Management Area Plan

Arvin-Edison Management Area
Kern County Subbasin

Prepared for
Arvin-Edison Water Storage District &
Arvin Community Services District

December 2019
TABLE OF CONTENTS

Executive Summary ........................................................................................................................................ 1
ES.1. Introduction ........................................................................................................................................ 1
ES.2. Sustainability Goal .......................................................................................................................... 2
ES.3. Plan Area ....................................................................................................................................... 2
ES.4. Stakeholder Outreach Efforts ......................................................................................................... 3
ES.5. Hydrogeologic Conceptual Model ................................................................................................ 4
ES.6. Existing Groundwater Conditions .............................................................................................. 5
ES.7. Water Budget ................................................................................................................................ 6
ES.8. Sustainable Management Criteria .............................................................................................. 8
ES.9. Monitoring Network ....................................................................................................................... 11
ES.10. Projects and Management Actions .............................................................................................. 12
ES.11. GSP Implementation ................................................................................................................... 13
ES.12. GSP Implementation Costs and Funding .................................................................................... 14
ES.13. Conclusion .................................................................................................................................. 14

Introduction ................................................................................................................................................ 15
1. Purpose of the Groundwater Sustainability Plan .................................................................................. 15
2. Sustainability Goal ............................................................................................................................... 16
3. Agency Information ............................................................................................................................. 17
3.1. Name and Mailing Address of the Agency .................................................................................... 17
3.2. Organization and Management Structure of the Agency ................................................................. 17
3.3. MA Plan Manager ............................................................................................................................ 18
3.4. Legal Authority of the GSA ............................................................................................................ 18
3.5. Estimated Cost of Implementing the GSP and the Agency’s Approach to Meet Costs............... 18
4. GSP Organization .................................................................................................................................. 19

Plan Area ..................................................................................................................................................... 22
5. Description of the Plan Area .................................................................................................................. 22
5.1. Summary of Jurisdictional Areas and Other Features .................................................................... 22
5.2. Water Resources Monitoring and Management Programs ............................................................. 29
5.3. Land Use Elements or Topic Categories of Applicable General Plans ............................................ 36
5.4. Additional GSP Elements ................................................................................................................ 44
5.5. Notice and Communication ................................................................. 47

Basin Setting ......................................................................................... 55

6. Introduction to Basin Setting .............................................................. 55

7. Hydrogeologic Conceptual Model ..................................................... 56
   7.1. General Description ....................................................................... 56
   7.2. Cross-Sections .............................................................................. 66
   7.3. Physical Characteristics ............................................................... 68

8. Current and Historical Groundwater Conditions .................................. 72
   8.1. Data Sources and Compilation ..................................................... 72
   8.2. Groundwater Elevations and Flow Direction ............................... 74
   8.3. Change in Groundwater Storage ................................................. 78
   8.4. Seawater Intrusion ....................................................................... 80
   8.5. Groundwater Quality ................................................................. 80
   8.6. Land Subsidence ......................................................................... 85
   8.7. Interconnected Surface Water Systems ...................................... 86
   8.8. Groundwater Dependent Ecosystems ........................................... 86

9. Water Budget Information .................................................................. 88
   9.1. Water Budget Methods and Data Sources ..................................... 91
   9.2. Water Budget Results ................................................................. 93
   9.3. Current and Historical Water Budget ......................................... 101
   9.4. Projected Water Budget ............................................................ 103

10. Management Areas .......................................................................... 110
    10.1. Description and Justification .................................................... 110
    10.2. Minimum Thresholds and Measurable Objectives .................. 110
    10.3. Monitoring ............................................................................ 111

Sustainable Management Criteria .......................................................... 112

11. Introduction to Sustainable Management Criteria ............................... 112

12. Sustainability Goal ........................................................................... 113

13. Undesirable Results ........................................................................ 114
    13.1. Undesirable Results for Chronic Lowering of Groundwater Levels 114
    13.2. Undesirable Results for Reduction of Groundwater Storage ........ 116
    13.3. Undesirable Results for Seawater Intrusion ............................... 117
17.5. Addressing Overdraft Conditions ................................................................. 156
17.6. Permitting and Regulatory Process ............................................................ 156
17.7. Status and Implementation Timetable ....................................................... 157
17.8. Expected Benefits ...................................................................................... 157
17.9. Source and Reliability of Water from Outside AEWSD ............................ 158
17.10. Legal Authority Required ....................................................................... 159
17.11. Estimated Costs and Plans to Meet Them ............................................. 160

Plan Implementation .......................................................................................... 162

18. AEWSD Plan Implementation ........................................................................ 162
18.1. Plan Implementation Activities ................................................................. 162
18.2. Plan Implementation Costs ........................................................................ 168
18.3. Plan Implementation Schedule ................................................................. 169

19. ACSD Plan Implementation ........................................................................... 170
19.1. Plan Implementation Activities ................................................................. 170
19.2. Plan Implementation Costs ........................................................................ 174
19.3. Plan Implementation Schedule ................................................................. 174

References and Technical Studies .................................................................... 176

Appendices ....................................................................................................... 179
List of Tables

Plan Area
Table PA-1  Land Use Classification – Spring 2015
Table PA-2  ACSD Land Use Summary
Table PA-3  City of Arvin - Land Use Designations
Table PA-4  Comments and Input Received from Public During MA Plan Development

Basin Setting

Hydrogeologic Conceptual Model
Table HCM-1  Information Relevant to Definition of the Bottom of the Basin
Table HCM-2  Hydraulic Properties Extracted from C2VSim Models

Groundwater Conditions
Table GWC-1  Summary of DWR Water Year Types, 1995 - 2015
Table GWC-2  Change in Storage for Selected Time Periods
Table GWC-3  Summary of Active Point-Source Contamination Sites

Water Budget
Table WB-1  Comparison of Change in Groundwater Storage Estimates from Three Water Budget Estimation Methods
Table WB-2  Annual Surface Water Inflows and Outflows by Source Type
Table WB-3  Annual Inflows to and Outflows from the Groundwater System, and Change in Groundwater Storage
Table WB-4  Annual and Cumulative Change in Groundwater Storage between Seasonal Highs (Mar – Feb)
Table WB-5  Supplies, Demands, and Change in Groundwater Storage vs. DWR Water Year Type
Table WB-6  Annual Total Inflows, Outflows, and Change in Groundwater Storage
Table WB-7  Summary of Projected Water Budget Results without Project & Management Action Implementation
Table WB-8  Summary of Projected Water Budget Results with Project & Management Action Implementation

Sustainable Management Criteria
Table SMC-1  Summary of Undesirable Results Definitions within the Arvin-Edison Management Area
Table SMC-2  Spatial Scale of Minimum Threshold Definition
Table SMC-3  Summary of Minimum Thresholds, Interim Milestones, and Measurable Objectives for Chronic Lowering of Groundwater Levels
Table SMC-4  Summary of Minimum Thresholds, Interim Milestones, and Measurable Objectives for Degraded Water Quality
Table SMC-5  Summary of Minimum Thresholds, Interim Milestones, and Measurable Objectives for Land Subsidence
Table SMC-6  Interim Milestone Trajectory for Chronic Lowering of Groundwater Levels
Table SMC-7  Interim Milestone Trajectory for Degraded Water Quality
Table SMC-8  Interim Milestone Trajectory for Land Subsidence

Monitoring Network
Table MN-1  Summary of SGMA Monitoring Network
Table MN-2  Summary of Representative Monitoring Sites

Projects and Management Actions
Table PMA-1  Details of Projects and Management Actions
Table PMA-2  General Project and Management Actions Implementation Schedule (“Glide Path”)

Plan Implementation
Table PI-1  Estimated Costs for Plan Implementation
List of Figures

Plan Area

Figure PA-1 Plan Area and Relevant Boundaries
Figure PA-2 Federal and State Lands, and Protected Areas
Figure PA-3 Disadvantaged Communities
Figure PA-4 Spring 2015 Land Use
Figure PA-5 AEWSD Facilities and Surface Water Service Area
Figure PA-6 Well Density by PLSS Section from DWR Well Completion Reports
Figure PA-7 Kern County General Plan – Land Use Designation
Figure PA-8 Metropolitan Bakersfield General Plan – Land Use Designation

Basin Setting

Hydrogeologic Conceptual Model

Figure HCM-1 Arvin-Edison Water Storage District and Management Area
Figure HCM-2 Base of Fresh Groundwater, Based on Page, 1973 (USGS)
Figure HCM-3 Kern County Oil Fields
Figure HCM-4 Thickness of Layers 1 and 2 in C2VSim-FG Model (Beta Version)
Figure HCM-5 Summary of Well Screen Depth Data
Figure HCM-6 Contour Map of Base Elevation of “E”-Clay” and “A”-Clay Layers
Figure HCM-7 Yield Factors Based on Wood & Dale, 1964 (USGS)
Figure HCM-8 Hydraulic Properties in C2VSim-FG Model (Beta Version)
Figure HCM-9 CVHM Percent Coarse, Layers 3, 4, 6, 8
Figure HCM-10 General Groundwater Quality
Figure HCM-11 In-District Well Locations
Figure HCM-12 Surficial Geology and Cross-Section Locations
Figure HCM-13 Geologic Cross-Section A-A’
Figure HCM-14 Geologic Cross-Section B-B’
Figure HCM-15 Geologic Cross-Section C-C’
Figure HCM-16 Topography
Figure HCM-17 Soil Map Units
Figure HCM-18 Soil Characteristics – Hydrologic Soil Group
Figure HCM-19 Recharge and Discharge Areas
Figure HCM-20 Soil Recharge Potential based on SAGBI Dataset
Figure HCM-21  Natural Surface Water Features
Figure HCM-22  AEWSD Facilities and Surface Water Service Area

**Groundwater Conditions**

- Figure GWC-1  Groundwater Elevations – Spring 2015
- Figure GWC-2  Groundwater Elevations – Fall 2015
- Figure GWC-3  Water Service Areas
- Figure GWC-4  Depth to Groundwater – Spring 2015
- Figure GWC-5  Historical (1945-2018) Groundwater Elevation Hydrographs
- Figure GWC-6  Recent (1994-2018) Groundwater Elevation Hydrographs
- Figure GWC-7  Groundwater Storage Change, 1966 – 2016 and 1994 – 2015
- Figure GWC-8  Annual Change in Storage between Seasonal Highs vs. DWR Water Year Type
- Figure GWC-9  Groundwater Quality – Nitrate (as NO3) Concentrations (2016)
- Figure GWC-10  Groundwater Quality – Arsenic Concentrations (2016)
- Figure GWC-11  Groundwater Quality – Total Dissolved Solids Concentrations (2016)
- Figure GWC-12  Groundwater Quality – Change in Total Dissolved Solids (1966 – 2016)
- Figure GWC-13  Groundwater Quality – Boron Concentrations (2016)
- Figure GWC-14  Point Source Contamination Sites
- Figure GWC-15  Locations of Oil Fields, Active Injection Wells, and Produced Water Ponds
- Figure GWC-16  Historical (1949 – 2005) and Recent (2015 – 2016) Land Subsidence
- Figure GWC-17  Subsidence at Continuous GPS Benchmark ARM1 (2001 – 2017)
- Figure GWC-18  Natural Communities Commonly Associated with Groundwater (DWR)
- Figure GWC-19  Natural Communities Commonly Associated with Groundwater (DWR) – Caliente Creek

**Water Budget**

- Figure WB-1  Water Budget Domains and Subdomains
- Figure WB-2  Conceptual Water Budget Components and Linkages
- Figure WB-3  Annual Surface Water Inflows by Source
- Figure WB-4  Cumulative Surface Water Imports, 1966 – 2017
- Figure WB-5  Annual Surface Water Imports by Source
- Figure WB-6  Summary of Surface Water Import Sources, WY 1995 – 2014
- Figure WB-7  Annual Surface Water Outflows by Source
- Figure WB-8  Annual Groundwater Inflows and Outflows
Figure WB-9 Summary of Groundwater Inflows and Outflows, WY 1995 – 2014
Figure WB-10 Annual Change in Storage between Seasonal Highs
Figure WB-11 Cumulative Change in Storage, March 1994 – February 2015
Figure WB-12 Annual Change in Storage vs. DWR Water Year Type
Figure WB-13 Cumulative Change in Storage vs. DWR Water Year Type
Figure WB-14 Comparison of Modeled and Water Level-Based Estimated Change in Storage
Figure WB-15 Summary of Total Inflows and Outflows, WY 2015
Figure WB-16 Summary of Groundwater Inflows and Outflows, WY 2015
Figure WB-17 Annual Friant-Kern Imports vs. Contracted Supplies
Figure WB-18 Annual Inflows and Outflows
Figure WB-19 Summary of Total Inflows and Outflows, WY 1995 – 2014
Figure WB-20 Water Supply Portfolio and Annual Precipitation, WY 1995 – 2015
Figure WB-21 Observed vs. Modeled Change in Water Levels, WY 1995 – 2015
Figure WB-22 Projected Water Budget Supplies, Demands, and Shortfall Before Project & Management Action Implementation

Sustainable Management Criteria
Figure SMC-1 Representativeness of Monitoring Locations
Figure SMC-2 Water Level Sustainability Criteria – Hydrograph Analysis
Figure SMC-3 Proposed Water Level Minimum Thresholds
Figure SMC-4 Preliminary Well Impact Analysis by Sustainability Criteria Zone
Figure SMC-5 Preliminary Well Impact Analysis by PLSS Section
Figure SMC-6 Proposed Water Level Measurable Objectives
Figure SMC-7 Water Level Sustainability Criteria – Interim Milestones

Monitoring Network
Figure MN-1 SGMA Water Level Monitoring Network
Figure MN-2 SGMA Water Quality Monitoring Network
Figure MN-3 SGMA Land Subsidence Monitoring Network

Projects and Management Actions
Figure PMA-1 Locations of Proposed Projects and Management Actions
Figure PMA-2 C2VSim-FG Projected Hydrographs with and without P/MA Implementation
List of Appendices

Appendix A   GSP Submittal Checklist
Appendix B   Power & Water Resources Pooling Authority Description
Appendix C   White Lands Addendum
Appendix D   ACSD 2018 Water Use Summary
Appendix E   Summary of Stakeholder Communications and Engagement
Appendix F   Detailed Responses to Selected Comments Received Regarding the MA Plan
Appendix G   SWRCB Concurrence Letters Re: Edison Oil Field
Appendix H   Analysis of Temporal Characteristics of Available Groundwater Quality Data
Appendix I   Potential Additional Water Quality Data Sources
Appendix J   Methods and Data Used in the Water Budget Spreadsheet Model Approach
Appendix K   AEWSD CASGEM Monitoring Plan
Appendix L   AEWSD Long-term Access Agreement
Appendix M   Project and Management Action Information Forms
Appendix N   Board Resolution
**List of Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACSD</td>
<td>Arvin Community Services District</td>
</tr>
<tr>
<td>AEWSD</td>
<td>Arvin-Edison Water Storage District</td>
</tr>
<tr>
<td>AF</td>
<td>acre-feet</td>
</tr>
<tr>
<td>AFY</td>
<td>acre-feet per year</td>
</tr>
<tr>
<td>AWMP</td>
<td>Agricultural Water Management Plan</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practice</td>
</tr>
<tr>
<td>BO</td>
<td>Biological Opinion</td>
</tr>
<tr>
<td>BOS</td>
<td>bottom of screen</td>
</tr>
<tr>
<td>C2VSim</td>
<td>California Central Valley Groundwater-Surface Water Simulation Model</td>
</tr>
<tr>
<td>Cal EPA</td>
<td>California Environmental Protection Agency</td>
</tr>
<tr>
<td>CASGEM</td>
<td>California Statewide Groundwater Elevation Monitoring</td>
</tr>
<tr>
<td>CCR</td>
<td>California Code of Regulations</td>
</tr>
<tr>
<td>CDEC</td>
<td>California Data Exchange Center</td>
</tr>
<tr>
<td>CDMG</td>
<td>California Division of Mines and Geology</td>
</tr>
<tr>
<td>cfs</td>
<td>cubic feet per second</td>
</tr>
<tr>
<td>CGS</td>
<td>California Geological Survey</td>
</tr>
<tr>
<td>CIMIS</td>
<td>California Irrigation Management Information System</td>
</tr>
<tr>
<td>COCs</td>
<td>constituents of concern</td>
</tr>
<tr>
<td>CV</td>
<td>Central Valley</td>
</tr>
<tr>
<td>CVHM</td>
<td>Central Valley Hydrologic Model</td>
</tr>
<tr>
<td>CVP</td>
<td>Central Valley Project</td>
</tr>
<tr>
<td>CVRWQCB</td>
<td>Central Valley Regional Water Quality Control Board</td>
</tr>
<tr>
<td>CWC</td>
<td>California Water Code</td>
</tr>
<tr>
<td>CWD</td>
<td>Cawelo Water District</td>
</tr>
<tr>
<td>DAC</td>
<td>Disadvantaged Community</td>
</tr>
<tr>
<td>DDW</td>
<td>Division of Drinking Water</td>
</tr>
<tr>
<td>DMS</td>
<td>Data Management System</td>
</tr>
<tr>
<td>DOGGR</td>
<td>Division of Oil, Gas and Geothermal Resources</td>
</tr>
<tr>
<td>DTSC</td>
<td>Department of Toxic Substances Control</td>
</tr>
<tr>
<td>DWR</td>
<td>Department of Water Resources</td>
</tr>
<tr>
<td>EC</td>
<td>electrical conductance</td>
</tr>
<tr>
<td>EKI</td>
<td>EKI Environment &amp; Water, Inc.</td>
</tr>
<tr>
<td>ENCSD</td>
<td>East Niles Community Services District</td>
</tr>
<tr>
<td>ET</td>
<td>evapotranspiration</td>
</tr>
<tr>
<td>ETo</td>
<td>reference evapotranspiration</td>
</tr>
<tr>
<td>FKC</td>
<td>Friant-Kern Canal</td>
</tr>
<tr>
<td>ft</td>
<td>feet</td>
</tr>
<tr>
<td>ft bgs</td>
<td>feet below ground surface</td>
</tr>
<tr>
<td>ft msl</td>
<td>feet above mean sea level</td>
</tr>
<tr>
<td>ft/day</td>
<td>feet per day</td>
</tr>
<tr>
<td>ft²/day</td>
<td>feet squared per day</td>
</tr>
<tr>
<td>FWA</td>
<td>Friant Water Authority</td>
</tr>
</tbody>
</table>
NWIS | National Water Information System  
OCAP | 2008/2009 Long-Term Operations Criteria and Plan  
PLSS | Public Land Survey System  
P/MA | Project / Management Action  
PWRPA | Power & Water Resources Pooling Authority  
RMS | Representative Monitoring Site  
RMSE | root mean squared error  
RRBWSD | Rosedale-Rio Bravo Water Storage District  
SCEP | Stakeholder Communication and Engagement Plan  
SDAC | Severely Disadvantaged Community  
SGMA | Sustainable Groundwater Management Act  
SJRRP | San Joaquin River Restoration Project  
SMCs | Sustainable Management Criteria  
SSURGO | Soil Survey Geographic Database  
SWP | State Water Project  
SWRCB | State Water Resources Control Board  
SWSA | Surface Water Service Area  
SWSD | Semitropic Water Storage District  
SWID | Shafter-Wasco Irrigation District  
SSJMUD | Southern San Joaquin Municipal Utility District  
1,2,3-TCP | 1,2,3-trichloropropane  
TCWD | Tejon Castac Water District  
TDS | total dissolved solids  
TNC | The Nature Conservancy  
TOS | top of screen  
TRS | township-range-section  
ug | micrograms  
ug/L | micrograms per liter  
umhos/cm | microsiemens per centimeter  
UNAVCO | University Navstar Consortium  
USBR | United States Bureau of Reclamation  
USCS | Unified Soil Classification System  
USDA | United States Department of Agriculture  
USEPA | United States Environmental Protection Agency  
USGS | United States Geological Survey  
UWMP | Urban Water Management Plan  
WAPA | Western Areas Power Administration  
WDRs | Waste Discharge Requirements  
WDWA | Westside District Water Authority  
WKWD | West Kern Water District  
WMP | Water Management Plan  
WRMWSD | Wheeler Ridge-Maricopa Water Storage District
EXECUTIVE SUMMARY

ES.1. Introduction

On 16 September 2014, the California legislature enacted the Sustainable Groundwater Management Act (SGMA) whose primary purpose is to achieve and/or maintain sustainability within the state’s high and medium priority groundwater basins. Key tenets of SGMA are the concept of local control, use of best available data and science, and active engagement and consideration of all beneficial uses and users of groundwater. As such, SGMA empowers certain local agencies to form Groundwater Sustainability Agencies (GSAs) whose purpose is to manage basins sustainably through the development and implementation of Groundwater Sustainability Plans (GSPs). Under SGMA, GSPs are required to contain certain elements, the most significant of which include: a Sustainability Goal; a description of the area covered by the GSP (“Plan Area”); a description of the Basin Setting, including hydrogeologic conceptual model, historical and current groundwater conditions, and a water budget; locally-defined sustainability criteria; monitoring networks and protocols for sustainability indicators; and a description of projects and/or management actions that will be implemented to achieve or maintain sustainability.

