives to vote forwarded to and filed with this Board by the Board of Election appointed by this Board to hold and conduct on August 26, 1952, an election to vote upon the proposition of whether or not the Westlands Water District shall be formed, and electing the officers thereof if the same be formed, does hereby declare the result of said election to be as follows:

FOR the formation of Westlands Water District,	6,467,361	votes
AGAINST the formation of Westlands Water District,	none	votes
For Director, Ralph D. Carr	6,467,361	votes
For Director, Frank Diener	6,467,361	votes
For Director, A. L. Fourchy	6,467,129	votes
For Director, C. W. Goodwin	6,467,129	votes
For Director, J. E. O'Neill	6,467,361	votes
For Assessor, Louis Telesco	6,467,361	votes
For Treasurer, George D. Helvey	6,467,361	votes
For Tax Collector, Earl A. Harnish	6,467,361	votes

RESOLVED FURTHER: That more than a majority of votes cast at said election favor the formation of WESTLANDS WATER DISTRICT and the territory comprising said district and particularly described as follows, to wit:

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608 SECURITY BANK BLDG.
FRESNO, CALIFORNIA
TELEPHONE 3-2191

be and the same is hereby declared formed as a water district under the California Water District Law under the name of WESTLANDS WATER DISTRICT, and that

RALPH D. CARR, FRANK DIENER and J. E. O NEILL are hereby declared elected to the office of Directors of said Westlands Water District for terms of four (4) years; and A. L. FOURCHY and C. W. GOODWIN are hereby declared to be elected to the office of Directors of said Westlands Water District for a term of two (2) years; and that Louis Telesco, George D. Helvey and Earl A. Harnish are hereby declared elected to the offices of Assessor, Treasurer and Tax Collector respectively for a term of four (4) years, and that certificates of election be issued to said Directors and said officers for their respective offices;

RESOLVED FURTHER: That this resolution and order be entered in full upon the minutes of this Board, and that a certified copy thereof be immediately recorded in the office of the County Recorder, County of Fresno, State of California, and in the office of the County Recorder, County of Kings, State of California.

AYES: Supervisors Malm, Peckinpah, Clark, Cadwallader, Cruff

46831

NOES: None

ABSENT: None

RECORDED AT REQUEST OF
Fresno County Supervisors
AT 25 MIN. PAST 10 M

SEP 12 1952
BOOK 3209 PAGE 266
FRESNO COUNTY CALIFORNIA
J. E. FARLEY, COUNTY RECORDER
BY [signature] DEPUTY RECORDER

STATE OF CALIFORNIA, } ss
COUNTY OF FRESNO. }
I, J. L. BROWN, County Clerk and ex-officio Clerk of the Board of Supervisors of said Fresno County, do hereby certify the foregoing to be a full, true and correct copy of the original ...
now of record in my office.
IN WITNESS WHEREOF I have hereunto set my hand and affixed the seal of said Board of Supervisors this 11th day of Sept, 1952
J. L. BROWN
County Clerk and Ex-officio Clerk of said Board of Supervisors.
By [signature], Deputy Clerk.

APPENDIX B

Resolution 111-16 (July 19, 2016)

LSCE

RESOLUTION NO. 111-16

A RESOLUTION OF THE BOARD OF DIRECTORS ELECTING FOR WESTLANDS WATER DISTRICT TO SERVE AS A GROUNDWATER SUSTAINABILITY AGENCY PURSUANT TO THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT

WHEREAS, the Sustainable Groundwater Management Act (SGMA), California Water Code section 10720, et. seq., which was signed into law on September 16, 2014, requires that each California groundwater basin or subbasin be managed by a Groundwater Sustainability Agency (GSA), or multiple GSAs, and that such management be implemented pursuant to an approved Groundwater Sustainability Plan (GSP) or multiple GSPs; and

WHEREAS, Westlands Water District (District) is a local agency as defined in Water Code section 10721(n); and

WHEREAS, California Water section 10723(a) authorizes any local agency overlying a groundwater subbasin to become a GSA for that basin; and

WHEREAS, the District's service area overlies the subbasin defined as the Westside Subbasin in the San Joaquin Valley Basin, as depicted by the map attached hereto as Exhibit A, 2016 boundary modification pending, an un-adjudicated groundwater basin in Fresno and Kings Counties; and

WHEREAS, public hearings were noticed in the Fresno Bee and Hanford Sentinel on June 28, 2016 and July 5, 2016 pursuant to Water Code Section 10723(b); and

WHEREAS, the District held public hearings on July 13, 2016 and July 19, 2016 to consider forming a GSA of the Westside Subbasin; and

WHEREAS, after considering the GSA formation and hearing public testimony, the Board determined that it is in the best interest of the District, its landowners, and water users to serve as the GSA of the Westside Subbasin.

NOW, THEREFORE, BE IT AND IT IS HEREBY RESOLVED as follows:

1. The District elects to serve as the GSA of the Westside Subbasin as depicted by the map attached hereto as Exhibit A, including future revisions approved by the District and the California Department of Water Resources.

2. Within thirty days of the effective date of this Resolution, the General Manager or his designee shall submit a notice of intent to the California Department of Water

Resources, pursuant to Water Code Section 10723.8(a), and complete all necessary tasks related to this matter.

3. The General Manger or his designee shall, after complying with Water Code Section 10723.8, begin developing a GSP for the Westside Subbasin in accordance with the GSP emergency regulations.

4. The General Manager or his designee shall maintain a list of interested parties regarding the newly formed GSA pursuant to Water Code Section 10723.4.

Adopted at a regular meeting of the Board of Directors, at Fresno, California, this 19th day of July, 2016.

AYES: Directors Anderson, Coelho, Errotabere, Esajian, Enos, Neves, Peracchi and Woolf.

NOES: None

ABSENT: Director Bourdeau

Dave Ciapponi, Secretary

STATE OF CALIFORNIA)
)ss
COUNTY OF FRESNO)

I, Dave Ciapponi, do hereby certify that I am the duly appointed, qualified and acting Secretary of Westlands Water District, a public district organized under the laws of the State of California with its offices at Fresno, California; that Resolution No. 111-16 was duly and regularly adopted by the Board of Directors of Westlands Water District at a meeting of said Board of Directors duly called and held on the 19th of July, 2016, at the offices of said Westlands Water District at which a quorum of said Directors was present and acting; and that said Resolution is still in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and seal as Secretary of said District this 20th day of July, 2016.

Secretary
Westlands Water District

APPENDIX C

Exclusive GSA (November 1, 2016)

LSCE

Westlands Water District
3130 N. Fresno Street, P.O. Box 6056, Fresno, California 93703-6056, (559) 224-1523, FAX (559) 241-6277

July 21, 2016

VIA EMAIL
California Department of Water Resources
Attention: Mark Nordberg, GSA Project Manager

SUBJECT: Notices of Intent to Serve as the Groundwater Sustainability Agency for the Westside Subbasin

Dear Mr. Nordberg,

The purpose of this letter is to provide notice to the Department of Water Resources (DWR), pursuant Water Code Section 10723.8, regarding Westlands Water District's (Westlands) Board decision to serve as the Groundwater Sustainability Agency (GSA) of the Westside Subbasin (Subbasin Number 5-22.09, also shown as Exhibit A). Westlands is a local agency with water supply and water management responsibilities in the area overlying the Westside Subbasin, and is an appropriate local agency to serve as the GSA for the Westside Subbasin. At this time, no other entity has filed a notice of intent to serve as a GSA for the management area identified in Exhibit A.

The proposed GSA management area is approximately 626,400 acres, which includes 12,100 acres outside of Westlands' jurisdictional boundary that reside in Fresno and Kings Counties. Westlands and Fresno County will execute a Memorandum of Understanding which authorizes Westlands to serve as the GSA for all the Fresno County lands within the Westside Subbasin, where no other agency is acting as the GSA.

On July 13, 2016 in Kings County and July 19, 2016 in Fresno County, Westlands held public hearings to receive public testimony as to whether Westlands should serve as the GSA of the Westside Subbasin. In compliance with Water Code Section 10723 (b) and Government Code 6066, notices (Exhibit B) of these hearings were advertised in Fresno and Kings Counties newspapers on June 27 and July 5.