SGMA also requires a significant element of stakeholder outreach to ensure that all beneficial uses and users of groundwater are given the opportunity to provide input into the GSP development and implementation process.

This GSP Management Area Plan (“MA Plan”) has been jointly prepared by Arvin-Edison Water Storage District (AEWSD) and Arvin Community Services District (ACSD) and covers an area called the “Arvin-Edison Management Area” or “Management Area”. The Arvin-Edison Management Area underlies the AEWSD and ACSD service areas, excluding the area overlain by the East Niles Community Services District (within the Kern River GSA Management Area), and is located in the southern portion of the Kern County Subbasin of the San Joaquin Valley Groundwater Basin (Department of Water Resources [DWR] Basin No. 5-022.14; referred to herein as the “Kern Subbasin” or “basin”). The Kern Subbasin is one of 21 basins and subbasins identified by the DWR as being critically overdrafted, a designation that triggers an accelerated timetable for GSP development by 2020 and achievement of sustainability by 2040.

The Kern Groundwater Authority (KGA) GSA, of which both AEWSD and ACSD are members, is the largest of the 11 GSAs that have been formed within the Kern Subbasin. The KGA GSA was formed in 2017 upon adoption of a Joint Powers Agreement by all members and is governed by a 16-member Board of Directors.
that includes a representative of each member agency. The KGA GSA is preparing an “Umbrella GSP” that, in addition to providing content for the entire KGA GSA area, includes individual Management Area Plans that contain more detailed information for each member agency’s service area. Areas of the Kern Subbasin that are outside of the KGA GSA GSP are covered under five separate, coordinated GSPs that have been developed by other GSAs.

The KGA Umbrella GSP and this MA Plan for the Arvin-Edison Management Area have been developed to meet SGMA regulatory requirements\(^1\) while reflecting local needs and preserving local control over water resources. Together, these documents provide a path to maintain the long-term sustainability of locally-managed groundwater resources now and into the future.

**ES.2. Sustainability Goal**

The Sustainability Goal for the Arvin-Edison Management Area is to maintain an economically-viable groundwater resource that supports the current and future beneficial uses of groundwater (including municipal, agricultural, industrial, public supply, domestic, and environmental) by utilizing the area’s groundwater resources within the local sustainable yield. Long-term groundwater sustainability will be evaluated and maintained in compliance with locally-defined sustainability criteria. The Management Area will remain in compliance through the continued importation of surface water as well as implementation of projects and management actions to both increase water supplies and reduce demands within the Management Area. The District’s historical efforts to achieve a balanced and sustainable water supply for all lands, including to both the Surface Water Service Area and the Groundwater Service Area, and in an equitable manner, will continue under SGMA.

The local sustainability goal, above, is consistent with and in addition to the basin-wide sustainability goal being adopted by all GSAs in the Kern Subbasin.

**ES.3. Plan Area**

The Arvin-Edison Management Area covers 105,630 acres in the southeastern portion of the Kern Subbasin. Located at the southern end of the state’s Central Valley, the Kern Subbasin is the largest groundwater basin in the state and is bordered on the north by the Tulare Lake Subbasin, the Tule Subbasin, and the Kettleman Plain Subbasin and on the south by the White Wolf Subbasin. The Arvin-Edison Management Area (shown at right) is bordered on the north by the City of Bakersfield, on the west by Kern Delta Water District, on the southwest by Wheeler Ridge-Maricopa Water Storage District (WRMWSD) and on the east by Tejon-Castac Water District. To the northeast are unincorporated and “non-districted” lands, some of which have requested inclusion in this MA Plan and whose information is included in an Appendix hereto.

---

\(^1\) Regulations for GSP development are contained within Title 23 of the California Code of Regulations (CCR) Division 2 Chapter 1.5 Subchapter 2.
Most lands within the Management Area are developed for irrigated agriculture (see figure at right), which use a combination of imported surface water provided by AEWSD and groundwater from AEWSD and/or private wells as water supply. AEWSD has a water supply contract with the Friant Division of the Central Valley Project and has invested considerably over the years in water management programs (additional supplies) and infrastructure to import, convey, recharge/recover, and distribute water to its customers and/or its partners. Through its conjunctive management of water supplies, AEWSD has provided a substantial net benefit to groundwater conditions within its service area.2

The City of Arvin (population of approximately 21,000) is located in the west-central portion of the Management Area and is served with municipal and industrial (M&I) water supply by ACSD. The source for this M&I water supply is local groundwater. Several other small public water systems exist within the Management Area, most serving small populations of residents/customers or employees at various industrial/food processing facilities. Most of the Management Area is designated by the U.S. Census Bureau as Disadvantaged Community (DAC) or Severely Disadvantaged Community (SDAC). The City of Arvin is classified as an SDAC. The active participation of ACSD, whose customers are the residents of the City of Arvin, in the preparation of this MA Plan is just one key way in which the interests of DACs have been considered herein.

ES.4. Stakeholder Outreach Efforts

A Stakeholder Communication and Engagement Plan (SCEP) was completed to fulfill notice and communication requirements in order to achieve active engagement and input of all beneficial users of groundwater within the Arvin-Edison Management Area during the development and implementation of this MA Plan. The goal of the outreach efforts described in the SCEP is to encourage open and transparent engagement by diverse stakeholders. Public participation has been welcomed throughout the MA Plan development process. Venues for stakeholder engagement and input have included: Arvin-Edison Management Area SGMA Stakeholder Workshops, AEWSD Board meetings, ACSD Board Meetings, KGA GSA Board Meetings, and KGA GSA-hosted Stakeholder Workshops and Meetings. Other outreach to

---

2 A portion of the southern Arvin-Edison Management Area, known as the “AEWSD/WRMWSD overlap area”, receives imported water from Wheeler Ridge-Maricopa Water Storage District (WRMWSD). WRMWSD will continue to serve surface water to those lands within the overlap area that have contracts with and have historically received water from WRMWSD.
Management Area stakeholders has included: distribution and collection of a Stakeholder Survey and an Agriculture-specific Stakeholder Survey, various letters from AEWSD and KGA to landowners, and small group or one-on-one meetings between District staff and interested parties. AEWSD and ACSD have also conducted extensive coordination with other KGA members and GSAs in the Kern Subbasin.

ES.5. Hydrogeologic Conceptual Model

The Arvin-Edison Management Area is located in the southeastern portion of the Kern Subbasin, south of the Kern River. The Kern Subbasin occupies a large structural trough filled with thick sedimentary deposits of continental and marine origin. The local geology underlying the Management Area reflects its location near the edge of the basin, proximal to the Sierra Nevada Mountains which are a source for the sediments washed down into the basin (see figure below). The “principal aquifer” is defined in the Management Area as the aquifer materials encountered within the depths of production wells in the area and is comprised of fluvial and alluvial deposits of Miocene to Recent age. In the western portion of the Management Area, a regional clay layer (the “E”-Clay) is found at intermediate depths and creates more confined conditions in the underlying sediments. Aquifer conditions in general are more unconfined to semi-confined in the shallower and eastern areas and more confined in the deeper and western areas. Several faults are present in the Management Area, including the White Wolf Fault that forms the southern boundary of the Kern Subbasin and the Edison Fault near the northern boundary. Both faults appear to affect groundwater flow as evidenced by higher groundwater levels on their upgradient sides.

Due to its location near the edge of the basin, the Management Area has fairly coarse and permeable soils that are conducive to recharge from precipitation and excess applied water (see figure at right)\(^3\). AEWSD operates four primary spreading basin facilities totaling approximately 1,350 acres to take advantage of these favorable recharge conditions. Over 2.2 million acre-feet have been recharged in these spreading basins since 1966.

\(^3\) Irrigation practices are generally highly efficient within the Arvin-Edison Management area; however, recharge of applied water includes some irrigation inefficiency as well as water applied for leaching purposes and other non-consumptive operational uses.
ES.6. Existing Groundwater Conditions

Information on groundwater conditions within the Management Area is presented in this MA Plan with respect to the six “Sustainability Indicators” defined under SGMA, which include the following:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Seawater intrusion
- Degraded water quality
- Land subsidence
- Depletion of interconnected surface water

**Water Levels:** Groundwater levels within the Management Area are presented using contour maps depicting recent (2015) seasonal high (spring) and seasonal low (fall) conditions, as well as hydrographs from 15 representative wells throughout the Management Area that have extended historical records. In general, the available data indicate groundwater flow directions are generally from the surrounding uplands towards the basin, from south to north across the White Wolf Fault, and from west to east in the west/central portion of the Management Area (see figure below). Relative highs and lows appear to be controlled, at least in part, by the distribution of groundwater pumping versus surface water deliveries. Depths to groundwater in Spring 2015 range from approximately 150 to over 500 feet below ground surface (ft bgs), indicating that connections to surface water and the existence of groundwater dependent ecosystems (GDEs) are unlikely. Hydrographs show the long-term positive effects of AEWSD’s surface water importation (i.e., the AEWSD “Project”) in raising groundwater levels, tempered by the effects of the recent severe drought.

*Average Static Depth to Water with and without AEWSD Project*
Groundwater Storage: Changes in groundwater storage over selected time periods of interest were analyzed by comparing water levels at the beginning and the end of several different periods, and also show the positive impacts of AEWSD’s surface water importation and the variability caused by wet and dry climate periods. Spatially, the changes in storage are more positive in the AEWSD Surface Water Service Area compared to areas that rely solely on groundwater for supply. During the historical water budget period (1994 through 2015), annual changes in groundwater storage between (February/March) seasonal highs were estimated using the water budget model (discussed below) and range from +155,000 acre-feet per year (AFY) to -185,000 AFY.

Water Quality: Agricultural use is the dominant beneficial use within the Management Area, and groundwater quality is generally suitable for agricultural uses. That being said, in some instances concentrations of nitrate, arsenic, total dissolved solids (TDS), boron, iron and manganese have been detected in groundwater (legacy and naturally-occurring) within or near the Arvin-Edison Management Area above drinking water standards and/or agricultural water quality goals. Future monitoring efforts will include routine collection of water quality data, which will fill the current water quality data gap for the area. These and data from nearby wells outside of the Management Area will be periodically reviewed and water quality trends will be evaluated as part of future GSP implementation efforts for the Management Area. Further, water quality issues related to potential constituents or concern are regulated separately under the Irrigated Lands Regulatory Program (ILRP), Central Valley-Salinity Alternatives for Long-term Sustainability (CV-SALTS), and the State Water Resources Control Board (SWRCB).

ACSD is actively addressing high arsenic levels in some of its production wells through its Arsenic Mitigation Project that involves replacing impacted wells. ACSD also provides arsenic-free water from filling stations at selected locations and has installed a treatment system for a well impacted by a newly-regulated chemical, 1,2,3-TCP. Ongoing and future water quality monitoring efforts throughout the Management Area will allow for further evaluation of these constituents and any possible connection between groundwater quality and levels.

Land Subsidence: Some amount of land subsidence has been documented within the Arvin-Edison Management Area over both historical (1949-2005) and recent (2014-2016) timeframes. Subsidence due to aquitard depressurization following groundwater withdrawal tends to be greater in the areas to the west that rely solely on groundwater for water supply and are underlain by a greater proportion of fine-grained deposits. Subsidence has the potential to affect critical infrastructure including gravity-driven water conveyance systems (canals) but has been actively managed by AEWSD to date.

Interconnected Surface Waters: Due to the great depth to groundwater in the principal aquifer (i.e., greater than 150 ft bgs), it appears that there are no interconnected surface water systems within the Management Area. Similarly, while the DWR dataset of Natural Communities Commonly Associate with Groundwater (NCCAG) shows some areas within the Management Area as NCCAG, due to the great depth to groundwater these areas do not appear to be GDEs.

Seawater Intrusion: The Management Area is located far from coastal areas. As a result, seawater intrusion is not considered to be an issue for this area.

ES.7. Water Budget

For the Kern Subbasin as a whole, the basin GSAs coordinated on two basin-wide water budget approaches, as described in the KGA Umbrella GSP: (1) development of a numerical model based on the
California Central Valley Groundwater/Surface Water Simulation Model (C2VSim) to estimate the basin-wide water budget, and (2) development of a “checkbook” water accounting approach that estimates supply, demand, and shortages using certain management assumptions. In addition, on a local Management Area basis, a spreadsheet water budget model was developed and calibrated to observed water level/storage changes to provide locally-refined water budget information. While the numerical model and “checkbook” water accounting approaches are described in the KGA Umbrella GSP, the calibrated spreadsheet model is the basis for the detailed historical and current water budget information presented herein (see figure below) but is not a determination of water rights. Based on the 1995 to 2014 historical water budget time period (DWR water years [WY] 1995 through 2014; October 1994 through September 2014), the sustainable yield for the Management Area is conservatively estimated to be, at a minimum, approximately 84,200 AFY under current supply and demand conditions (approximately 0.80 AFY/acre over the 105,630-acre Management Area). Because it is based on a calculation of pumping to achieve net zero decrease in groundwater storage, this sustainable yield is defined in such a way as to avoid the occurrence of Undesirable Results for relevant Sustainability Indicators (discussed further below), and is consistent with the current assumptions for basin-coordinated “native yield” (0.15 AFY/acre) and further addresses effective precipitation and the contribution to groundwater from recharge activities as well as return flow of applied imported surface water.

Over this historical period, the average annual change in groundwater storage in the Management Area was +1,364 AFY.

Water budget information under projected (future) conditions was also developed using the calibrated spreadsheet water budget model, with DWR-provided inputs for climate variables (i.e., adjusted precipitation and evapotranspiration) and water supply assumptions (i.e., changes to imported water supplies). The projected water budget assesses the magnitude of the net water supply deficit under future conditions that would need to be addressed through Projects and Management Actions (P/MAs) to
prevent Undesirable Results and achieve the Sustainability Goal. Consistent with the basin-wide efforts, three projected water budget scenarios were developed for this analysis: a Baseline Scenario, a 2030 Climate Change Scenario, and a 2070 Climate Change Scenario. For the Baseline condition, the long-term average change in groundwater storage was estimated to be +1,660 AFY for the analytical spreadsheet model, and -8,418 AFY for the basin-wide “checkbook” method (see table below). The projected deficit under the 2030 Climate Change Scenario (-31,586 AF) was used as the basis to develop P/MAs for the Management Area.

### Comparison of Change in Storage Estimates (AFY) from Three Water Budget Estimation Methods

<table>
<thead>
<tr>
<th>Period / Scenario</th>
<th>Basin-wide Numerical Model</th>
<th>Local Analytical Spreadsheet Model</th>
<th>Basin-wide “Checkbook” Water Accounting Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Period (WY 1995 – 2014)</td>
<td>18,208</td>
<td>1,364</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Current Period (WY 2015)</td>
<td>-112,364</td>
<td>-164,385</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline with no Projects</td>
<td>2,750</td>
<td>1,660</td>
<td>-8,418</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070)</td>
<td>-782</td>
<td>-31,586</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>2030 Climate Change with no Projects</td>
<td>26,503</td>
<td>343</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070)</td>
<td>-8,695</td>
<td>-56,333</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>2070 Climate Change with no Projects</td>
<td>17,855</td>
<td>28</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

Each estimate presented above includes data gaps and has varying degrees of accuracy and/or reliability. As part of MA Plan implementation, these numbers will be refined as additional information is developed.

### ES.8. Sustainable Management Criteria

Sustainable Management Criteria (SMCs) are the metrics by which groundwater sustainability is judged under SGMA. Key terms related to SMCs under SGMA include the following:

**Undesirable Results**: Undesirable Results are the significant and unreasonable occurrence of conditions, for any of the six Sustainability Indicators defined under SGMA, that adversely affect groundwater use in the basin. Definitions of Undesirable Results for the basin have been developed through a coordinated effort of the basin GSAs and are described in the KGA GSA Umbrella GSP. The basin-wide definitions of Undesirable Results allow for local definition Minimum Thresholds and the combination thereof that is considered significant and unreasonable. Therefore, the broad basin-wide Undesirable Results definitions
Summary of Sustainable Management Criteria Evaluation

<table>
<thead>
<tr>
<th>Sustainability Indicator</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Lowering of GW Levels</td>
<td>Initial MTs were calculated at each long-term hydrograph well site considering historical lows, recent 10-year groundwater level trends, and the variability or range in groundwater levels. Initial MOs were set based on Fall 2015 levels. These estimates were then generalized into four Sustainability Zones to allow flexibility for establishing the SGMA Monitoring Network. Undesirable Results are defined as 40% or more of monitoring sites exceeding MTs over a two-year period. Water levels will be monitored semi-annually within the Management Area. P/MAs will be implemented to maintain water levels above MOs/MTs.</td>
</tr>
<tr>
<td>Reduction of GW Storage</td>
<td>Over the basin-selected historical water budget period (WY 1995-2014) groundwater storage in the Management Area increased at approximately 1,360 AFY. MOs/MTs for lowering of groundwater levels will be used as a proxy for the reduction of groundwater storage.</td>
</tr>
<tr>
<td>Seawater Intrusion</td>
<td>No saltwater bodies are present near the Management Area. Therefore, no MOs/MTs have been developed for this indicator.</td>
</tr>
<tr>
<td>Degraded Water Quality</td>
<td>MTs/MOs for Degraded Water Quality are defined at one well in the ACSD well network (Well #14) for only Arsenic(^4). The SMCs are tied to regulatory water quality standards – the MT is set at the California MCL of 10 micrograms per liter ((\mu g/L)), and the MO is set to 75% of the MCL or 7.5 (\mu g/L). In addition to the monitoring of water quality per Title 22, other representative wells will be monitored annually throughout the Management Area. If data suggest that water quality is being affected by groundwater management practices, MOs/MTs for water quality will be revisited.</td>
</tr>
<tr>
<td>Land Subsidence</td>
<td>MTs/MOs have been developed for a set of local survey benchmark locations along critical infrastructure (canal conveyance). The MT is the maximum rate of subsidence observed from 2014-2018, projected through 2040. The MO is set at the same rate, projected through 2030.</td>
</tr>
<tr>
<td>Surface Water Depletion</td>
<td>No interconnected surface waters are present in the Management Area. Groundwater is approximately 150 ft bgs or deeper. Therefore, no MOs/MTs have been developed for this indicator.</td>
</tr>
</tbody>
</table>

were refined locally for the Arvin-Edison Management Area to better reflect local groundwater conditions and beneficial uses.

**Minimum Thresholds:** Minimum Thresholds (MTs) are the numeric criteria for each Sustainability Indicator that, if exceeded in a locally-defined combination of monitoring sites, may constitute an Undesirable Results for that indicator. Where appropriate, the MTs for the Sustainability Indicators have been set using groundwater levels as a proxy.

**Measurable Objectives:** Measurable Objectives (MOs) are a specific set of quantifiable goals for the maintenance or improvement of groundwater conditions. MOs use the same units and metrics as the MTs and are thus directly comparable.

**Interim Milestones:** Interim Milestones are a set of target values representing measurable groundwater conditions in increments of five (5) years over the 20-year statutory deadline for achieving sustainability.