Westlands did not receive any written comments prior to the hearings. Additionally, Westlands did not receive any oral or written opposition during either of the hearings. The only comments Westlands received were in support of Westlands' GSA formation from Kings and Fresno Counties. Kings County's Board of Supervisors unanimously supported (Exhibit C) Westlands' GSA formation.

Immediately following the public hearing on July 19, Westlands' Board of Directors took action to serve as the GSA of the Westside Subbasin and approved Resolution 111-16, which directs Westlands' Staff to file a notice of intent for Westlands to serve as the exclusive GSA of the Westside Subbasin.

Interested parties within Westlands' proposed GSA management area were determined pursuant to Water Code Sections 10723.2, and include:

(a) Holders of overlying groundwater rights, including:
  (1) Agricultural Users: Westlands' proposed GSA management area is composed primarily of agricultural users, within Westlands' jurisdictional boundary. Land owners within the Westside Subbasin hold the groundwater rights within the GSA management area. The GSA shall consider the interest of individual land owners in the development of the GSP for the Westside Subbasin. Effective May 17, 2016, Westlands provided interested parties a means to provide comments and will host of a series of workshops to best address suggestions/concerns in the development of the GSP.
  (2) Domestic Well Users: Westlands' proposed GSA service area contains approximately 35 domestic well users. Westlands has yet to determine if the domestic well locations will be subject to the GSP developed by Westlands because SGMA classifies domestic well users producing less than two acre-feet per year as de minimis extractors.

(b) Municipal Wells Operators: The Westside Subbasin boundary includes eight communities; the cities of Avenal and Huron; the communities of Three Rocks, Cantua Creek, Turk, Calfax, O'Neil Farms and El Porvenir. To Westlands' knowledge, Cantua Creek is the only community that extracts groundwater for municipal use. However, Westlands will work with any of these interested parties to develop a GSP that sustainably manages the Westside Subbasin.

(c) Public Water Systems: The Westside Subbasin boundary includes eight public water systems; Avenal, Huron, Three Rocks, Cantua Creek, Turk, Calfax, O'Neil Farms and El Porvenir.

(d) Local Planning Agencies: Fresno and Kings Counties. Westlands will sign a Memorandum of Understanding with Fresno County for coverage of county areas that fall outside of Westlands' jurisdictional boundary. Kings County provided Westlands with a letter supporting our GSA activities (Exhibit C).

(e) Environmental Users of Groundwater: The Westside Subbasin includes Pilobos Wildlife Area and Pleasant Valley Ecological Area. Reliance on groundwater is unknown at this time, however Westlands will work with interested parties when developing a GSP.

(f) Surface Water Users: The Westside Subbasin does not encompass hydrologic surface water bodies.

(g) Federal Government: Naval Air Station Lemoore (NASL) resides within the Westside Subbasin. NASL's interest will be included in the development of the GSP.

(h) California Tribes: The Westside Subbasin boundary does not include California Tribes.

(i) Disadvantage Communities: The Westside Subbasin boundary includes five disadvantage communities; Avenal, Huron, Three Rocks, Cantua Creek, and Lemoore Station (also referred to as NASL).

(j) Disadvantaged Unincorporated Communities: The Westside Subbasin boundary includes five disadvantaged unincorporated communities; Calflax, Cantua Creek, Mendota, Three Rocks, and Turk.

(k) Entities Listed in Section 10927 that are monitoring and reporting groundwater elevations in all or parts of the groundwater basin managed by the GSA:

- Broadview Water District
- Westlands Water District
- San Luis & Delta Mendota Water Authority

Westlands will host a series of interactive workshops to provide water users, land owners, and interested parties' information/ updates on the District's GSP development. The workshops will provide a public forum allowing for collaboration with the District's staff during SGMA implementation.

If you have any questions, please call Kiti Campbell at 559-241-6226 or me at 559-241-6215. Thank you for reviewing Westlands' Notice of Intent to serve as the GSA of the Westside Subbasin.