---

\(^4\) SGMA does not empower GSAs to develop or enforce water quality standards; that authority rests with the State Water Resources Control Board (SWRCB) Division of Drinking Water and the County. Because of the limited purview of GSAs with respect to water quality, and the rightful emphasis on those constituents that may be related to groundwater quantity management activities, the only constituent of concern applicable within the Arvin-Edison Management Area is arsenic in the vicinity of the City of Arvin and ACSD. Furthermore, drinking water quality regulations for public water systems apply at the point of delivery to customers, not in the raw water source, and ACSD blends water from its various well sources.
Chronic Lowering of Groundwater Levels is arguably the most fundamental Sustainability Indicator for the Arvin-Edison Management Area, as it influences several other key Sustainability Indicators, including Reduction of Groundwater Storage and Land Subsidence. The SMCs for Chronic Lowering of Groundwater Levels were developed through temporal analysis of long-term groundwater level data at 15 representative wells with long-term records and generalized into four zones (see figure at right). These generalized MTs were evaluated against known well depths to assess potential impacts on existing wells (i.e., potential dewatering of shallow wells with attendant mitigation procedures). The process for developing the MTs and MOs and the results were presented on multiple occasions in public meetings to allow for stakeholder input.

Significant Groundwater Storage exists within the Arvin-Edison Management Area, and it is estimated that it would take 42 years of zero recharge to deplete the usable storage under current extraction rates. As such, it was determined to be sufficiently protective to define the SMCs for Reduction of Groundwater Storage based on the use of SMCs for Chronic Lowering of Groundwater Levels as a proxy.

SMCs for Degraded Water Quality are defined at one representative well in the ACSD well network (Well #14) for Arsenic. The SMCs are tied to regulatory water quality standards – the MT is set at the California MCL of 10 micrograms per liter (ug/L), and the MO is set to 75% of the MCL or 7.5 ug/L. Numerous other regulatory programs address water quality, in addition to SGMA (e.g., Irrigated Lands). Further, a causal nexus between measured constituent concentrations and water levels and groundwater management actions within the Management Area has not been established based on available data. On-going monitoring for all potential constituents of concern will continue, and if a nexus between these constituent concentrations and water levels and groundwater management actions is established, then the SMCs for water quality will be revisited.

The SMCs for Land Subsidence are based on observed rates of subsidence from ground-based surveys between 2014 and 2018. The rationale is that such subsidence has been historically managed by AEWSD through maintenance and improvements to its facilities (e.g., increasing additional freeboard to its canals), and AEWSD could likely continue to manage/mitigate further subsidence if it were to occur at similar or lower rates. The MO is defined as the amount of land subsidence that would occur if the maximum observed subsidence rates (2014 – 2018) were to continue through 2030 and then cease. A basin-wide subsidence monitoring program is also being developed and will be implemented.
As discussed above, Depletion of Interconnected Surface Water has not been observed within the Arvin-Edison Management Area and is not applicable due to the great depths to groundwater in the principal aquifer. Likewise, Seawater Intrusion does not exist within the Kern Subbasin. Therefore, no SMCs for both of these Sustainable Indicators are defined in this MA Plan.

**ES.9. Monitoring Network**

The objective of the Arvin-Edison Management Area Monitoring Network is to (continue to) collect sufficient data to allow for assessment of the Sustainability Indicators relevant to the Management Area, and potential impacts to the beneficial uses and users of groundwater. The proposed Monitoring Network was developed to ensure sufficient spatial distribution and spatial density. The network consists of 16 representative monitoring sites for groundwater levels and (by proxy) groundwater storage, eight (8) sites for monitoring groundwater quality (although only one site, the ACSD Well #14, is for SGMA compliance purposes), and five (5) sites for monitoring land subsidence. The SGMA-compliance network for the Management Area supplements other monitoring networks and programs in the basin such as DWR California Statewide Groundwater Elevation Monitoring (CASGEM), Central Valley-Salinity Alternatives for Long-term Sustainability (CV-SALTS), Kern County Water Agency (KCWA) semiannual groundwater monitoring program, etc. and basin-wide monitoring networks related to SGMA compliance such as the KGA’s land subsidence network.

Data collected from the SGMA-compliant Monitoring Network will be uploaded to the Data Management System (DMS) maintained for the basin and reported to the DWR in accordance with the Monitoring Protocols developed for the basin as described in the KGA Umbrella GSP or Coordination Agreement. In addition, local data will be stored and managed in an Arvin-Edison Management Area-specific DMS. Additional data collected as part of AEWSD’s and ACSD’s other regular monitoring programs may be used in conjunction with data collected from the SGMA-compliant Monitoring Network to meet compliance with GSP Emergency Regulations regarding Annual Reporting or as otherwise deemed necessary for the Arvin-Edison Management Area.
ES.10. Projects and Management Actions

Achieving sustainability in the Arvin-Edison Management Area will require implementation of P/MA to address projected water budget deficits and water quality impacts within the ACSD production well network. As such, AEWSD has developed a portfolio of P/MA, each with specific expected benefits, implementation triggers, and costs. A preliminary “glide path” has been developed that results in closing of the currently identified future assumed “deficit” of approximately -31,600 AFY by 2040. Accelerated implementation of P/MA will be triggered if observed groundwater conditions deteriorate, as measured against defined SMCs at the representative monitoring sites.

The initial focus will be implementing a Project portfolio with supply augmentation as the primary expected benefit. These projects are grouped into the following categories:

- Projects to Enhance Recharge;
- Projects to Expand or Develop New In-Lieu Areas;
- Projects to Manage and/or Capture Floodwater;
- Projects to Increase Surface Storage Capacity / Delivery Flexibility; and
- Projects to Develop New Supplies.

The Management Actions listed below have water demand reduction as their primary expected benefit and are grouped into the following categories:

- Management Actions / Policies to Reduce Overall Water Demand; and
- Management Actions / Policies to Reduce Groundwater Pumping.

In addition to the above water quantity-related P/MA identified by AEWSD, ACSD has developed and is implementing two (2) Projects to improve the quality of drinking water served by ACSD, including:

- ACSD Emergency 1,2,3-TCP Treatment at Well No. 13; and
- ACSD Arsenic Mitigation Project – Phase II

The supply augmentation and demand reduction P/MA listed above comprise a diverse portfolio of options that can be implemented as necessary by AEWSD and ACSD to achieve sustainability from a total water quantity and water quality perspective, respectively. Simulation results from the projected P/MA

---

5 The net deficit to be addressed by the 2040 GSP implementation deadline is the estimated deficit under the 2030 Climate Change scenario.

6 150 acres of land that were previously planted as a vineyard in a part of AEWSD that has shown decreasing groundwater levels were recently purchased and are being developed into a new groundwater recharge facility. This project has both supply augmentation and demand reduction benefits.
across the basin utilizing basin-wide numerical (C2VSim) model indicate that P/MA implementation along the planned glide path will successfully achieve sustainability and avoid Undesirable Results for Groundwater Levels (and by proxy for the other applicable Sustainability Indicators) (see figure at left). The glide path provides a general guide to how quickly these benefits are to be realized. However, the exact schedule and order of implementation is not known, and further analysis will be conducted to prioritize the P/MAs in consideration of factors including permitting, engineering feasibility, cost effectiveness and other factors. In general, P/MAs being considered for implementation will be discussed during regular AEWSD Board Meetings, which are open to the public. Additional stakeholder outreach efforts will be conducted prior to and during P/MA implementation, as required by law.

**ES.11. GSP Implementation**

Key GSP implementation activities that will be performed by AEWSD and ACSD over the next five (5) years include:

- Monitoring and data collection;
- P/MA implementation and priorities thereof;
- Policy development to support GSP implementation;
- Technical and non-technical coordination with other water management entities in the basin;
- Continued outreach and engagement with stakeholders;
- Annual reporting;
- Enforcement and response actions, as necessary; and
- Evaluation and updates, as necessary, of the Arvin-Edison MA Plan as part of the required periodic evaluations (i.e., “five-year updates”).
ES.12. GSP Implementation Costs and Funding

Costs to implement this MA Plan can be divided into several groups, as follows:

- Costs of local groundwater management activities;
- AEWSD’s and ACSD’s proportional share of costs for basin-wide groundwater management activities; and
- Costs to implement P/MAs, including capital/one-time costs and ongoing costs.

The estimated costs to AEWSD for local groundwater management activities is approximately $270,000 per year, the estimated proportional share of costs for basin-wide groundwater management activities is approximately $120,000 per year, and the estimated costs to implement P/MAs is approximately $4.3 million per year in the first five years, decreasing to between approximately $1.5 million to $2.25 million per year in the subsequent 15 years; the P/MA costs will be further studied within the initial 5-year period. ACSD has estimated SGMA compliance costs to be approximately $50,000 per year.

Sources of funding for SGMA compliance activities for both AEWSD and ACSD will include primarily regular fees and assessments from customers and rate payers. This primary source of revenue will be supplement to the greatest extent possible through loans and grants, and possibly by additional fees imposed as an incentive to discourage unsustainable water use practices. AEWSD and ACSD will likely need to raise revenue through fees and charges that will be conducted pursuant to applicable laws and regulations (e.g., Proposition 218 and related laws).

ES.13. Conclusion

The passage of SGMA in 2014 ushered in a new era of mandatory groundwater management in California’s most intensively used groundwater basins. The law was followed by promulgation of a robust regulatory framework for GSA formation, GSP development, and implementation thereof. The law and regulations emphasize the use of best available science, local control and decision making, and active engagement of affected stakeholders. Because of the breadth and scope of the groundwater sustainability problem in California and the legislative and regulatory response to it, SGMA presents significant challenges both for local implementing agencies and groundwater users alike. Achieving and maintaining sustainability in the face of uncertain future water supply conditions while addressing and balancing the needs of all beneficial uses and groundwater users will require significant effort, creative solutions, and unprecedented collaboration. As the implementing agencies within the Arvin-Edison Management Area, AEWSD and ACSD are committed to facing these challenges in a manner that upholds the interests of local landowners and constituents.
INTRODUCTION

1. PURPOSE OF THE GROUNDWATER SUSTAINABILITY PLAN

The purpose of this Groundwater Sustainability Plan (GSP) Management Area Plan (MA Plan) is to, in combination with the Kern Groundwater Authority (KGA) Groundwater Sustainability Agency (GSA)\(^7\) and the other GSAs in the Kern County Subbasin (Kern Subbasin), meet the regulatory requirements set forth in the three-bill legislative package consisting of Assembly Bill (AB) 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (SGMA)\(^8\). SGMA defines sustainable groundwater management as the “management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results”. Undesirable results are defined by SGMA as any of the following effects caused by groundwater conditions occurring throughout the basin:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply;
- Significant and unreasonable reduction of groundwater storage;
- Significant and unreasonable seawater intrusion;
- Significant and unreasonable degraded water quality;
- Significant and unreasonable land subsidence; and/or
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

The Kern Subbasin has been identified by the California Department of Water Resources (DWR) as critically overdrafted. This MA Plan has been developed in coordination with the KGA GSA to meet SGMA regulatory requirements by the January 31, 2020 deadline for critically-overdrafted basins while reflecting local needs and preserving local control over water resources. This MA Plan, in coordination with the KGA Umbrella GSP and the other GSPs in the Kern Subbasin, provides a path to achieve and document sustainable groundwater management within 20 years following Plan adoption, and preserves the long-term sustainability of locally-managed groundwater resources now and into the future. This MA Plan was approved for inclusion in the KGA GSA Umbrella GSP by the AEWSD Board on 10 December 2019 (Appendix N).

---

\(^7\) Per Section 2.03(b)(i) of the Joint Powers Agreement (JPA) executed on 22 March 2017, AEWSD maintains its right to “become a GSA individually or collectively within the General Member’s boundaries or the Management Area managed in whole or in part by such General Member”.

\(^8\) Nothing in this Management Area Plan or in the related Groundwater Sustainability Plan determines or alters surface water rights or groundwater rights under common law, any provision of law that determines or grants surface water rights, or otherwise (see, CWC § 10720.5(b)). This Management Area Plan and the related Groundwater Sustainability Plan shall be construed consistent with Section 2 of Article X of the California Constitution and nothing provided in this Chapter modifies rights or priorities to use or store groundwater except as expressly stated in CWC § 10720.5(a). The District reserves and retains all rights to the use of water to the extent provided by law.
2. **SUSTAINABILITY GOAL**

The Sustainability Goal for the Arvin-Edison Management Area is to maintain an economically-viable groundwater resource that supports the current and future beneficial uses of groundwater (including municipal, agricultural, industrial, public supply, domestic, and environmental) by utilizing the area’s groundwater resources within the local sustainable yield. Long-term groundwater sustainability will be evaluated and maintained in compliance with locally-defined sustainability criteria. The Management Area will remain in compliance through the continued importation of surface water as well as implementation of projects and management actions to both increase water supplies and reduce demands within the Management Area. The District’s historical efforts to achieve a balanced and sustainable water supply for all lands, including to both the Surface Water Service Area and the Groundwater Service Area, and in an equitable manner, will continue under SGMA.

The local sustainability goal, above, is consistent with and in addition to the basin-wide sustainability goal being adopted by all GSAs in the Kern Subbasin, defined (as of 9 August 2019) below:

“The sustainability goal of the Kern County Subbasin is to:

- Achieve sustainable groundwater management in the Kern County Subbasin through the implementation of projects and management actions at the member agency level of each GSA.
- Maintain its groundwater use within the sustainable yield of the basin.
- Operate within the established sustainable management criteria, which are based on the collective technical information presented in the GSPs in the Subbasin.
- Implement projects and management actions that include a variety of water supply development and demand management actions.
- Collectively bring the Subbasin into sustainability and to maintain sustainability over the implementation and planning horizon.

Further, the Subbasin sustainability goal includes a commitment to monitor and report groundwater conditions, as required by SGMA, and to continue coordination among the KGA member agencies and all other GSA’s in the Subbasin to identify the potential for, or presence of, undesirable results and actions to prevent undesirable results. The coordination process established in the development of this GSP and memorialized in the Coordination Agreement will ensure that the Subbasin is managed as a shared groundwater resource and that the districts within the Subbasin work collaboratively towards achieving and maintaining sustainable groundwater use.”
3. AGENCY INFORMATION

3.1. Name and Mailing Address of the Agency

This MA Plan has been prepared Arvin-Edison Water Storage District (AEWSD) and Arvin Community Services District (ACSD). Both AEWSD and ACSD are members of the Kern Groundwater Authority Groundwater Sustainability Agency (KGA GSA or Agency) per a Joint Powers Agreement executed on 22 March 2017. Information regarding the mailing address for AEWSD and ACSD is provided below, and the Agency’s mailing address is presented in the KGA GSA “Umbrella” GSP.

The mailing address for the AEWSD is:

P.O. Box 175
Arvin, California 93203-0175

The mailing address for ACSD is:

309 Campus Drive
Arvin, CA 93203

3.2. Organization and Management Structure of the Agency

Per the Joint Powers Agreement (JPA) executed on 22 March 2017, the KGA GSA Board is composed of one representative from each of the general member agencies\(^9\), including: Arvin Community Services District (ACSD), AEWSD, Cawelo Water District (CWD), Kern County Water Agency (KCWA) on behalf of Pioneer Project, Kern-Tulare Water District (KTWD), Kern Water Bank Authority (KWBA), North Kern Water Storage District (NKWSD), Rosedale-Rio Bravo Water Storage District (RRBWSD), Semitropic Water Storage District (SWSD), Shafter-Wasco Irrigation District (SWID), Southern San Joaquin Municipal Utility District (SSJMUD), Tejon-Castac Water District (TCWD), West Kern Water District (WKWD), Westside District Water Authority (WDWA) and Wheeler-Ridge Maricopa Water Storage District (WRMWSD), and the City of Shafter.

To facilitate the implementation of the KGA GSA GSP, the Agency's jurisdictional area is divided into management areas formed by the portion of the Kern Subbasin that underlies the boundaries of each general member agency. Each general member agency will prepare a refined Management Area Plan for their management area.

The AEWSD Board of Directors also represents the Arvin-Edison Management Area and it is formed by nine directors. A current list of AEWSD Directors can be found on the District’s website at http://www.aewsd.org.

\(^9\) See executed JPA for a full list of member agencies to the KGA.
The KGA GSA was formed by a resolution of the Board of Directors of the Kern Groundwater Authority on 26 April 2017. The KGA GSA is governed by a Board of Directors that includes a representative of each member agency. Information regarding current KGA GSA Board members can be found on the KGA’s website at http://www.kerngwa.com/.

3.3. **MA Plan Manager**

**23 CCR § 354.6(c)**

The Plan Manager for the KGA Umbrella GSP is Patty Poire. The contact information for Ms. Poire is presented in the KGA GSA Umbrella GSP.

The Plan Managers for this MA Plan are Jeevan Muhar, Engineer Manager of the AEWSD and Raul Barraza, General Manager of the ACSD. The contact information for Mr. Muhar and Mr. Barraza is provided below.

- **Jeevan Muhar**
  - Engineer-Manager
  - Arvin-Edison Water Storage District
  - P.O. Box 175
  - Arvin, CA 93203
  - Office phone: 661-854-5573
  - Office fax: 661-854-5213
  - email: jmuhar@aewsd.org

- **Raul Barraza**
  - General Manager
  - Arvin Community Services District
  - 309 Campus Drive
  - Arvin, CA 93203
  - Office phone: 661-854-2127
  - Office fax: 661-854-8230
  - Email: rbarraza@arvincsd.com

3.4. **Legal Authority of the GSA**

**23 CCR § 354.6(d)**

The KGA GSA applied for and was granted GSA status under SGMA (California Water Code [CWC] § 10723(c)). Please refer to the KGA Umbrella GSP for further discussion of the legal authority of the KGA GSA, demonstrating that it has the legal authority to implement the GSP.

3.5. **Estimated Cost of Implementing the GSP and the Agency’s Approach to Meet Costs**

**23 CCR § 354.6(e)**

Information on estimated costs to implement the GSP within the Arvin-Edison Management Area, and the AEWSD’s plan to meet those costs is provided in *Section 18.2 Plan Implementation Costs*. 
4. GSP ORGANIZATION

This MA Plan is organized as follows:

- Sections 1 through 4 comprise the Introduction, including the following sections:
  - Section 1. Purpose of the Groundwater Sustainability Plan
  - Section 2. Sustainability Goal
  - Section 3. Agency Information
  - Section 4. GSP Organization

- Section 5 provides a Description of the Plan Area.

- Sections 6 through 10 present the Basin Setting, including the following sections:
  - Section 6. Introduction to Basin Setting
  - Section 7. Hydrogeologic Conceptual Model
  - Section 8. Current and Historical Groundwater Conditions
  - Section 9. Water Budget Information
  - Section 10. Management Areas

- Sections 11 through 15 present the Sustainable Management Criteria, including the following sections:
  - Section 11. Introduction to Sustainable Management Criteria
  - Section 12. Sustainability Goal
  - Section 13. Undesirable Results
  - Section 14. Minimum Thresholds
  - Section 15. Measurable Objectives and Interim Milestones

- Section 16 presents the Monitoring Network.

- Section 17 presents the Projects and Management Actions.

- Sections 18 and 19 present Plan Implementation, including the following sections:
  - Section 18.
  - AEWSD Plan Implementation
  - Section 19. ACSD Plan Implementation

- References and Technical Studies are included at the end of this document.

- Supporting information is provided in appendices as follows:
  - Appendix A. GSP Submittal Checklist
  - Appendix B. Power & Water Resources Pooling Authority Description
  - Appendix C. White Lands Addendum
Specific sections of this MA Plan that provide information pertaining to the **Arvin Community Services District (ACSD)** include:

- Section 3. Agency Information
- Section 5. Description of the Plan Area
- Section 7. Hydrogeologic Conceptual Model, including
  - Section 7.1. General Description
  - Section 7.3.4. Recharge and Discharge Areas
- Section 8. Current and Historical Groundwater Conditions, including
  - Section 8.5. Groundwater Quality
- Section 9. Water Budget Information
- Section 10. Management Areas
- Section 13. Undesirable Results, including
  - Section 13.4. Undesirable Results for Degraded Water Quality
  - Section 13.7. Undesirable Results Summary
- Section 14. Minimum Thresholds, including
  - Section 14.1. Minimum Threshold for Chronic Lowering of Groundwater Levels
  - Section 14.4. Minimum Threshold for Degraded Water Quality
- Section 15. Measurable Objectives and Interim Milestones, including
  - Section 15.4. Measurable Objectives and Interim Milestones for Degraded Water Quality
- Section 16. Monitoring Network, including
Section 16.1.1. Monitoring Network for Chronic Lowering of Groundwater Levels
Section 16.1.4. Monitoring Network for Degraded Water Quality
Section 16.4. Assessment and Improvement of Monitoring Network

- Section 17. Projects and Management Actions
- Section 19. ACSD Plan Implementation
- Appendix D. ACSD 2018 Water Use Summary
5. DESCRIPTION OF THE PLAN AREA

This section presents a description of the Plan Area for the Arvin-Edison Management Area and a summary of the relevant jurisdictional boundaries and other key land use features potentially relevant to the sustainable management of groundwater in the Management Area. This section also describes the water monitoring programs, water and power management programs, and general plans relevant to the Management Area and their influence on the development and execution of this Groundwater Sustainability Plan (GSP) Management Area Plan (MA Plan).