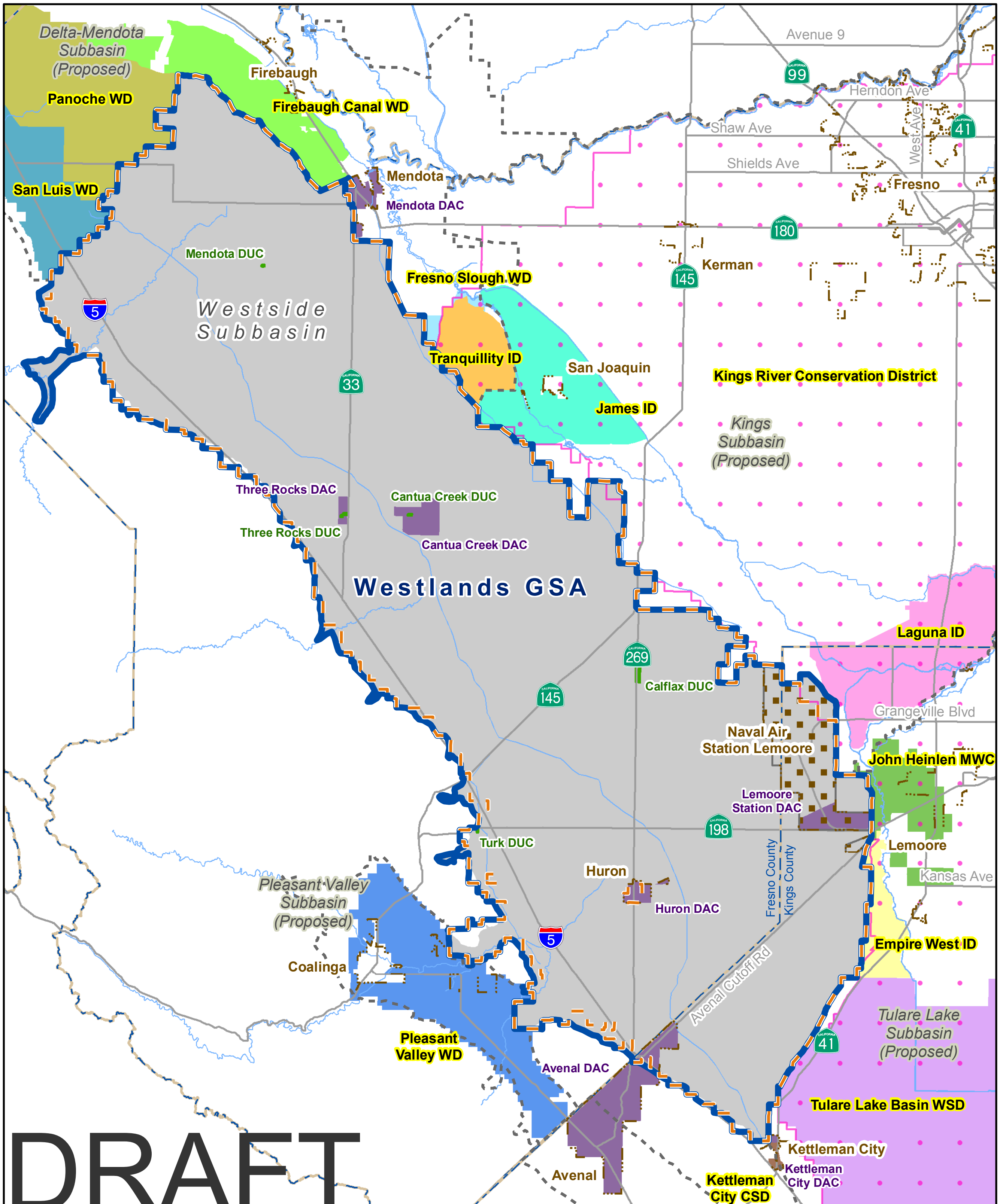
Sincerely,

Jose Gutierrez, P.E.