5.1. Summary of Jurisdictional Areas and Other Features

5.1.1. Area Covered by the Plan

As discussed previously in Section 3.2 Organization and Management Structure of the Agency, this MA Plan is a locally refined subcomponent of the “Umbrella” GSP prepared by the KGA GSA. This MA Plan covers a portion of the KGA GSA area, specifically the portion underlying AEWSD. The area covered by this MA Plan, referred to herein as the “Arvin-Edison Management Area” and shown on Figure PA-1, includes all AEWSD lands within the Kern Subbasin (California Department of Water Resources [DWR] Basin 5-022.14, referred to herein as the Kern Subbasin or Basin) that are not overlapped by the East Niles Community Services District (ENCSD); the area of overlap between AEWSD and ENCSD is managed under a separate GSP being prepared by the Kern River GSA. Lands within the AEWSD service area that are located in the White Wolf Subbasin are managed under a separate GSP being prepared by the White Wolf GSA.

Additional water agencies whose jurisdictional boundaries overlap the Arvin-Edison Management Area and who are represented by the Arvin-Edison MA Plan include the Arvin Community Services District (ACSD) and Mettler County Water District (MCWD). The Wheeler Ridge-Maricopa Water Storage District (WRMWSD) and Tejon-Castac Water District (TCWD) jurisdictional boundaries also partially overlap the Arvin-Edison Management Area, both in the Kern Subbasin and the White Wolf Subbasin; these entities are participating members of the KGA GSA and are developing separate Management Area Plans for their jurisdictional areas within the Kern Subbasin in close coordination with AEWSD.

The Arvin-Edison Management Area is located in the southeastern portion of the Kern Subbasin. The basin is bounded on the north by the Tulare Lake Subbasin (DWR Basin 5-022.12), the Tule Subbasin (DWR Basin 5-022.13) and the Kettleman Plain Subbasin (DWR Basin 5-022.17), on the south by the White Wolf Subbasin. The boundaries of these subbasins are indicated on Figure PA-1.
Subbasin (DWR Basin 5-022.18) on the west side by the Coastal Range and on the east side by the Tehachapi Range.

The Arvin-Edison Management Area encompasses 105,630 acres of the KGA GSA. The ACSD urban area consists of approximately 2,450 acres, wholly within the Arvin-Edison Management Area. There are currently four other Groundwater Sustainability Agencies (GSAs) within the Kern Subbasin\(^{11,12}\) that are preparing independent GSPs that will be coordinated with the KGA GSA GSP: Buena Vista Water Storage District, Henry Miller Water District, Kern River GSA, and Olcese GSA. Other GSAs that are within the KGA GSA GSP are Cawelo GSA, Pioneer GSA, Semitropic Water Storage District (SWSD), and the West Kern Water District (WKWD). The rest of the basin is comprised of un-districted lands (i.e. “white lands”), some of which have executed management agreements with nearby water districts or other public agencies.

5.1.2. Adjudicated Areas

- \(23\) CCR § 354.8(a)(2)
- \(23\) CCR § 354.8(b)

The basin is not adjudicated, and no portion of the basin is being managed pursuant to an alternative.

5.1.3. Jurisdictional Boundaries

- \(23\) CCR § 354.8(a)(3)
- \(23\) CCR § 354.8(b)

The Arvin-Edison Management Area falls entirely within Kern County and contains the City of Arvin and Mettler, a census designated place. As shown on Figure PA-1, water agencies and public water systems that at least partially overlie the Arvin-Edison Management Area include: WRMWSD, TCWD, ACSD, MCWD, ENCS, KCWA #ID4, Orange Grove RV Park, Grimmway Enterprises Malaga Water System, Heck Cellars Water System, and Grimmway Farms Frozen Foods. Additional water agencies in the vicinity of the Management Area include: California Water Service Company-Bakersfield and Kern Delta Water District (KDWD).

Another public agency with jurisdiction within the Arvin-Edison Management Area is the Power & Water Resources Pooling Authority (PWRPA), formed by several irrigation and water districts through a Joint Powers Agreement (JPA). The PWRPA, of which AEWSD is a participant, has the authority to enable projects and programs related to water and energy (see Appendix B). AEWSD plans to expand this program in the future upon further development of groundwater banking facilities and in-lieu projects (see Section 5.2 Water Resources Monitoring and Management Programs and Section 17 Projects and Management Actions for further details).

According to the information made available by DWR\(^\text{13}\) in support of the development of GSPs, there are currently no tribal lands nor federal lands within or in the vicinity of the Arvin-Edison Management Area\(^\text{14}\).

\(^{11}\) SGMA Portal: https://sgma.water.ca.gov/portal/gsa/all, retrieved on 11/30/2018.
\(^{12}\) AEWSD Board has adopted a resolution to become an exclusive GSA for the Arvin-Edison Management Area and plans to finalize this in early 2020 (see Section 19.1 - Plan Implementation Activities)
\(^{13}\) SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer
\(^{14}\) The Tejon Tribe is a Federally-recognized tribe that is in the process of securing Tribal Land Trust status for 305 acres in the AEWSD service area.
State lands within the Management Area include the 226-acre Bakersfield Cactus Ecological Reserve that is located near Caliente Creek in the northeastern portion of AEWSD (see Figure PA-2) and maintained by the California Department of Fish and Wildlife. Additional protected lands include a small (<100 acre) dedicated Conservation Easement Area in the TCWD-AEWSD overlap area close to the eastern boundary of AEWSD (see Figure PA-2). Tribal, federal and state lands within the KGA GSA are identified in the KGA GSA’s Umbrella GSP.

The DWR further presents information regarding U.S. Census Blocks, Tracts and Places that are defined as disadvantaged communities (DAC) or severely disadvantaged communities (SDAC). Figure PA-3 shows the DAC/SDAC designations within the Arvin-Edison Management Area. A majority of the Management Area is considered a DAC based on the Census Block Group and Census Tract characterizations. Additionally, Mettler is defined as a DAC and the City of Arvin is defined as a SDAC based on the Census Place characterization.

The Arvin-Edison Management Area is located entirely within the Kern County General Plan area, and a portion is also within the Metropolitan Bakersfield General Plan area (see Figure PA-7 and Figure PA-8). The Management Area also encompasses the entire ACSD urban area, which is covered by the City of Arvin General Plan. Each of these plans are described further in Section 5.3 Land Use Elements or Topic Categories of Applicable General Plans. Other relevant planning documents developed for Kern County and the Management Area vicinity (e.g., habitat conservation plans, hazard mitigation plans, etc.) are further described in the Umbrella GSP.

5.1.4. **Existing Land Use and Water Use**

- **23 CCR § 354.8(a)(4)**
- **23 CCR § 354.8(b)**

As shown on Figure PA-4, intensive agriculture is the primary land use within the Arvin-Edison Management Area, followed by undeveloped/non-irrigated areas and urban/industrial areas, including solar. As of Spring 2015, approximately 89,800 acres are classified as irrigated agricultural lands within the Management Area, 5,000 acres are classified as non-irrigated agricultural, 4,600 acres are classified as urban lands, 4,200 acres are classified as native lands, and an additional 2,300 acres are covered by AEWSD’s canal and spreading basin facilities. Table PA-1 includes a more detailed breakdown of the land use in the Management Area.

---

15 Per the Tejon Ranch Conservation & Land Use Agreement (Tejon Ranch Company, 2008)
16 Reported urban area currently includes approximately 1,700 acres of solar facilities within the Management Area. Continued expansion of solar facilities is expected to occur in the future.
17 Spring 2015 was selected as the representative period for which to describe existing land and water use as this is the closest season to the SGMA baseline date (1 January 2015, per CWC § 10727.2(b)(4)) and is also consistent with how “current conditions” are being defined within the Groundwater Conditions and Water Budget sections of the KGA GSP (see Sections 8 and 9.3).
### Table PA-1. Land Use Classification – Spring 2015

<table>
<thead>
<tr>
<th>DWR Land Use Classification</th>
<th>Acreage&lt;sup&gt;18&lt;/sup&gt;</th>
<th>Percent of Total Acreage</th>
<th>Percent of Irrigated Ag. Lands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck, nursery, and berry crops</td>
<td>26,417</td>
<td>25%</td>
<td>29%</td>
</tr>
<tr>
<td>Vineyards</td>
<td>19,631</td>
<td>19%</td>
<td>22%</td>
</tr>
<tr>
<td>Citrus</td>
<td>14,901</td>
<td>14%</td>
<td>17%</td>
</tr>
<tr>
<td>Field crops</td>
<td>12,995</td>
<td>12%</td>
<td>14%</td>
</tr>
<tr>
<td>Deciduous fruits and nuts</td>
<td>11,128</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td>Grain and hay crops</td>
<td>3,773</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Pasture</td>
<td>686</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Semi-agricultural</td>
<td>293</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Ag Non-Irrigated</td>
<td>4,981</td>
<td>5%</td>
<td>NA</td>
</tr>
<tr>
<td>Urban (including solar, see footnote 8)</td>
<td>4,592</td>
<td>4%</td>
<td>NA</td>
</tr>
<tr>
<td>Native vegetation</td>
<td>4,163</td>
<td>4%</td>
<td>NA</td>
</tr>
<tr>
<td>Canals, spreading basins, and other surface water features</td>
<td>2,343</td>
<td>2%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>105,902</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Urban potable water demands within the Arvin-Edison Management Area (i.e., City of Arvin and Mettler) are entirely met by ACSD and MCWD with groundwater. The ACSD serves a population of 20,850 through 3,885 service connections and MCWD serves a population of 157 through 17 service connections<sup>19</sup>. The potable consumption of groundwater in the Management Area also includes limited use by domestic well owners and public water systems.

Agricultural water demands are met by conjunctive use of imported surface water and/or groundwater depending on location within the Arvin-Edison Management Area<sup>20</sup>. AEWSD has a contract with the

---

<sup>18</sup> The slight mismatch in total acreage in Table PA-1 versus the value provided in Section 5.1.1 is likely due to minor inconsistencies in the land use shapefile used for this analysis.

<sup>19</sup> Information retrieved from the California Environmental Health Tracking Program Water Boundary Tool on 02/21/2019. The ACSD data was last updated on 08/13/2018 and MCWD on 09/23/2016.

<sup>20</sup> A small portion of agricultural water demands are met by recycled wastewater from agricultural processing facilities within AEWSD.
United States Bureau of Reclamation (USBR) for 40,000 acre-feet per year (AFY) of Class 1 water and 311,675 AFY of Class 2 water from the Friant Division of the Central Valley Project (CVP), delivered through the Friant-Kern Canal (AEWSD, 2015). AEWSD also has access to water from the following associated sources: Recovered Water Account [RWA], Unreleased Restoration Flows [URF], Recapture & Recirculation [R/R], and Section 215 water. Pursuant to transfer agreements with partner agencies, AEWSD has also obtained imported water from other sources such as the State Water Project (SWP), Westside CVP, and the Kern, Kings, Kaweah and St. John’s Rivers. Figure PA-5 shows the parcels that are located within the AEWSD Surface Water Service Area (SWSA). The remainder of the Management Area relies on groundwater to meet demands, although in recent years AEWSD has expanded its Temporary Water Service and In-Lieu programs to extend surface water delivery to some limited additional parcels (details of the Temporary Water Service Program and In-Lieu Program are discussed in Section 5.2.3 Conjoint Use in the Arvin-Edison Management Area). AEWSD customers with surface water contracts are not precluded from pumping underlying groundwater for beneficial use.

**ACSD Land and Water Use**

Lands contained within ACSD’s boundary are both urban and agricultural. The total acreage within ACSD’s boundary is 2,450 acres. This includes about 450 acres of open land and 450 acres of farmed lands. It is anticipated that the open lands will eventually be developed to urban uses as in-fill projects. The acreage that is developed to urban uses (residential, commercial/industrial, public parks, schools, public buildings) is about 1,508 acres. This area estimate reflects the latest Local Agency Formation Commission (LAFCo) mapping. ACSD lands are generally located south of Sunset Boulevard, north of Burkett Boulevard, east of Comanche Drive and west of Tejon Highway. However, there are lands that are a part of ACSD that are external to the main boundary. These are designated “islands” and are included the acreage tabulation below. Acreages are approximate and are not to be considered the product of an ACSD boundary survey conducted by a licensed land surveyor, but are rather included in Table PA-2 below for preparation of SGMA land and water use calculations.

**Table PA-2. ACSD Land Use Summary**

<table>
<thead>
<tr>
<th>Land Use Description</th>
<th>Area (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lands within ACSD Boundaries</td>
<td>2,447</td>
</tr>
<tr>
<td>Urban areas within ACSD Boundaries, 5 acres or greater, that are not developed</td>
<td>455</td>
</tr>
<tr>
<td>Areas that are intensively farmed</td>
<td>447</td>
</tr>
<tr>
<td>Special Use Lands (Ski Lakes)</td>
<td>37</td>
</tr>
<tr>
<td>Total Urban Developed Lands within the ACSD Boundary</td>
<td>1,508</td>
</tr>
</tbody>
</table>

Notes:

1. Lands within ACSD Boundaries include the contiguous area served by ACSD together with the individual parcels (“islands”) served external to the main body of ACSD lands.
2. As of January 1, 2019, there are 13 vacant tracts of land within the ACSD boundary. The size of these tracts varies from 5 acres to 125 acres.
There are 447 acres of farm lands within the ACSD boundary. These lands are intensively farmed and supplied with water from private non-ACSD wells, and with wastewater from the City of Arvin Wastewater Treatment Plant.

Water to fill and maintain the Ski Lakes is pumped by a private, non-ACSD well installed for that specific purpose. Domestic water to the households is provided by ACSD.

ACSD relies on groundwater as its only source of water. ACSD currently operates five wells. Three (3) of these wells are older wells that are contaminated with arsenic, nitrates and the volatile organic compound 1,2,3-TCP. They are scheduled to be replaced by newer wells that will be operational by mid-year 2020. ACSD has been operating under a USEPA Compliance Order for arsenic for the past 10 years, after the new arsenic regulations became effective in January of 2006. ACSD developed its Arsenic Mitigation Project in 2010 to deal with the arsenic problem and obtained financing from the State of California to drill two new wells in 2015 as the first phase in its Arsenic Mitigation Project. These two new wells were placed online in 2017 and comply with the new arsenic standards, however one of these wells was affected by the contaminant 1,2,3-TCP. A new maximum contaminant level (MCL) was established for 1,2,3-TCP, effective January 1, 2018. This well was taken out of service while a treatment system could be designed and installed. Treatment for this well was installed in late 2018/early 2019 and the well was returned to service in the Spring of 2019. ACSD obtained financing for Phase 2 of its Arsenic Mitigation Project in April 2019 and construction of three new replacement wells began on June 3, 2019. It is scheduled to be completed in June 2020.

Additionally, the USEPA released financing for construction of a new well to replace one of its wells that was in the path of a contaminant plume from the now-abandoned Brown and Bryant Superfund Site. The plume did not reach this well but was moving in its direction and the USEPA determined that it was in the best interest of ACSD to drill a new well to replace it. The new well (the fourth replacement well to be drilled in 2019) will be placed in service mid-year 2020. The well that was in the path of the plume was destroyed by ACSD in 2018.

The three older wells are scheduled to be destroyed after the new wells are placed online. As a part of Phase 2 of the Arsenic Mitigation Project there will be constructed a new one-million-gallon water storage tank with booster pumping plant, new connective piping for the wells, and a new SCADA system installed to monitor and control this system.

After completion of the above work, ACSD will have six new production wells and retain two of the older wells that have arsenic contaminant levels near the MCL. These two wells are scheduled to be part of an arsenic blending program that will be made possible by the installation of the new one-million-gallon storage tank. The Arsenic Mitigation Project is to drill new wells with Arsenic below the MCL and does not consider an arsenic treatment facility (combined nor wellhead treatment).
5.1.5. **Well Density per Square Mile**

- 23 CCR § 354.8(a)(5)
- 23 CCR § 354.8(b)

**Figure PA-6** shows the density of wells per square mile within the Arvin-Edison Management Area, based on Well Completion Report records compiled by DWR. According to these records, approximately 486 production wells, 140 domestic wells, and 22 public supply wells have been installed within the Public Land Survey System (PLSS) sections that fall partially or entirely within the Management Area. Communities dependent on groundwater within the Management Area are the City of Arvin and Mettler which are served by ACSD and MCWD as previously mentioned. According to ACSD records, there are ten wells within its service area; however, only four are active. The MCWD produces groundwater from two wells.

AEWSD’s internal Data Management System (DMS) identifies 819 wells within the Arvin-Edison Management Area (i.e., 444 production wells, 48 domestic/M&I wells, and 149 of unknown classification). As part of GSP preparation efforts, AEWSD is conducting an expansive investigation to reconcile the information in its DMS with the DWR records (e.g., to locate and identify the status of the 140 domestic wells and to validate DWR Well Completion Report records). These data reconciliation efforts are expected to continue as part of GSP implementation.

ACSD currently operates five wells (Nos. 8, 10, 11, 13, and 14). ACSD wells are located within a 6.4 square mile radius and are all located within the ACSD jurisdictional area.

5.1.6. **Lands Outside of District Covered by MA Plan**

Under SGMA (CWC § 10724), counties are presumed to be the GSA for areas that are not otherwise covered by another GSA, unless the county specifically opts out of this GSA role. In the Kern Subbasin, the County of Kern opted out of this role in early 2019 which resulted in lands outside of the other GSA boundaries being “uncovered”. To address this, the KGA sent notices to these “undistricted” land owners offering an opportunity to sign an agreement for coverage under the Management Area Plans of nearby KGA members. Fifteen landowners with a total of 54 parcels outside of AEWSD totaling approximately 8,517 acres (1,075 irrigated acres, 7,442 non-irrigated acres) accepted the offer to gain coverage under this MA Plan. Given the late time at which these offers were made and accepted following the County’s withdrawal, KGA determined that it would not be possible to cover these undistricted lands in the KGA member’s Management Area Plans to the same degree of detail as lands that were covered by KGA members from the start; instead, KGA determined that it would be appropriate to include the lands in an appendix to the Management Area Plans, providing basic information about each parcel including the owner, APN, area, land/water use, and well information. As such, **Appendix C** presents information on these lands, including a table with the above information as well as a figure showing their locations. In addition, for the subset of undistricted lands that are currently irrigated, a projected water budget has been developed and is included in **Appendix C**. It is the intention of KGA and its members to include

---

22 Each PLSS section represents approximately 1 square mile of area (i.e., 640 acres).
additional information for these lands (if they still need GSP coverage) in their 2025 Management Area Plan updates.

5.2. Water Resources Monitoring and Management Programs

5.2.1. Existing Monitoring and Management Programs

- **The California Statewide Groundwater Elevation Monitoring (CASGEM) Program** which tracks long-term groundwater elevation trends in groundwater basins throughout California. The program’s mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California’s alluvial groundwater basins. AEWSD has been a Monitoring Entity under the CASGEM Program since 2011.

- **The Groundwater Ambient Monitoring and Assessment (GAMA) Program** which is California's comprehensive groundwater quality monitoring program that was created by the State Water Resources Control Board (SWRCB) in 2000. The GAMA Program monitors groundwater quality trends throughout California, including within the Arvin-Edison Management Area.\(^{23}\)

- **The SWRCB’s Division of Drinking Water** monitors groundwater quality from public water system wells. Public water systems included within the Arvin Edison Management Area are described in Section 5.1.3 Jurisdictional Boundaries of this document.

- **The Monitoring and Reporting Program (MRP)** from the Irrigated Lands Regulatory Program (ILRP), establishes the specific surface and groundwater monitoring, reporting, and electronic data deliverable requirements for irrigated lands used for commercial purposes within the Tulare Lake Basin Area (The ILRP is further described in the section below “Existing Management Programs”). The purpose of this MRP is to determine the effects of irrigated lands waste discharges on water quality and assess the effectiveness of ILRP management actions. Data and reports are available in the GAMA database (CVRWQCB, 2013).

- **Central Valley-Salinity Alternatives for Long-term Sustainability (CV-SALTS)** is a collaborative stakeholder driven and managed program to develop sustainable salinity and nitrate management planning for the Central Valley. The Kern Subbasin is a Priority 2 basin for nitrate management. Consequently, the nitrate control program schedule is set to begin in 2021 as described in the Umbrella GSP.

- **AEWSD** conducts regular groundwater level monitoring and groundwater quality sampling in selected wells throughout the Management Area as part of its on-going water resources management efforts and as part of compliance with its water banking agreements.

\(^{23}\) GAMA Website: https://www.waterboards.ca.gov/water_issues/programs/gama/about.html.
• AEWSD monitors flowrates on all of its wells using propeller flowmeters, and also measures pumping in some private agricultural wells as part of a voluntary grant funded program.

• AEWSD measures all imported surface water and deliveries to its customers and spreading works. All water banking and water transfer programs in which AEWSD participates include monitoring and reporting programs as well. Both ACSD and MCWD conduct regular groundwater quality sampling of their public supply wells for compliance with California Code of Regulations Title 22 Drinking Water Standards. For example, ACSD monitors wells on a quarterly basis for contaminants of concern such as arsenic and 1,2,3-TCP, and conducts UCMR testing required by the federal government every three years.

• WRMWSD conducts periodic groundwater level monitoring and groundwater quality sampling in selected wells within the AEWSD-WRMWSD overlap portion of the Management Area.

The CASGEM groundwater elevations (and groundwater elevations from wells in the AEWSD and WRMWSD monitoring networks) have been used to characterize groundwater level conditions (see Section 8.2 Groundwater Elevations and Flow Direction). Water quality data from the above sources have been used to identify groundwater quality conditions (see Section 8.5 Groundwater Quality).

Various surface water monitoring programs are also active within the Kern Subbasin (e.g., California Data Exchange Center [CDEC], United States Geological Survey [USGS] National Water Information System [NWIS], etc.). However, there are no active monitoring points within or proximate to the Arvin-Edison Management Area as natural surface water resources are limited to a small number of ephemeral creeks draining into the area from surrounding watersheds to the east\(^\text{24}\) (see Section 7.3.5 Surface Water Bodies).

Land subsidence data in the vicinity of AEWS is available through the following sources:

• University Navstar\(^\text{25}\) Consortium (UNAVCO) Plate Boundary Observatory’s continuous and conventional GPS network;

• Remote sensing studies by NASA Jet Propulsion Laboratory (JPL); and

• AEWSD’s internal ground-surface elevation monitoring network.

Additional groundwater level and water quality monitoring programs throughout the Kern Subbasin are described in the Umbrella GSP, as are additional land subsidence monitoring programs.

From the above-mentioned monitoring programs, the Arvin-Edison Management Area will incorporate the AEWSD CASGEM Monitoring Plan into its monitoring network, as applicable. AEWSD, ACSD and MCSD also conduct routine groundwater quality monitoring as part of their management efforts – these existing programs will continue and will inform the GSP implementation. For land subsidence, AEWSD is developing a monitoring network to better understand this phenomenon locally. The Arvin-Edison Management Area Monitoring Network is further described in Section 16 Monitoring Network.

Existing Management Programs

Existing groundwater management programs within the Arvin-Edison Management Area include:

\(^\text{24}\) The USGS NWIS reports a historical gauge in Caliente Creek (USGS 11196400) with monthly streamflow data between Oct 1964 to Feb 1983.

\(^\text{25}\) Navstar is a network of U.S. satellites that provide GPS services.
The Arvin-Edison Management Area falls within the South County Subregion of the Kern County Integrated Regional Water Management Region (Kern Region) and is therefore included in the November 2011 Kern Integrated Regional Water Management Plan (Kern IRWMP; Kennedy/Jenks Consultants, 2011 and currently being updated by Provost & Pritchard). The Kern Region covers approximately 5,690 square miles of Kern County and a small portion of southern Kings County. The key issues, needs, challenges, and priorities for the South County subregion, according to the Kern IRWMP (2011), include the following:

- Decreased Imported Water Supply;
- Water Quality/Groundwater Contamination;
- Urban Growth Encroachment on Key Recharge Areas; and
- Water Rights.

A 2019 Kern IRWMP update that is consistent with the 2016 IRWM Guideline requirements was recently approved by DWR (9 December 2019) and is now entering a 30-day Public Comment Period that is expected to be completed in mid-January 2020. Subsequent adoption of the 2019 Plan update is anticipated to occur in February 2020.

The AEWSD Groundwater Management Plan (GWMP) was developed in 2003 (pursuant to California Water Code [CWC] § 10750 et seq., § 10753.7, and § 10753.8) and has completed annual reports that collect all groundwater related items into a single report aimed to implement groundwater management strategies that would maintain high quality and dependable water resources while minimizing negative impacts within the AEWSD service area. This MA Plan extends and supersedes the groundwater management efforts outlined in the GWMP, but a brief summary is included below for completeness. Specifically, the AEWSD GWMP (2003) set forth the following groundwater management objectives to guide its water management activities, programs, and projects:

- Water supply reliability;
- Water supply affordability;
- Groundwater overdraft;
- Groundwater quality;
- Compliance with contracts, agreements, laws, and cooperation with other agencies;
- Inelastic land surface subsidence; and
- Groundwater monitoring.

AEWSD’s USBR Water Management Plan (WMP) was first developed in 1996 (then referred to as a USBR “Water Conservation Plan”), was revised in 2013 to comply with new requirements of Senate Bill (SB) x7 of 2009 and was last updated in October 2018 pursuant to the Central Valley Improvement Act of 1992 and Section 210(b) of the Reclamation Reform Act of 1982. This WMP describes water use within AEWSD, provides an inventory of water resources, contains a Drought Management Plan, and establishes Best Management Practices (BMPs) for agricultural contractors to improve water use efficiency. Some examples of these practices include: metering delivered
water, supporting the local Resource Conservation District’s Mobile Lab Program’s program of conducting on-farm evaluations, supporting more precise irrigation and delivery scheduling, etc.

- The Irrigated Lands Regulatory Program (ILRP), initiated in 2003 for surface water and last modified in 2013 to include groundwater provisions, is a program whose objective is to protect both groundwater and surface water from irrigated agricultural waste dischargers throughout the Central Valley. The ILRP is implemented through CVRWQCB Orders, also called Waste Discharge Requirements (WDRs). Order R5-2013-0120 (Order) regulates discharges in the Tulare Lake Basin. The ILRP makes third parties responsible for fulfilling regional requirements and conditions (e.g. surface and groundwater monitoring) and certain management actions. AEWSD is a member of the Kern River Watershed Coalition Authority (KRWCA) which is a third-party coalition that formed in 2014 to respond to the Order and amendments thereof. Key management elements of the ILRP are: Sediment and Erosion Control Plan, Nitrogen Management Plan and Mitigation Monitoring. The overall goals of the ILRP for the Tulare Lake Basin Area are:
  o To restore and/or maintain the highest reasonable quality of state waters;
  o Minimize waste discharge from irrigated agricultural lands that could degrade state waters quality;
  o Maintain the economic viability of agriculture in California’s Central Valley (CV); and
  o Ensure that irrigated agricultural discharges do not impair access by CV communities and residents to safe and reliable drinking water.

In accordance with these goals, the objectives are the following:
  o Restore and/or maintain appropriate beneficial uses established in CVRWQCB plans by ensuring that all state waters meet applicable water quality objectives; and
  o Encourage implementation of management practices that improve water quality in keeping with the first objective, without jeopardizing the economic viability for all sizes of irrigated agricultural operations.

- The 2015 ACSD Urban Water Management Plan (UWMP), compliant with the California Water Code (CWC) § 10610-10656 and § 10608, provides an assessment of the existing and planned water demands and water resources within the ACSD service area through 2040. The ACWSD UWMP includes a description of the reliability of the local groundwater supply and its vulnerability to seasonal or climatic shortage, anticipated water projects, the water demand management measures implemented by ACSD, and ACSD’s water shortage contingency plan (ACSD, 2016).

5.2.2. Operational Flexibility Limitations

[23 CCR § 354.8(d)]

The above water resource monitoring and management programs are not expected to limit operational flexibility in the basin or the Arvin-Edison Management Area. In fact, some of these monitoring networks will be integral to the on-going monitoring and reporting that will be conducted pursuant to this MA Plan (see Section 16 Monitoring Network).
For example, the IRWMP and GSP development are complimentary management processes. To the extent that the issues identified for the greater IRWMP region affect the Management Area, these issues will be discussed in the following sections of this MA Plan. The implementation of this MA Plan will contribute to the sustainable use of water supplies within the IRWMP region and the IRWMP is not expected to limit operational flexibility in the Arvin-Edison Management Area.

ACSD water wells and water system are controlled by the ACSD. Water restrictions in the ACSD urban area will be controlled by the ACSD. The ACSD UWMP contains provisions consistent with water use as contemplated by the AEWSD GSP. The ACSD needs to meet certain guidelines under Title 22 to provide water to its customers and will do so while being consistent with the objectives set forth in the GSP.

The ACSD UWMP reports a 2015 water demand of close to 2,000 AFY and projects a future demand of up to 6,400 AFY in 2040. A more detailed breakdown of ACSD Water Use estimates as of 2018 is provided in Appendix D. Currently, AEWSD and ACSD have executed a Memorandum of Understanding (MOU) that, among other things, provides ACSD with a “...right of first refusal to purchase any pumping allocations offered for sale through such approved market mechanism up to the quantity actually needed by ACSD to serve its customers, not to exceed 1.8 AF per acre of developed urban lands”\(^{26}\). Beyond the cooperative relationship established in the MOU, and the need to establish Sustainability Criteria that are protective in the ACSD urban area, it is not expected that the water use by ACSD will limit operational flexibility of the Arvin-Edison Management Area.

Most of the groundwater management objectives identified in the AEWSD GWMP and AWMP are consistent with the issues and objectives identified in the following sections of this MA Plan. The implementation of this MA Plan will contribute to the sustainable groundwater use within the Arvin-Edison Management Area. Therefore, this GSP compliments and supersedes the GWMP.

### 5.2.3. Conjunctive Use in the Arvin-Edison Management Area

\(\checkmark\) 23 CCR § 354.8(e)

Since the mid-1960s AEWSD has supported the conjunctive use of surface water (CVP, SWP, Kern River, and other surface water/river systems) and groundwater resources within the Arvin-Edison Management Area, which has been the primary cause of the recovery and stability of groundwater levels observed in the area (see Section 8 Current and Historical Groundwater Conditions). Since the availability of most of AEWSD’s imported surface water supply varies depending on hydrology and other factors (see Section 9.2.1 Surface Water Inflows and Outflows), AEWSD actively develops and implements conjunctive use programs wherein the underlying groundwater basin is utilized directly for seasonal and long-term carry-over storage. Because of this, AEWSD’s distribution system, from the beginning, has incorporated recharge basins and AEWSD-owned deep wells to capture, store, and recover wet period water for later use during dry periods. AEWSD’s historical operations to import, manage, and store water within the District have resulted in benefits to both the Surface Water Service Area (SWSA) and the Groundwater-only Service Area (GWSA). As part of Plan Implementation, AEWSD will continue to refine and update its

---

\(^{26}\) Additional relevant terms of the MOU include: Sewage effluent resulting from ACSD extractions of groundwater and delivery of water to its customers is collected, treated, and disposed of by the City of Arvin and the Parties wish to ensure that any return flow from the ultimate disposition of the treated effluent is considered when accounting for net groundwater use in the area.
policies as appropriate regarding General Project and General Administration Service Charges (see Section 18.1 Plan Implementation Activities).

AEWSD operates a large-scale groundwater storage and recovery program within the Arvin-Edison Management Area that includes three spreading basin facilities (totaling approximately 1,350 acres) and 82 recovery wells (see Section 7.3.4 Recharge and Discharge Areas). Between July 1966 and December 2018, a total of over 2.3 million acre-feet (AF) of water has been delivered to these facilities, an average of approximately 43,300 AFY. Net percolation\(^{27}\) for the same period was approximately 2.22 million AF, averaging approximately 42,400 AFY.

The Metropolitan Water District (MWD) first entered into a banking agreement with AEWSD in 1997, which was then amended in 2007.\(^{28}\) Since the program inception through 2018, MWD has stored approximately 580,000 AF of water in AEWSD banking facilities, and AEWSD has returned about 400,000 AF of recovered banked supplies. The MWD banking agreement establishes a maximum regulation capacity (i.e., maximum storage of MWD water) of 350,000 AF and a return volume between 40,000 AF and 75,000 AF in any given year. Available MWD water is the volume of delivered water minus a fixed 10% loss factor that is assessed to address losses incurred due to transportation, evaporation, metering discrepancies, etc. The 10% loss factor was set conservatively to assure that more water is stored than recovered, ensuring a net gain to the Basin from the Program. As of 23 May 2019, the current MWD balance in AEWSD’s spreading facilities is approximately 153,200 AF.

AEWSD currently maintains active partnerships with several agencies on an annual basis to support the transfer and exchange of surface water within and outside of the Kern Subbasin\(^{29}\). AEWSD also participates in several out-of-District groundwater storage and recovery programs both within and outside the Kern Subbasin. As an example, and as of February 2019, AEWSD has 77,590 AF of imported water supplies banked and available to withdraw in various locations outside the Arvin-Edison Management Area, including:

- 58,886 AF in the RRBWSD water bank;
- 10,704 AF in the Westside Mutual Water Company water bank; and
- 8,000 AF in the Kaweah Delta Water Conservation District water bank.

Recently, AEWSD has increased its conjunctive use efforts through the development of the North In-Lieu Project (NILP), also referred to as the DiGiorgio Unit In-Lieu Project. This project involves expanding the SWSA by approximately 3,900 acres and incorporating groundwater wells within this area into the AEWSD distribution system for increased extraction capability when necessary. Additional conjunctive use projects are considered in Section 17 Projects and Management Actions.

The NILP is planned to be developed over several phases: Phase I, completed in 2018, consisted of the expansion of AEWSD’s network (2.7 miles of bi-directional pipelines) to serve two purposes: (1) provide surface water supply to 743 acres that were previously located outside of the SWSA, and (2) connect five

---

27 Net percolation is defined as the net amount of water infiltrated into basin from the recharge facilities. This is calculated as the delivered water minus losses due to evaporation and other factors.

28 From the First Amended and Restated Agreement Between Arvin-Edison Water Storage District and Metropolitan Water District of Southern California for a Water Management Program, dated 9 October 2007. This agreement currently extends through 2034.

29 AEWSD has had over 72 partners since 1995.
pumping facilities located within the Phase I area such that they can pump water back to the North Canal, thereby fully integrating landowner pumping facilities to AEWSD’s water and power distribution systems. The remaining phases will be initiated once funding is secured and are included in the Projects and Management Actions described in Section 17 Projects and Management Actions. The Groundwater Service Program (GWSP), approved in February 2019 by AEWSD’s board, provides for an agreement between AEWSD and NILP participants so that together NILP and the GWSP meet AEWSD’s goal to increase conjunctive use planning procedures to improve overall supply reliability while minimizing total water supply costs. Under the GWSP, AEWSD can also provide PWRPA electrical service to any landowner well pumping facilities within the District as a means to minimize costs associated with groundwater recovery operations and further integrate them into its comprehensive water and power distribution systems.

The NILP incorporates five new connected electrical loads consisting of 1,000 horsepower. The GWSP meets the Western Areas Power Administration (WAPA) wholesale distribution tariff with Pacific Gas & Electric (PG&E) and consequently requests that PWRPA approve the additional loads. Development of future phases of the NILP are included as a Project and Management Action to this MA Plan (see “DiGiorgio Unit In-Lieu Project” description in Section 17 Projects and Management Actions). With this management area plan, the GWSP may also be expanded to all landowner well pumping facilities provided agreements are executed with the District to transfer groundwater pumping facilities.

AEWSD further plans to extend the in-lieu SWSA by an additional 2,500 acres through its proposed Frick Unit In-Lieu Project. This project will involve the development of a pressure pipeline system that connects to AEWSD’s Forest-Frick Pumping Plant facility and/or the Eastside Canal (maintained by KDWD) to provide surface water service to customers along the northwestern AEWSD boundary. The AEWSD Board recently approved Task Orders of over $300,000 for its engineering consultant (Provost & Pritchard) to continue with 30% design and complete environmental documentation for the NILP and additional in-lieu areas, as well as the Forest-Frick Pumping Plant facility and Eastside Canal intertie. This project will be initiated once funding is secured. There is no current estimated timeframe of completion.

AEWSD also operates a Temporary Water Service Program to contracted landowners within its jurisdictional boundaries, both for agricultural uses as well as other special purposes defined by AEWSD. Temporary Water Service for Agricultural Uses is water service made available for agricultural use on an interruptible and non-dependable basis to lands outside the Surface Water Service Area, and at times the District would otherwise be spreading and recharging water. As the delivery of temporary water offsets groundwater extraction this program serves as an “in-lieu” recharge program. In the event that the Board determines that temporary water service for a given period or water year is in the best interest of AEWSD, the Board may authorize such service and set charges. Such temporary water service shall be made available only to lands having an independent alternative source of water and no crop is to be planted which will be dependent upon the continued delivery of the temporary water. In order that land located outside the Surface Water Service Area is to be eligible for temporary water service, the landowner shall have executed an agreement establishing a covenant running with the land, in a form provided by AEWSD, wherein the landowner expressly acknowledged that the affected lands have no right to Contract Water Service from AEWSD. Such temporary water service may be made available to eligible land through an existing farm turnout or through a temporary farm turnout to be installed by AEWSD at landowner’s expense and used to serve temporary water or directly from AEWSD’s Distribution Facilities canals through pumps and metering devices installed to AEWSD’s specifications and at landowner’s expense, which
facilities shall be operated solely by AEWSD personnel; provided that AEWSD facilities are able to deliver the extra water and the delivery of such water does not interfere with water service deliveries to Water Users within the Surface Water Service Area.

Temporary Water Service for Special Purposes is water service made available on an interruptible and non-dependable basis for uses not directed to agricultural uses, within or outside of the Surface Water Service Area. Such water may be made available at the discretion of the Engineer-Manager on a short-term basis only, and AEWSD reserves the right to discontinue such service at any time. Persons wishing such service must either make arrangements with a Water User for use of turnout facilities or with AEWSD if water is to be taken directly from AEWSD's canal or other facility; file with AEWSD a form of contract entitled "Arvin-Edison Water Storage District Contract for Temporary Water Service for Special Purposes"; and make such payments or deposit such funds as are set forth in said form of contract pursuant to policy established by the Board from time to time.

5.3. Land Use Elements or Topic Categories of Applicable General Plans

☐ 23 CCR § 354.8(f)

The following sections describe topic categories of general plans and other planning documents with specific relevance to the Arvin-Edison Management Area MA Plan. Other planning documents developed for Kern County and the Arvin-Edison Management Area vicinity (e.g., habitat conservation plans, hazard mitigation plans, etc.) are further described in the Umbrella GSP.

5.3.1. Kern County General Plan

☐ 23 CCR § 354.8(f)(1)

The Arvin-Edison Management Area is located within the Kern County General Plan area (Kern County, 2009). The current Kern County General Plan was first adopted in 2004 and has undergone several amendments; the most recent amendment was approved in 2009 (General Plan). The County is currently working to update its General Plan through 2040, with completion of the “2040 General Plan” expected in 2019. This section identifies relevant policies in the current General Plan that could: (1) affect water demands in the Arvin-Edison Management Area (e.g., due to population growth and development of the built environment), (2) influence the GSP’s ability to achieve sustainable groundwater use, and (3) affect implementation of General Plan land use policies.

Figure PA-7 shows the current General Plan land use designations within the Arvin-Edison Management Area. The land use designations include primarily intensive and extensive agriculture, residential, mineral and petroleum, industrial, and incorporated cities (City of Arvin). These designations are generally consistent with the predominantly agricultural land use within the Management Area as shown in Figure PA-4.

The Land Use, Open Space, and Conservation Element (Chapter 1) of the General Plan includes the following goals, policies, and implementation measures that are related to groundwater or land use management, and that could potentially influence the implementation of this GSP.