Deputy General Manager Resources

Enclosures: Resolution 111-16
Exhibit A
Exhibit B
Exhibit C

DRAFT



Legend

- Major Roads
- Waterway
- WWD Service Area Boundary
- SGMA Proposed San Joaquin Valley Subbasins
- Proposed Westside Subbasin July 2016
- Proposed Groundwater Sustainability Agency of the Westside Subbasin and Westlands Water District (July 2016)

Affected or Adjacent Local Agencies

- Water Districts

Municipal/Jurisdictional Boundaries

- Disadvantaged Community (DAC)
- Disadvantaged Unincorporated Community (DUC)
- Naval Air Station Lemoore
- City/Community

0 3 6 Miles

Exhibit A
Proposed Groundwater Sustainability Agency of the Westside Subbasin
July 2016 Revisions

WESTLANDS WATER DISTRICT
3130 N. FRESNO ST.
FRESNO, CALIFORNIA 93703
559.224.1523 FAX 559.241.6277

R:\DWGS\Archived\2016-W-0042\GSA Formation Map 07182016 8 by 11 Ver B.mxd

Date: 7/19/2016

DRAFT

WESTLANDS WATER DISTRICT
3130 N FRESNO ST
FRESNO, CA 93703

Exhibit B

PROOF OF PUBLICATION

COUNTY OF FRESNO
STATE OF CALIFORNIA

The undersigned states:

McClatchy Newspapers in and on all dates herein stated was a corporation, and the owner and publisher of The Fresno Bee. The Fresno Bee is a daily newspaper of general circulation now published, and on all-the-dates herein stated was published in the City of Fresno, County of Fresno, and has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of November 28, 1994, Action No. 520058-9.
The undersigned is and on all dates herein mentioned was a citizen of the United States, over the age of twenty-one years, and is the principal clerk of the printer and publisher of said newspaper; and that the notice, a copy of which is hereto annexed, marked Exhibit A, hereby made a part hereof, was published in The Fresno Bee in each issue thereof (in type not smaller than nonpareil), on the following dates.

June 28, 2016, July 05, 2016

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated July 05, 2016

PUBLIC NOTICE

#2531229

NOTICE OF PUBLIC HEARINGS

WESTLANDS WATER DISTRICT NOTICE OF PUBLIC HEARINGS
TO CONSIDER FORMATION OF A GROUNDWATER SUSTAINABILITY AGENCY
UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT

NOTICE IS HEREBY GIVEN that the Board of Directors, acting pursuant Water Code Section 10723, will hold two (2) public hearings to consider whether Westlands Water District will serve as the Groundwater Sustainability Agency for the Westside Groundwater Subbasin. The first hearing will be held at 29951 Omaha Ave., Kettleman City, CA 93239 on July 13, 2016 commencing at 8:30 AM. The second hearing will be held at the District's Fresno Office at 3130 N Fresno Street, Fresno, CA 93703 on July 19, 2016 commencing at 1:00 PM.

WESTLANDS WATER DISTRICT
3130 N FRESNO ST
FRESNO, CA 93703

PROOF OF PUBLICATION

COUNTY OF FRESNO
STATE OF CALIFORNIA

The undersigned states:

McClatchy Newspapers in and on all dates herein stated was a corporation, and the owner and publisher of The Fresno Bee. The Fresno Bee is a daily newspaper of general circulation now published, and on all-the-dates herein stated was published in the City of Fresno, County of Fresno, and has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of November 28, 1994, Action No. 520058-9.
The undersigned is and on all dates herein mentioned was a citizen of the United States, over the age of twenty-one years, and is the principal clerk of the printer and publisher of said newspaper; and that the notice, a copy of which is hereto annexed, marked Exhibit A, hereby made a part hereof, was published in The Fresno Bee in each issue thereof (in type not smaller than nonpareil), on the following dates.

June 28, 2016, July 05, 2016

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated July 05, 2016

Holly Zanata

PUBLIC NOTICE

#2531229

NOTICE OF PUBLIC HEARINGS

WESTLANDS WATER DISTRICT NOTICE OF PUBLIC HEARINGS
TO CONSIDER FORMATION OF A GROUNDWATER SUSTAINABILITY AGENCY
UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT

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