Physical and Environmental Constraints
• **Implementation Measure C.** Cooperate with the Kern County Water Agency to classify lands in the County overlying groundwater according to groundwater quantity and quality limitations.

**Public Facilities and Services**

• **Goal 5.** Ensure that adequate supplies of quality (appropriate for intended use) water are available to residential, industrial, and agricultural users within Kern County.

• **Goal 7.** Facilitate the provision of reliable and cost-effective utility services to residents of Kern County.

• **Policy 2.** The efficient and cost-effective delivery of public services and facilities will be promoted by designating areas for urban development which occur within or adjacent to areas with adequate public service and facility capacity.

• **Policy 2.a.** Ensure that water quality standards are met for existing users and future development.

**Residential**

• **Goal 6.** Promote the conservation of water quantity and quality in Kern County.

• **Goal 7.** Minimize land use conflicts between residential and resource, commercial, or industrial land uses.

**Industrial**

• **Goal 2.** Promote the future economic strength and well-being of Kern County and its residents without detriment to its environmental quality.

**Energy**

• **Goal:** Encourage safe and orderly commercial solar development.

• **Policy 4.** The County should encourage solar development in the desert and valley regions previously disturbed and discourage development of energy projects on undisturbed land supporting State or federally protected plant and wildlife species.

• **Implementation Measure A.** The County shall continue to maintain, and update as necessary, provisions in the Kern County Zoning Ordinance to provide adequate development standards for commercial solar energy development.

• **Implementation Measure B.** The County should work with affected State and federal agencies and interest groups to establish consistent policies for solar energy development.

**Resource**

• **Goal 6.** Encourage alternative sources of energy, such as solar and wind energy, while protecting the environment.

• **Policy 7.** Areas designated for agricultural use, which include Class I and II land classifications and other enhanced agricultural soils with surface delivery water systems, should be protected from incompatible residential, commercial, and industrial subdivision and development activities.
• **Policy 10.** To encourage effective groundwater resource management for the long-term economic benefit of the County the following shall be considered:
  
  • **Policy 10.a.** Promote groundwater recharge activities in various zone districts.
  
  • **Policy 10.c.** Support the development of groundwater management plans.
  
  • **Policy 10.d.** Support the development of future sources of additional surface water and groundwater, including conjunctive use, recycled water, conservation, additional storage of surface water and groundwater and desalination.

**General Provisions**

• **Goal 1.** Ensure that the County can accommodate anticipated future growth and development while maintaining a safe and healthful environment and a prosperous economy by preserving valuable natural resources, guiding development away from hazardous areas, and assuring the provision of adequate public services.

• **Policy 40.** Encourage utilization of community water systems rather than the reliance on individual wells.

• **Policy 41.** Review development proposals to ensure adequate water is available to accommodate projected growth.

• **Policy 45.** New high consumptive water uses, such as lakes and golf courses, should require evidence of additional verified sources of water other than local groundwater. Other sources may include recycled stormwater or wastewater.

• **Implementation Measure U.** The Kern County Environmental Health Services Department will develop guidelines for the protection of groundwater quality which will include comprehensive well construction standards and the promotion of groundwater protection for identified degraded watersheds.

| ✓ 23 CCR § 354.8(f)(2) |
| ✓ 23 CCR § 354.8(f)(3) |

The above goals, policies and implementation measures established by the General Plan are complementary to sustainable groundwater management of the Arvin-Edison Management Area relative to future land use development and conservation (i.e., the General Plan encourages development of the County’s groundwater supply to ensure that existing users have access to high quality water, and states that future growth should be accommodated only while ensuring that adequate high-quality water supplies are available to existing and future users). Successful implementation of this MA Plan will help to ensure that the Arvin-Edison Management Area’s groundwater supply is managed in a sustainable manner, and will provide routine reporting of groundwater conditions that Kern County and others can use to inform local decisions on growth and development. Therefore, implementation of General Plan policies is not expected to affect the ability of the Management Area to achieve groundwater sustainability.

Likewise, implementation of this MA Plan is not anticipated to significantly affect the water supply assumptions or land use plans within the General Plan over the planning horizon. Given that the General Plan is being updated concurrently with the development of this MA Plan, and the County has been
engaged in the process of GSP development through its past participation in the KGA GSA, it is anticipated that the 2040 General Plan would consider this MA Plan and utilize consistent water supply assumptions over the 2040 planning horizon. As required by California Government Code § 65352.5(d), the GSA will coordinate with and provide the necessary information to land use planning agencies that are adopting or amending their general plan.

5.3.2. Metropolitan Bakersfield General Plan

The northeastern portion of the Arvin-Edison Management Area overlies the City of Bakersfield General Plan Area; therefore, it is subject to the Metropolitan Bakersfield General Plan (City of Bakersfield, 2016). The current City General Plan was first adopted in 2002 updated in January 2016 (City General Plan). This section identifies relevant policies in the City General Plan that could affect water management in the Management Area.

The City General Plan land use designations include primarily residential - low density, residential - rural, residential - suburban, resource - extensive, open space - slopes (areas with greater than equal to thirty percent slope), open space (floodplains and resource management areas and agriculture uses). As seen in Figure PA-8, primary land use designations within the portion of the City General Plan overlain by the Arvin-Edison Management Area include intensive agriculture and mineral and petroleum. These designations are generally consistent with the predominantly agricultural land use within the Management Area shown in Figure PA-4 and the Kern County General Plan land use designations shown in Figure PA-7.

The Land Use Element (Chapter II) of the City General Plan includes the following goals, policies, and implementation measures that are related to groundwater or land use management, that could potentially influence the implementation of this MA Plan.

- **Goal 6.** Accommodate new development that is sensitive to the natural environment, and accounts for environmental hazards.
- **Policy 77.** Allow for the continuance of agricultural uses in areas designated for future urban growth.
- **Policy 79.** Provide for an orderly outward expansion of new "urban" development (any commercial, industrial, and residential development having a density greater than one unit per acre) so that it maintains continuity of existing development, allows for the incremental expansion of infrastructure and public services, minimizes impacts on natural environmental resources, and provides a high-quality environment for living and business.
- **Policy 80.** Assure that General Plan Amendment proposals for the conversion of designated agricultural lands to urban development occur in an orderly and logical manner giving full consideration to the effect on existing agricultural areas.
- **Implementation 7.** Environmental Review. Local guidelines for project processing shall reflect California Environmental Quality Act (CEQA) Guidelines which state that the environmental effects of a project must be taken into account as part of project consideration.

☑️ 23 CCR § 354.8(f)(1)
The Conservation Element (Chapter V) of the City General Plan includes the following goals, policies, and implementation measures that are related to groundwater or land use management, that could potentially influence the implementation of this GSP.

**Mineral Resources**

- **Goal 4.** Protect land, water, air quality and visual resources from environmental damage resulting from mineral and energy resource development.

**Soils and Agriculture**

- **Goal 2.** Promote soil conservation and minimize development of prime agricultural land.
- **Goal 3.** Establish urban development patterns and practices that promote soil conservation and that protect areas of agricultural production of food and fiber crops, and nursery products.
- **Policy 4.** Monitor the amount of prime agricultural land taken out of production for urban uses or added within the plan area.
- **Policy 10.** Encourage landowners to retain their lands in agricultural production.
- **Policy 14.** When considering proposals to convert designated agricultural lands to nonagricultural use, the decision-making body of the City and County shall evaluate the following factors to determine the appropriateness of the proposal: Ability to be provided with urban services (sewer, water, roads, etc.).

**Water Resources**

- **Goal 1.** Conserve and augment the available water resources of the planning area.
- **Goal 2.** Assure that adequate groundwater resources remain available to the planning area.
- **Goal 3.** Continue cooperative planning for and implementation of programs and projects which will resolve water resource deficiencies and water quality problems.
- **Goal 5.** Achieve a continuing balance between competing demands for water resource usage.
- **Goal 6.** Maintain effective cooperative planning programs for water resource conservation and utilization in the planning area by involving all responsible water agencies in the planning process.
- **Policy 1.** Develop and maintain facilities for groundwater recharge in the planning area.
- **Policy 2.** Minimize the loss of water which could otherwise be utilized for groundwater recharge purposes and benefit planning area groundwater aquifers from diversion to locations outside the area.
- **Policy 3.** Support programs to convey water from other than San Joaquin Valley basin sources to the planning area.
- **Policy 4.** Support programs and policies which assure continuance or augmentation of Kern River surface water supplies.
- **Policy 5.** Work towards resolving the problem of groundwater resource deficiencies in the upland portions of the planning area.
- **Policy 6.** Protect planning area groundwater resources from further quality degradation.
• **Policy 7.** Provide substitute or supplemental water resources to areas already impacted by groundwater quality degradation by supporting facilities construction for surface water diversions.

• **Policy 8.** Consider each proposal for water resource usage within the context of total planning area needs and priorities-major incremental water transport, groundwater recharge, flood control, recreational needs, riparian habitat preservation and conservation.

• **Policy 9.** Encourage and implement water conservation measures and programs.

• **Implementation measure 2.** Support all financially feasible and practical groundwater projects, for the augmentation of groundwater recharge for the south San Joaquin Valley basin by the construction and operation of additional recharge facilities or the importation of additional water for basin recharge.

• **Implementation measure 5.** Initiate and/or support planning, financing, construction and implementation programs for supplying upland portions of the planning area having groundwater deficiencies with an adequate water supply.

• **Implementation measure 10.** Support additional water conservation measures and programs of benefit to the planning area.

<table>
<thead>
<tr>
<th>23 CCR § 354.8(f)(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 CCR § 354.8(f)(3)</td>
</tr>
</tbody>
</table>

The above goals, policies and implementation measures established by the City General Plan are complementary to sustainable groundwater management of the Arvin-Edison Management Area relative to future land use development and conservation. The City General Plan establishes as a general goal for groundwater management to reach a condition of “safe yield” for the groundwater basin. Furthermore, it acknowledges the need to provide a stable water supply and considers water resources as a major factor for development decisions. Successful implementation of this MA Plan will help to ensure that the Arvin-Edison Management Area’s groundwater supply is managed in a sustainable manner and will provide routine reporting of groundwater conditions that the City of Bakersfield and others can use to inform local decisions on growth and development. Therefore, implementation of City General Plan policies is not expected to affect the ability of the Management Area to achieve groundwater sustainability. Likewise, implementation of this MA Plan is not anticipated to affect the City’s water supply assumptions or land use plans. As required by California Government Code § 65352.5(d), the GSA will coordinate with and provide the necessary information to land use planning agencies that are adopting or amending their general plan.

### 5.3.3. City of Arvin General Plan

| 23 CCR § 354.8(f)(1) |

The City of Arvin falls entirely within the Arvin-Edison Management Area and therefore the City of Arvin General Plan (City of Arvin, 2012) is relevant to the Management Area. The current City of Arvin General Plan was updated in August 2012. This section identifies relevant policies in the Arvin General Plan that could affect water management in the Arvin-Edison Management Area.
The Arvin General Plan land use designations are listed in the following table. These designations are consistent with AEWSD’s land use designations shown in Figure PA-4, Kern County General Plan land use designations shown in Figure PA-7, and the City of Bakersfield General Plan land use designations shown in Figure PA-8.

<table>
<thead>
<tr>
<th>Land Use Designation</th>
<th>Acres</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estate Residential</td>
<td>294.8</td>
<td>9.6%</td>
</tr>
<tr>
<td>Residential Reserve</td>
<td>179.1</td>
<td>5.8%</td>
</tr>
<tr>
<td>Low Density Residential</td>
<td>950.7</td>
<td>30.9%</td>
</tr>
<tr>
<td>Medium Density Residential</td>
<td>18.0</td>
<td>0.6%</td>
</tr>
<tr>
<td>High Density Residential</td>
<td>158.3</td>
<td>5.1%</td>
</tr>
<tr>
<td>General Commercial</td>
<td>151.4</td>
<td>4.9%</td>
</tr>
<tr>
<td>Light Industrial</td>
<td>291.9</td>
<td>9.5%</td>
</tr>
<tr>
<td>Heavy Industrial</td>
<td>512.5</td>
<td>16.7%</td>
</tr>
<tr>
<td>Parks</td>
<td>45.2</td>
<td>1.5%</td>
</tr>
<tr>
<td>Public Facilities</td>
<td>19.7</td>
<td>0.6%</td>
</tr>
<tr>
<td>Schools</td>
<td>129.9</td>
<td>4.2%</td>
</tr>
<tr>
<td>Agricultural</td>
<td>1.0</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Streets/ROW</td>
<td>325.0</td>
<td>10.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3,077.5</td>
<td></td>
</tr>
</tbody>
</table>

*Source: City of Arvin General Plan*

The Conservation and Open Space Element of the City of Arvin General Plan includes the following goals and policies that are related to groundwater or land use management, that could potentially influence the implementation of this MA Plan.

- **Goal 3** Maintain and enhance groundwater levels in order to assure an adequate supply for future City water need.
  - Policy CO-3.1 Encourage continued groundwater recharge efforts of the Arvin-Edison Water Storage District.
Policy CO-3.2 Embark on a public education program regarding water conservation practices in residential, commercial, industrial and public facility development.

Policy CO-3.3 Encourage the use of reclaimed wastewater for appropriate uses such as agricultural irrigation or frost protection.

Policy CO-3.4 Require thorough information in all environmental assessments for projects which may have a substantial effect on groundwater levels.

**Goal 4** Continue to provide high quality water for domestic use within the City of Arvin.

- Policy CO-4.1 Monitor water quality regularly in all wells in the Arvin Community Services District.
- Policy CO-4.2 Investigate means of protecting the groundwater supply from contamination by agricultural chemicals.
- Policy CO-4.3 Ensure that all components of the City's infrastructure related to water delivery and consumption, including those on private property, are functioning properly to protect water quality.

The above goals and policies established by the City of Arvin General Plan are complementary to sustainable groundwater management of the Arvin-Edison Management Area relative to future land use development and conservation. The City of Arvin General Plan establishes as a purpose for the Conservation and Open Space Element: “...to promote the protection, stewardship, and use of the City’s natural resources and to prevent wastefulness, unsustainable usage, and neglect. Furthermore, all of the Elements of the General Plan reflect the principles of integration of SB 375, the Sustainable Communities Planning Act of 2008”. Considering ACSD’s active involvement in the development of this MA Plan, the implementation of City of Arvin General Plan policies is not expected to affect the ability of the Management Area to achieve groundwater sustainability. Likewise, implementation of this MA Plan is not anticipated to affect the City of Arvin’s water supply assumptions or land use plans. The goals and objectives of the ACSD UWMP are consistent with and compliment this MA Plan. As required by California Government Code § 65352.5(d), the GSA will coordinate with and provide the necessary information to land use planning agencies that are adopting or amending their general plan.

### 5.3.4. Well Permitting Process

The Water Well Program issues permits to construct, reconstruct and destroy water wells. All wells must be constructed in accordance with Kern County Ordinance Code Section 14.08, and the Department of Water Resources' Bulletin 74-81 and Bulletin 74-90, except as modified by subsequent revisions. The ordinance requires, among other things, that domestic and agricultural wells be installed a minimum distance from potential pollution and contaminant sources, water quality be tested for new and reconstructed wells, an NSF 61 approved flowmeter be installed, and the final well construction be inspected by County staff. Recently, the KCPHSD released a
supplemental well application for wells intended to be installed in overdrafted basins. This new form additionally requires water district and GSA information, and grants GSAs review power. As of 11 June 2019, it is AEWSD’s policy to provide a written response to KCPHSD and the well applicant when supplemental well application forms are received.

**Well Permitting Urban Process**

ACSD has the authority to construct water wells without obtaining permits thru the County of Kern. The ACSD operates under a water supply permit issued by the State of California. ACSD must obtain authorization to discharge new wells into the distribution system after a review of water quality by the SWRCB. This review considers the construction of the well and wellsite, discharge piping and chlorination equipment, a review of the risk of contamination of the new well from external sources of contamination, and the sanitary and security measures put in place to protect the well from accidental/unintended contamination (such as flooding) as well as terrorism and vandalism.

### 5.4. Additional GSP Elements

#### 23 CCR § 354.8(g)

Per CWC § 10727.4, a GSP shall include, where appropriate and in collaboration with the appropriate agencies, all of the following:

**Control of saline water intrusion**

Because the Arvin-Edison Management Area is located far from coastal areas, seawater intrusion is not considered to be an issue. Waste discharges containing saline water are a concern, but they are regulated by the CVRWQCB. Oil field produced water (water brought up with oil) has high salinity in some areas. AEWSD supports the CVRWCB and Division of Oil, Gas, and Geothermal Resources (DOGGR) regulations that protect groundwater from being contaminated by oil field produced water and has been investigating water treatment programs to turn it into a new resource.

**Wellhead protection**

The Kern County Public Health Services Department Water Well Program issues permits to construct, reconstruct and destroy water wells (see Section 5.3.4 Well Permitting Process). AEWSD actively assists its landowners to comply with County wellhead protection and well destruction policies.

**Migration of contaminated groundwater**

AEWSD has been active in monitoring where contaminated groundwater is and gets involved as an interested party to support migration control and groundwater cleanup projects. A USEPA Superfund site in Arvin is an example of this.

**Well abandonment and well destruction program**

The KCPHSD Water Well Program issues permits to construct, reconstruct and destroy water wells (see Section 5.3.4 Well Permitting Process). AEWSD has been active to assist landowners in converting wells into monitoring wells. This has included obtaining grants from DWR that included funds to assist landowners with well conversion costs. AEWSD will continue to support the County's Program.
**Plan Area**
**Management Area Plan**
**Arvin-Edison Management Area, Kern Subbasin**

**Replenishment of groundwater extractions**

AEWSD actively manages the groundwater basin within its boundaries through conjunctive use, groundwater banking and recovery using its system of spreading basins, and other programs (see Section 5.2.3 *Conjunctive Use in the Arvin-Edison Management Area*). Projects and programs to replenish extracted groundwater, such as the Temporary Water Service Contracts and North In-Lieu Project will be pursued as funding permits and as required to maintain sustainable groundwater conditions as defined in this GSP.

**Conjunctive use and underground storage**

AEWSD actively manages the groundwater basin within its boundaries through conjunctive use and other programs (see Section 5.2.3 *Conjunctive Use in the Arvin-Edison Management Area*). Conjunctive use will continue to be a fundamental principle for AEWSD. Expanding Temporary Water Service Contracts for landowners in the GWSA, and the North and Eastside In-Lieu Projects are examples of opportunities AEWSD will employ, as funding and landowner interest allows, to maintain sustainable underground storage in AEWSD.

**Well construction policies**

The KCPHSD Water Well Program issues permits to construct, reconstruct and destroy water wells (see Section 5.3.4 *Well Permitting Process*). AEWSD will continue to support the County's Program.

**Groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects**

AEWSD will continue to be an active interested party in groundwater contamination cleanup. Its involvement in the ILRP through the Kern River Watershed Coalition on behalf of AEWSD's landowners will continue for water quality protection.

Expansion of recharge projects such as the North In-Lieu Project and Temporary Water Service Contracts will continue to be pursued as funding and landowner interest permit.

AEWSD is a participant in water storage projects that have the potential to improve surface water supplies (and groundwater conditions as a result) such as the Temperance Flat Reservoir Authority through the Friant Water Authority as funding and regulatory permitting processes allow. Groundwater storage projects such as the Metropolitan Water District banking program will continue to be supported and is in favor of AEWSD’s long term groundwater sustainability.

Water recycling programs with the City of Bakersfield and ACSD are being investigated and will be pursued if deemed to be feasible, economical, and superior to other options for groundwater sustainability. Similarly, potential treatment and beneficial use of produced water from oil fields is being investigated.

AEWSD will continue to facilitate groundwater conveyance within its distribution systems to assist growers with drought protection.

AEWSD’s work on its masterplan for groundwater extraction facilities will continue to support sustainable groundwater supplies.

**Efficient water management practices**

AEWSD constantly pursues gaining efficiency through its water management practices, currently its water management practices for agricultural and urban contractors are described in the USBR AEWSD Water
Management Plan (AEWSD, 2018) and the ACSD UWMP (ACSD, 2016) describes ACSD’s plan to reduce urban per capita potable water demand. These plans are summarized in Section 5.2.1 Existing Monitoring and Management Programs. AEWSD plans to continue its efficient water management practices.

Relationships with State and federal regulatory agencies

As described above, AEWSD maintains a federal water supply contract with the USBR for its Friant Division surface water supply. AEWSD also maintains a power supply contract with the Western Areas Power Administration (WAPA). AEWSD also has multiple agreements in place with DWR relating to its system of connections to California Aqueduct. ACSD reports to the SWRCB for Title 22 drinking water compliance and also receives state funding for various drinking water projects (see Section 8.5 Groundwater Quality). As part of its 2012 annual update to the GWMP, AEWSD listed the following proposed management actions to continue relationships with Federal, State, and Local Agencies:

- Continue coordination of Project operations and monitoring programs with USBR;
- Monitor DWR and USBR Grant Funding Programs to seek funding for projects to improve groundwater conditions;
- Continue participation in the Friant Water Authority;
- Continue participation in KCWA’s IRWMP, and other programs;
- Continue participation in Cross Valley Canal Advisory Committee;
- Continue participation in San Joaquin River Restoration Project (SJRRP) implementation meetings to minimize loss of Friant-Kern Canal Water Supplies and maximize the importation of Recapture/Recirculation water;
- Participate in studies and meeting with other agencies with an overall goal of maintaining highest incoming surface water quality possible;
- Continue operating water management programs with other agencies to increase supplies and reduce water costs;
- Continue participation in Kern River Watershed Coalition Authority to assist growers to comply with the ILRP;
- Continue participation in the Kern Basin, including agencies South of Kern River with the goal of improved local management of the Kern Basin; and
- Continue as a CASGEM reporting agency.

Land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity

Applicable land use planning documents and processes are discussed in Section 5.3 Land Use Elements or Topic Categories of Applicable General Plans. AEWSD plans to continue cooperating with those planning agencies as SGMA implementation unfolds.
Impacts on Groundwater Dependent Ecosystems

Impacts on Groundwater Dependent Ecosystems are discussed in Section 8.8 Groundwater Dependent Ecosystems. Groundwater levels in the Arvin-Edison Management Area are too deep to support groundwater dependent ecosystems.

5.5. Notice and Communication

23 CCR § 354.10

The Arvin-Edison Management Area adopted its Stakeholder Communication and Engagement Plan (SCEP) in June 2018 to fulfill notice and communication requirements. The SCEP is a living document with frequent updates and is available by request to AEWSD and is included herein in Appendix E. Following the public process described herein, this MA Plan was approved for inclusion in the KGA GSA Umbrella GSP by the AEWSD Board on 10 December 2019, as documented in Appendix N.

5.5.1. Beneficial Uses and Users of Groundwater

23 CCR § 354.10(a)

As part of the SCEP, beneficial uses and users of groundwater in the Basin were identified, including various holders of overlying groundwater rights (agricultural users, domestic users, commercial/industrial users, etc.), municipal well operators, public water systems, local land use planning agencies, environmental users of groundwater, surface water users, the federal government, Native American tribes, and DACs/SDACs (see SCEP Section 3). Additionally, a Stakeholder Constituency “Lay of the Land” exercise was developed which identified stakeholders in the Arvin-Edison Management Area, key interests and issues, and the level of engagement expected with each stakeholder (see SCEP Table 1). This exercise will be updated during MA Plan implementation.

5.5.2. Public Meetings Summary

23 CCR § 354.10(b)

The list below identifies public meetings, workshops, and direct outreach specific to SGMA and AEWSD’s MA Plan development. Detailed meeting minutes and materials are available by request to AEWSD.

AEWSD Board Meetings

The AEWSD Board meets monthly at its offices. Regular SGMA updates are provided by Staff and/or AEWSD’s consultant, and stakeholders are provided the opportunity to provide input on the GSP development and implementation process. Appendix E includes a list of meeting dates where SGMA topics have been discussed at the AEWSD Board Meeting. This information will be updated throughout MA Plan development and/or implementation.

Stakeholder Workshops

AEWSD has hosted multiple workshops to educate its customers and other stakeholders within the Arvin-Edison Management Area regarding SGMA, including:
AEWSD SGMA Landowner Workshop #1 – 17 November 2016
AEWSD SGMA Landowner Workshop #2 – 8 December 2016
AEWSD SGMA Landowner Workshop #3 – 2 October 2018; multiple workshops hosted in coordination with ACSD and Self-Help Enterprises
Kern Subbasin Open House – 14 May 2019
AEWSD SGMA Landowner Workshop #4 – 30 May 2019; multiple workshops hosted in coordination with ACSD, MCWD and Self-Help Enterprises
Kern Subbasin GSP Public Review Open House – 26 September 2019

As mentioned above, AEWSD and ACSD worked with the local community groups, Self-Help Enterprises, in hosting several of the stakeholder workshops, including provided Spanish language translation. This list will be populated throughout MA Plan implementation. Stakeholder questions were answered during the workshop and a record of key questions and responses is provided in Appendix E. A detailed Implementation Plan has been developed (see Sections 18 and 19) in response to stakeholder interest in what SGMA implementation would look like locally.

Miscellaneous Meetings

AEWSD staff have conducted and/or attended numerous meetings where SGMA and related issues have been discussed. Appendix E includes a list of meeting dates where SGMA topics have been discussed with various entities and stakeholders in the basin. This list will be updated throughout MA Plan implementation.

Direct Outreach

Through the distribution of letters and surveys, AEWSD has made numerous efforts to secure local stakeholder input during the SGMA process (see Appendix E):

- KGA stakeholder survey distribution and respondence (May 2018 – July 2018);
- KGA agricultural stakeholder survey distribution and respondence (December 2018 – January 2019);
- Public water system data request (October 2018 – January 2019);
- KGA Landowner Letter (May 2019);
- AEWSD Landowner letter (June 2019); and
- AEWSD White Lands Landowner letter (July 2019)

Results from these outreach efforts have been compiled and reviewed. Data and information received from respondents has been incorporated into the AEWSD DMS and into this MA Plan, as appropriate. The list above will be updated throughout MA Plan implementation.
5.5.3. Comments Received Regarding the MA Plan

As described in the above sections and in the remainder of this section, AEWSD and ACSD have conducted extensive engagement of stakeholders through the MA Plan development process. During this time, input and feedback from the public has been encouraged. Table PA-4 below summarizes the comments and input received and how that input was incorporated into the MA Plan. In some cases, more detailed responses can be found in Appendix F.

Table PA-4. Comments and Input Received from Public During MA Plan Development

<table>
<thead>
<tr>
<th>Source</th>
<th>Date</th>
<th>Type of Input</th>
<th>How Input was Incorporated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landowners</td>
<td>various</td>
<td>Responses to Stakeholder Survey (34)</td>
<td>Incorporated relevant information into Plan Area (see Section 5.5.4).</td>
</tr>
<tr>
<td>Agricultural stakeholders</td>
<td>various</td>
<td>Responses to Agricultural Stakeholder Survey (11)</td>
<td>Incorporated relevant information into Groundwater Conditions and Water Budget; incorporated data into the DMS.</td>
</tr>
<tr>
<td>The Nature Conservancy (TNC)</td>
<td>27 October 2018</td>
<td>Letter to KGA regarding consideration of Groundwater Dependent Ecosystems (GDEs) in GSPs</td>
<td>As recommended by TNC, reviewed the GDE Guidance Document for GSPs and the Groundwater Resource Hub and conducted analysis of the presence of GDEs (see Section 8.8, Figure GWC-18 and Figure GWC-19).</td>
</tr>
<tr>
<td>Leadership Counsel for Justice and Accountability (LCJA)</td>
<td>19 December 2018</td>
<td>Letter to KGA regarding the KGA adoption of the Undesirable Results definitions</td>
<td>AEWSD has worked closely with ACSD, neighboring GSAs and KGA members and other stakeholders within its service area to develop its local definitions of Undesirable Results that are protective of beneficial users (see Section 14).</td>
</tr>
<tr>
<td>Source</td>
<td>Date</td>
<td>Type of Input</td>
<td>How Input was Incorporated</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>LCJA</td>
<td>25 June 2019</td>
<td>Letter to KGA entitled <em>Concerns and Recommendations to Ensure that Kern Groundwater Authority GSA GSP Protects Vulnerable Drinking Water Users</em></td>
<td>AEWS&amp;D has worked closely with ACSD and other Public Water Systems in its service area to understand water quality conditions (Section 8.5) and to ensure that the Sustainability Criteria are protective of water quality and beneficial users (see Sections 13.4, 14.4, 15.4).</td>
</tr>
<tr>
<td>LCJA</td>
<td>10 July 2019</td>
<td>Letter to AEWS&amp;D entitled <em>Concerns and Recommendations to Ensure that all Water Districts Protect Vulnerable Drinking Water Users during GSP Development</em></td>
<td>AEWS&amp;D has worked closely with ACSD and other Public Water Systems in its service area to understand water quality conditions (Section 8.5) and to ensure that the Sustainability Criteria are protective of water quality and beneficial users (see Sections 13.4, 14.4, 15.4).</td>
</tr>
<tr>
<td>LCJA</td>
<td>8 October 2019</td>
<td>Email to AEWS&amp;D with questions regarding MA Plan</td>
<td>Responded to questions in email dated 7 November 2019 (see Appendix F).</td>
</tr>
<tr>
<td>Chevron</td>
<td>20 November 2019</td>
<td>Email to KGA with comments on KGA Umbrella GSP</td>
<td>No changes to MA Plan were requested or made. KGA incorporated suggested changes into the KGA Umbrella GSP.</td>
</tr>
<tr>
<td>LCJA</td>
<td>26 November 2019</td>
<td>Letter to KGA with comments on KGA Public Draft GSP</td>
<td>Detailed responses to portions of the LCJA letter specific the Arvin-Edison MA Plan are included in Appendix F. Revisions were made to Sections 5.5 and 18.1.6.</td>
</tr>
<tr>
<td>Source</td>
<td>Date</td>
<td>Type of Input</td>
<td>How Input was Incorporated</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shafter-Wasco Irrigation District</td>
<td>26 November 2019</td>
<td>Letter to KGA entitled <em>Water budget guidance inside individual Groundwater Sustainability Plans</em></td>
<td>Comments noted. No changes to MA Plan requested or made.</td>
</tr>
<tr>
<td>Farmland Reserve</td>
<td>27 November 2019</td>
<td>Letter to AEWSD with comments on AEWSD Public Draft MA Plan</td>
<td>Clarifying text added to the Executive Summary and Section 9.1.3. Detailed responses are included in Appendix F.</td>
</tr>
<tr>
<td>Hancock Farmland Services</td>
<td>27 November 2019</td>
<td>Letter to KGA with comments on KGA Public Draft GSP</td>
<td>Clarifying text added to the Executive Summary and Sections 9.1.3 and 18.1.4. Detailed responses are included in Appendix F.</td>
</tr>
<tr>
<td>TNC</td>
<td>27 November 2019</td>
<td>Letter to KGA with comments on KGA Public Draft GSP</td>
<td>Clarifying text added to Sections 7.3.5 and 8.8. See Appendix F for additional information.</td>
</tr>
<tr>
<td>Westchester Group Investment Management</td>
<td>27 November 2019</td>
<td>Letter to KGA with comments on KGA Public Draft GSP</td>
<td>Clarifying text added to the Executive Summary and Sections 8.1, 9.1.3, 18.1.2 and 18.1.4. Detailed responses are included in Appendix F.</td>
</tr>
<tr>
<td>Wonderful Orchards / Wonderful Citrus</td>
<td>27 November 2019</td>
<td>Letter to AEWSD with comments on KGA Public Draft GSP and AEWSD Public Draft MA Plan</td>
<td>Clarifying text added to the Executive Summary and Sections 8.1, 9.1.3, 18.1.2 and 18.1.4. Detailed responses are included in Appendix F.</td>
</tr>
<tr>
<td>Eastside Water Management Agency</td>
<td>27 November 2019</td>
<td>Letter to KGA entitled <em>Re: Implementation of the GSP</em></td>
<td>Comments noted. No changes to MA Plan requested or made.</td>
</tr>
<tr>
<td>Committee for a Better Arvin</td>
<td>3 December 2019</td>
<td>Letter in support of AEWSD and ACSD MA Plan development efforts</td>
<td>Feedback is noted. No changes to MA Plan were requested or made.</td>
</tr>
</tbody>
</table>

AEWSD and ACSD welcome further comments during MA Plan implementation. In addition to Table PA-4 above and Appendix F a detailed list of questions from the public and answers during the public meetings and stakeholder outreach activities described above can be found in Appendix E.
5.5.4. **Communication**

- **☑ 23 CCR § 354.10(d)**

The SCEP outlines AEWSD’s communication goals.

**Decision-Making Process**

- **☑ 23 CCR § 354.10(d)(1)**

The SCEP Section 2.2 outlines the AEWSD decision-making process. Briefly, the process involves decision making by the AEWSD Board of Directors during Board meetings which are open to the public. In addition, the KGA GSA Board of Directors makes decisions of the KGA GSA at its public Board meetings. The KGA GSA Board is supported by committees composed of representatives of each KGA GSA board member, whose role is to provide recommendations to the KGA GSA Board on technical and other matters.

**Public Engagement Opportunities**

- **☑ 23 CCR § 354.10(d)(2)**

The SCEP Section 6 discusses public engagement opportunities and SCEP Sections 5 and 6 discuss how public input and responses will be handled. These opportunities include AEWSD Board meetings, the stakeholder workshops, the planned public hearing at which the Draft MA Plan will be available for public comments, and the various stakeholder surveys, discussed below.

**Stakeholder Involvement**

- **☑ 23 CCR § 354.10(d)(3)**

The SCEP Section 5 outlines AEWSD’s goals, including open and transparent engagement with diverse stakeholders. Additionally, SCEP Section 4 outlines describes the Stakeholder Survey which AEWSD used to gain additional knowledge on stakeholders within the Management Area. Specifically:

- Results from 34 Stakeholder Survey responses received indicate that:
  - 63% of respondents are ag users; 30% are Public Water Systems users; 66% use both surface water and groundwater; and 9% use groundwater only.

- Results from 11 Agriculture Stakeholder Survey responses received indicate that:
  - 90% of respondents irrigate through a mixture of surface water and groundwater; and 10% irrigate with groundwater only.
  - 10% use drip irrigation only; 50% use a combination of drip and micro-sprinkler irrigation; and 30% use a combination of sprinklers and drip irrigation.

As a result of the Stakeholder Survey, several basin stakeholders provided data on their wells to AEWSD for consideration and inclusion in the MA Plan. Data included well locations, well construction information, depth to water measurements, estimated pumping rates, lithologic and geophysical logs, water quality data, and pump tests. These data were added to the DMS for the Arvin-Edison Management Area and considered during assessment of groundwater conditions (**Section 8 Current and Historical Groundwater Conditions**).
District staff have also made numerous outreach efforts to landowners within the District regarding well status information and access for monitoring. This effort has represented a constructive effort to improve local knowledge of well conditions and to engage landowners in SGMA implementation efforts.

Public Notification

The SCEP Sections 5 and 6 details the methodology that is being followed to inform the public on MA Plan updates, status, and actions.

5.5.5. Interagency Coordination

AEWSD has actively engaged in both intrabasin and interbasin coordination efforts through multiple avenues during the GSP development process, including:

KGA Board/Coordination Committee Meetings

Prior to enactment of the SGMA, the KGA was established to provide a framework for the active, comprehensive management of the groundwater basin underlying the valley portion of Kern County, to preserve and maintain local control of groundwater resources and provide long term surety for all basin users. With passage of the SGMA, the KGA seeks to coordinate local groundwater management efforts and is working with its members to determine the most cost effective and efficient way of meeting the new requirements of the SGMA. During 2016-2018 the KGA Board of Directors met monthly at the Kern County office in Bakersfield. These monthly meetings have continued into 2019, now at the Greater Bakersfield Chamber of Commerce. Meeting agendas and other information can be found at http://www.kerngwa.com.

The KGA Stakeholder Coordination Committee meets monthly at RRBWSD. Meeting agendas and other information can be found at http://www.kerngwa.com/.

Kern Managers Meetings

Managers of member agencies to the KGA as well as representatives from other Kern Subbasin GSAs (Kern River GSA, Henry Miller Water District, etc.) meet weekly at RRBWSD to discuss Basin-wide SGMA topics ranging from monitoring network coordination to Basin-wide modeling efforts and sustainable management criteria development.

South of Kern River Coordination Meetings

AEWSD and neighboring agencies in the “south of Kern River” portion of the Basin have periodically convened to coordinate on major GSP development topics, including methodologies and data sources used to develop the Basin Setting, Water Budget, and Sustainability Criteria sections of their respective GSPs/Management Area Plans and the development of projects and management actions.

White Wolf Basin GSA

The White Wolf GSA was formed in 2017 by three water districts: AEWSD, TCWD, and WRMWSD, as well as Kern County (as a non-voting member). Prior to that, the GSA parties coordinated in an effort to subdivide the Kern Subbasin into two separate subbasins and remove the critical-overdraft status from the newly formed White Wolf Subbasin. By December of 2016, both goals were accomplished, and the
White Wolf GSA is currently in the process of developing a GSP. The White Wolf GSA meets quarterly at WRMWSD’s offices.

**City of Arvin and ACSD**

AEWSD staff has met multiple times with the City of Arvin and ACSD to discuss issues related to recycled water, SGMA, and other matters. Significant joint effort and coordination supported development of this MA Plan.

**Appendix E** includes a detailed record of the above inter-agency and inter- and intra-basin coordination efforts that AEWSD has been active in. This list will be populated throughout MA Plan development and/or implementation.

**5.5.6. Interbasin Coordination**

AEWSD has actively participated in interbasin coordination with the neighboring White Wolf Subbasin (DWR 5-022.18), Tule Subbasin (DWR 5-022.13), and Tulare Lake Subbasin (DWR 5-022.12) throughout the GSP development process through its membership with the KGA. Coordination topics have included subsidence concerns along the Friant-Kern Canal, delineation of the White Wolf Fault, and cross-boundary flows between subbasins. AEWSD has also actively reviewed and provided comment on Draft GSP documents from neighboring basins (e.g., Tule Subbasin) as well as other GSPs and GSP chapters within the Kern Basin.
Plan Area and Relevant Boundaries

Arvin-Edison Management Area

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

GSA Name
- Kern Groundwater Authority GSA
- Kern River GSA

Abbreviations
- AEWSD = Arvin-Edison Water Storage District
- DWR = California Department of Water Resources
- GSA = Groundwater Sustainability Agency
- MA = Management Area

Notes
1. All locations are approximate.
2. The Plan Area is the Arvin-Edison Management Area.
3. The pastel filled areas represent public and private water systems neighboring the Arvin-Edison Management Area.
4. The City of Arvin boundary is the same as their General Plan boundary.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater Bulletin 118 - 2016 Update.
Kern County, California
December 2019
B60064.01
Figure PA-2

Abbreviations

AEWSD = Arvin-Edison Water Storage District
CCED = California Conservation Easement Database
DWR = California Department of Water Resources

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. Ecological Reserves from California Protected Areas Database downloaded on 20 December 2018 from https://data.cnra.ca.gov/dataset/california-protected-areas-database-2018a
Disadvantaged Communities

Abbreviations
AEWSD = Arvin-Edison Water Storage District
CCED = California Conservation Easement Database
DWR = California Department of Water Resources

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI’s ArcGIS Online world topographic map, obtained 22 November 2019.
Figure PA-4
Arvin-Edison Water Storage District

Legend

AEWSD
Groundwater Subbasin

Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

DWR 2015 Land Use Designations

- Citrus
- Deciduous Fruits and Nuts
- Field Crops
- Grain And Hay Crops
- Native Vegetation
- Pasture
- Semiagricultural
- Truck, Nursery And Berry Crops
- Vineyards
- Canals and Spreading Basins
- Idle / Non-Irrigated
- Urban

Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources

Notes
1. All locations are approximate.

Sources
1. Aerial basemap provided by ESRI’s ArcGIS Online, obtained 22 November 2019.
2. Land use data provided by AEWSD on 3 March 2017.
1. All locations are approximate.
2. Users outside the SWSA rely exclusively on groundwater, however, users on the SWSA are not precluded of using groundwater.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. AEWSD units and facility locations provided to EKI by AEWSD on 3 March 2017.
Abbreviations
CSD = Community Services District
CWD = County Water District
DWR = California Department of Water Resources
PLSS = Public Land Survey System

Notes
1. All locations are approximate.
2. Mettler and the City of Arvin and are the only communities dependent on groundwater within the Arvin-Edison Management Area.

Sources
1. Well Count per square mile (PLSS section) from Well Completion Report Map Application, obtained on 19 October 2018, website: https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da2a8fb623b37
Legend

- AEWSD

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Land Use Designation
- Extensive Agriculture
- Extensive Agriculture (Min. 20 Acre Parcel Size)
- Incorporated Cities
- Intensive Agriculture
- Intensive Agriculture (Min. 20 Acre Parcel Size)
- Low Medium Density Residential
- Mineral and Petroleum
- Mineral and Petroleum (Min. 5 Acre Parcel Size)
- Residential/ Other
- Service Industrial
- Solid Waste Facilities

Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources

Notes
1. All locations are approximate.

Sources
1. Kern County General Plan information obtained on 16 August 2018 from:
   http://esps.kerndsa.com/gis/gis-download-data

Kern County General Plan - Land Use Designation
Legend

- Arvin-Edison Water Storage District
- City of Arvin
- City of Bakersfield
- Metropolitan Bakersfield General Plan

Groundwater Subbasin

- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Land Use Designation

- Residential-Estate
- Residential-Low Medium Density
- Residential-Low /Low Medium Density
- Extensive Agriculture
- Intensive Agriculture
- Mineral and Petroleum
- Residential-Rural
- Industrial-Service
- Residential-Suburban

Abbreviations

DWR = California Department of Water Resources

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.

Metroplitan Bakersfield General Plan - Land Use Designation

Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure PA-8
BASIN SETTING

6. INTRODUCTION TO BASIN SETTING

This section presents Basin Setting information for the Arvin-Edison Management Area. As discussed previously in Section 5 Description of the Plan Area, the Arvin-Edison Management Area consists of the portion of the AEWSD service area within the Kern Subbasin that is not overlapped by ENCSD (Figure HCM-1). In some cases, Basin Setting information for areas proximal to, but outside of, the Arvin-Edison Management Area (e.g., within the neighboring White Wolf Subbasin) is provided for context. Basin Setting information includes the Hydrogeologic Conceptual Model, Groundwater Conditions, and Water Budget.
7. HYDROGEOLOGIC CONCEPTUAL MODEL

This section presents the hydrogeologic conceptual model (HCM) for the Arvin-Edison Management Area. As described in the Hydrogeological Conceptual Model Best Management Practices (BMP) document (DWR, 2016), an HCM provides, through descriptive and graphical means, an understanding of the physical characteristics of an area that affect the occurrence and movement of groundwater, including geology, hydrology, land use, aquifers and aquitards, and water quality. This HCM serves as a foundation for subsequent Basin Setting analysis including water budgets (Section 9 Water Budget Information) and numerical models, monitoring network development (Section 16 Monitoring Network), and the development of sustainable management criteria (Sections 11 through 15). The HCM information presented herein is supplemental to and consistent with the HCM provided in the KGA’s Umbrella GSP and provides refined detail on HCM topics for the Management Area.

7.1. General Description

7.1.1. Geological and Structural Setting

The Arvin-Edison Management Area is located at the southern end of the San Joaquin Valley which is the portion of California’s Central Valley that is south of the San Joaquin/Sacramento River Delta. The San Joaquin Valley is a structural trough filled with tens of thousands of feet of Cenezoic continental and shallow marine sedimentary deposits shed from the surrounding mountains which include the Sierra Nevada Mountains to the east, the Coast Range Mountains to the west, and the San Emigdio and Tehachapi Mountains to the south (Davis et al., 1959). The structural trough is asymmetric, with its axis located west of the valley’s centerline at land surface (Scheirer, 2013). Locally, to the immediate west of the Management Area, the Maricopa Depocenter is a structural depression which has accumulated thicker deposits than the surrounding areas. The reader is referred to the Basin-wide geologic and structural setting discussion included in the KGA’s Umbrella GSP for additional information and map figures.

Due to its location near the North American and Pacific plate boundary, the southern San Joaquin Valley underwent complex patterns of tectonic evolution during the Cenezoic era, including phases of extension, uplift, subsidence, faulting, and flexure (Goodman and Malin, 1992). The White Wolf Fault cuts through the southern portion of AEWSD and forms the boundary between the Kern Subbasin to the north and the White Wolf Subbasin to the south. The White Wolf Fault is a recently active southward-dipping high-angle reverse fault that has resulted in significant displacement of stratigraphic units on either side (California Division of Mines, 1955; Hagan, 2001). The Edison Fault is a northward-dipping normal fault located near the eastern side of the Arvin-Edison Management Area. The Edison Fault has uplifted pre-Tertiary basement rocks on the south side to be adjacent to Tertiary sediments on the north side. The Edison Fault was most recently active during Oligocene, Miocene, and perhaps Pliocene times (Dibblee, Jr., and Chesterman, 1953). The Bakersfield Arch is a broad east-west trending structural dome in the vicinity of the Kern River, north of the Management Area. On the south side of the arch, sedimentary strata thin in
a northward direction. Three hydrogeologic cross-sections through the Management Area that further illustrate the complex subsurface structural relationships are discussed further in Section 7.2 Cross-Sections below.

7.1.2. Lateral Basin Boundaries

This MA Plan covers only the Arvin-Edison Management Area (see Figure HCM-1) which is within the larger Kern Subbasin. With the exception of its southern edge, the Arvin-Edison Management Area does not coincide with any part of the Kern Subbasin boundary, and therefore a complete discussion of the lateral basin boundaries is not provided herein, but rather in the KGA GSA Umbrella GSP.

The southern edge of the Arvin-Edison Management Area is coincident with the White Wolf Fault which is the boundary between the Kern Subbasin and the White Wolf Subbasin. As discussed above, the White Wolf Fault is a south-dipping reverse fault, with the northern block down-dropped relative to the southern block. There is also a component of left-lateral slip on the fault (California Division of Mines, 1955). The total vertical displacement is estimated to be over 10,000 feet and is greatest at the southwestern end and less to the northeast (California Division of Mines, 1955). As evidenced by surface rupture during the major earthquake of 21 July 1952, the White Wolf Fault is active, and its displacement plane extends to the ground surface, affecting the youngest sedimentary deposits.

Based on multiple lines of evidence, the fault acts as a significant barrier to groundwater flow, which is the basis for the subbasin boundary (Erler & Kalinowski, Inc., 2016). These lines of evidence include substantial groundwater elevation differences across the fault (based on analysis of available water level data and reports prepared by others), aquifer testing data from wells close to the fault that showed boundary effects, and groundwater modeling studies.

7.1.3. Bottom of the Basin

As discussed above, the southern San Joaquin Valley is a deep structural trough filled with a thick sequence of Tertiary sediments including sandstone, siltstone, shale, and conglomerate. As described below, multiple sources of information can be relied on to define the “bottom of the basin” for purposes of SGMA, including elevation maps of the basement bedrock surface, information on the base of fresh water, the presence, location and depth of oil and gas fields, “exempted” aquifers under the Safe Drinking Water Act (SDWA), and depth of groundwater extraction. Each of these is discussed below, with depth information presented as feet below ground surface (ft bgs) or feet above mean sea level (ft msl), based on the original source information. A summary comparison, including a unit normalization, is included in Table HCM-1.

Depth to Bedrock

The depth of pre-Tertiary basement rocks generally increases from east to west. Within the Arvin-Edison Management Area, the elevation of the top of the basement rock surface ranges from between -2,000 and -8,000 ft msl in the northern area, 0 to -6,000 ft msl in the eastern/central area, and approximately -10,000 to -20,000 ft msl in the far southwestern area (Scheirer, 2013). Given the land surface elevations, discussed further in Section 7.3 Physical Characteristics below, the depth to bedrock ranges from less than 1,000 ft bgs in the eastern area to over 20,000 ft bgs in the far southwestern area.
Base of Fresh Water

However, despite the substantial thickness of sedimentary strata overlying impermeable basement rock within this structural basin, in the case of the Central Valley it is more appropriate to consider geochemical properties (i.e., water quality) in determining the definable bottom of the basin (DWR, 2016). Documentation of the DWR’s C2VSim model states that “although the Central Valley sedimentary basins are very thick, the fresh water aquifer in each basin is very thin” (Brush et al., 2016).

Page (1973) mapped the elevation of the base of fresh water in the Kern Subbasin using a criterion for fresh water of specific conductance (also known as electrical conductivity or “EC”) of less than 3,000 micromhos per centimeter (umhos/cm). This EC is equivalent to a total dissolved solids (TDS) concentration of approximately 2,000 milligrams per liter (mg/L). The Page (1973) base of fresh water map does not cover the entire Arvin-Edison Management Area (i.e., the northeastern portion is not covered), but for the area that is covered, the base of fresh water elevation ranges from approximately -2,000 ft msl in the north-central portion of the Management Area to approximately -4,000 ft msl in the southwestern portion (Figure HCM-2). These elevations translate to a range of depths of approximately 2,500 ft bgs to 4,400 ft bgs.

Presence of Oil and Gas Fields

For over a century, oil and gas exploration and development has taken place throughout the Kern Subbasin, tapping various Tertiary sedimentary deposits. Such activity continues to this day and has resulted in the accumulation of a substantial body of knowledge concerning the regional geology, including stratigraphy, structural features, hydrocarbon occurrence, and the geochemical character of groundwater. Figure HCM-3 shows the locations of oil and gas fields in the vicinity of the Arvin-Edison Management Area, as mapped by the Division of Oil, Gas, and Geothermal Resources (DOGGR). The Edison Oil Field, located in the northern portion of the Arvin-Edison Management Area, contains several “pools” (subareas with distinct production characteristics and rules), including the Main Area, West Area, Jeppi Area, Portals-Fairfax Area, Race Track Hills Area, and (outside of the Arvin-Edison Management Area) the Edison Groves Area. The base of fresh water indicated on the field data sheets for these pools ranges from 1,700 ft bgs in the Main Area to 4,000 ft bgs in the West Area (DOGGR, 1998). The DOGGR base of fresh water determination is based primarily on salinity derived from borehole electric log (“e-log”) data, but in some cases is based on Boron content. The Mountain View Oil Field, located along the western edge of the Management Area, is comprised of five pools, including the Main Area, Arvin Area, West Arvin Area, Vaccaro Area, and Di Giorgio Area. The base of fresh water for all Mountain View field pools except the Main Area is between 2,000 and 2,900 ft bgs; for the Main Area the base of fresh water ranges from 1,150 to 4,800 ft bgs.

Exempted Aquifers

Under the Safe Drinking Water Act, the United States Environmental Protection Agency (and through a primacy agreement, the State Water Resources Control Board [SWRCB]) regulate injections into Underground Sources of Drinking Water. One such type of injections, known as “Class II injections”, involve either enhanced oil recovery or for disposal of fluids associated with oil and gas production. In general, Class II injections are prohibited under the SDWA, except in “exempted aquifers”. The DOGGR and SWRCB consider proposals for aquifer exemptions on a case by case basis. Within the Arvin-Edison Management Area, aquifer exemptions for several deeper formations within the Edison Oil field were proposed by DOGGR and approved by the SWRCB in two “final concurrence” letters dated 19 October
2018 and 4 February 2019 (see Appendix G). The 19 October 2018 letter approves the aquifer exemption proposal for formations including the Vedder Formation, Pyramid Hills Sands, and Main Wicker Sands, and the Transition/Santa Margarita Formation, and the 4 February 2019 letter approves the aquifer exemption proposal for the Chanac Formation (along the northern edge of the Management Area). Both approvals include the condition that fluids injected in the proposed exempted formations must be “of similar or better quality than the existing groundwater” in the area, as determined by Water Boards staff. Based on the DOGGR field data sheet for the Edison field, the Vedder, Pyramid Hills Sands, Main Wicker Sands, Transition/Santa Margarita, and Chanac formations occur at depths of 4,730 to 6,040 ft bgs, 4,620 to 5,950, 2,500 to 4,200 ft bgs, 1,700 to 4,100 ft bgs, and 1,150 to 3,300 ft bgs, respectively (DOGGR, 1998). AEWSD correspondence with local landowners suggests the depth to base of fresh water can be found as shallow as 1,200 ft. bgs in parts of the Edison Oil Field.

**Deepest Groundwater Extractions**

Another indication of the "bottom" of the basin in the Arvin-Edison Management Area comes from the basin representation within groundwater flow models, specifically the Department of Water Resources (DWR) C2VSim basin model (Brush et al., 2016). The HCM BMP (DWR, 2016) states that “the definable bottom of the basin should be at least as deep as the deepest groundwater extractions” (DWR, 2016). As described below, based on well construction information from 196 wells within the Kern Subbasin portion of the Management Area, all wells have depths less than 1,400 ft bgs.

The depth of groundwater extraction is further characterized in regional groundwater flow models. The C2VSim model (C2VSim-CG, version R374) divides the Central Valley alluvial basin vertically into three layers, the top two of which are pumped (i.e., could be considered to define the vertical extent of the basin). The updated version of C2VSim (C2VSim-FG, Beta version) uses the same layering scheme, but adjusts the thickness of Layers 1 through 3 and adds an additional Layer 4 below Layer 3. C2VSim-CG layer thickness data for 18 model nodes within and near the Arvin-Edison Management Area show that the combined thickness of Layers 1 and 2 (i.e., the unconfined and confined pumped layers) ranges from 1,438 ft to 2,146 ft, averaging 1,595 ft. C2VSim-FG layer thickness data for 145 model nodes within the Management Area show a combined thickness of Layers 1 and 2 ranging from 1,157 ft to 1,646 ft, averaging 1,488 ft (see Figure HCM-4). These combined Layer 1 and 2 thicknesses correspond to the total depth of the pumped zone in this model.

Given the above information, the controlling factor for the definable “bottom of the basin” is determined to be the depth of the base of fresh water. Within the Arvin-Edison Management Area, the bottom of the basin ranges in elevation from -2,000 to -3,200 ft msl in the northern portion to approximately -3,200 to -4,000 ft msl in the southern portion, corresponding to depths of approximately 2,500 ft bgs in the north to 4,400 ft bgs in the south. In the certain areas where pools within the Edison and Mountain View oil fields are shallower than the previously mentioned depths, the bottom of the basin is defined as the

---

30 GAMA Website: https://www.waterboards.ca.gov/water_issues/programs/gama/about.html.
30 http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/index_C2VSim.cfm
31 The depth of wells is determined from well construction information using the following data, in order of preference (if data are available): bottom of screen depth, completed depth, or total depth.
32 C2VSim-FG, Beta version is currently uncalibrated, and various potential concerns have been identified regarding this model’s parameterization of the Kern and White Wolf Subbasins, including representation of the White Wolf Fault (location and hydraulic properties), hydraulic properties of the aquifers, etc. as discussed in detail in the letter to DWR from the White Wolf GSA, of which AEWSD is a member, on 9 July 2018.
(shallower) depth of fresh water from the DOGGR oil field data. It is recognized, however, that the maximum depth of wells is only about 1,400 feet, and therefore a substantial volume of groundwater above the “bottom of the basin” has not been tapped by water wells.

Table HCM-1. Information Relevant to Definition of the Bottom of the Basin

<table>
<thead>
<tr>
<th>Type of Information</th>
<th>Source(s)</th>
<th>Parameter Range within Arvin-Edison Management Area</th>
<th>Elevation Range (ft msl)</th>
<th>Depth Range (ft bgs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrock Basement Composite Surface</td>
<td>Scheirer, 2013</td>
<td>Northern area: -2,000 to -8,000</td>
<td>Northern area: 2,500 to 8,500</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eastern/central area: 0 to -6,000</td>
<td>Eastern/central area: 1,000 to 6,500</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Southwestern area: -10,000 to -20,000</td>
<td>Southwestern area: 10,500 to -20,500</td>
<td></td>
</tr>
<tr>
<td>Base of Fresh Water</td>
<td>Page, 1973</td>
<td>Northern Area: -2,000 to -3,200</td>
<td>Northern Area: 2,500 +</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Southern area: -3,200 to -4,000</td>
<td>Southern area: Up to 4,400</td>
<td></td>
</tr>
<tr>
<td>Oil Field Base of Fresh Water Information</td>
<td>DOGGR, 1998</td>
<td>Edison oil field area: -1,000 to -3,300</td>
<td>Edison oil field area: 1,700 to 4,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mountain View oil field area: -700 to -4,300</td>
<td>Mountain View oil field area: 1,150 to 4,800</td>
<td></td>
</tr>
<tr>
<td>Exempted Aquifers</td>
<td>SWRCB; DOGGR</td>
<td>Edison oil field area: -800 to -3,300</td>
<td>Edison oil field area: 1,500 to 6,040</td>
<td></td>
</tr>
<tr>
<td>Deepest Groundwater Extractions from Regional Groundwater Model</td>
<td>Brush et al., 2016; DWR, 2018</td>
<td>C2VSim-CG (R374): -734 to -1,244</td>
<td>C2VSim-CG (R374): 1,458 to 2,146</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2VSim-FG (Beta): -340 to -1,151</td>
<td>C2VSim-FG (Beta): 1,157 to 1,646</td>
<td></td>
</tr>
</tbody>
</table>

Note:
(1) Shaded cells indicate estimated values based on approximate ground surface elevation.
Principal Aquifers and Aquitards

Principal aquifers are defined in the GSP Emergency Regulations as “aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems” (23 CCR § 351(aa)). In an area with significant groundwater development, such as the Arvin-Edison Management Area, it is therefore reasonable to equate the principal aquifers with the aquifers from which wells pump water for water supply. This in turn can be deduced through examination of the depths of water supply production wells.

Based on well construction information from 196 wells within the Kern Subbasin portion of the Arvin-Edison Management Area, all wells have depths33 less than 1,400 ft bgs, and approximately 90 percent of wells have depths between 400 and 1,200 ft bgs (see Figure HCM-5). This indicates that the principal aquifer(s) are those that are encountered within the top 1,400 ft bgs. The following discussion, therefore, focuses on the aquifer materials encountered in this depth zone. The surficial geology within the Management Area is discussed further below in Section 7.3 Physical Characteristics, and the stratigraphic relations and well log information along the lines of section are presented on cross-sections A-A’, B-B’, and C-C’, discussed further below in Section 7.2 Cross-Sections.

Formation Names and Occurrence

The stratigraphy in the depth zone of the principal aquifer includes (from shallowest to deepest; youngest to oldest), the Quaternary (Recent and Pleistocene) Alluvium deposits and the late Tertiary (Miocene and Pliocene) Kern River Formation (KRF).

The Alluvium deposits, sometimes divided into Younger (Recent) and Older (Pleistocene) units (e.g., Wood and Dale, 1964), are composed generally of unconsolidated sands and gravels, coarser towards its base, and is somewhat coarser than the underlying deposits (Croft, 1972). However, the Older Alluvium and late Tertiary KRF are similar in depositional/lithologic character and are difficult to distinguish from one another.

The KRF is analogous to (and sometimes considered part of) the Tulare Formation (Croft, 1972). The name “Kern River Formation” was originally used by Diepenbrock (1933) and subsequently formalized by Bartow and Pittman (1983). The KRF consists of unconsolidated beds of sand and conglomerate with interbeds of siltstone and mudstone, is generally poorly-sorted with medium- to large-scale cross-bedding, and was deposited in fluvial, braided-channel environments (Bartow and Pittman, 1983). The fluvial origin of the KRF results in channel-like bodies of coarse-grained materials which can provide anisotropic hydraulic connections. These channels are largely unmapped but have occasionally been deduced through detailed local-scale hydrogeologic inference (e.g., CVRWQCB, 2009). Near the base of the formation, the KRF includes intervals containing hydrocarbon-bearing sands, lenticular in shape and separated by lower permeability silt and clay interbeds. Most of the oil contained within these oil sands migrated upwards from older marine units.

---

33 The depth of wells is determined from well construction information using the following data, in order of preference (if data are available): bottom of screen depth, completed depth, or total depth.
Underlying the KRF (generally beneath the principal aquifer) are the Miocene Chanac (and in some areas, generally westward, the Etchegoin Formation). The contact between the KRF and the Chanac is possibly unconformable (Bartow and Pittman, 1983). Below the Chanac Formation is the Miocene marine Santa Margarita Formation (Bartow and Pittman, 1983).

A significant regional aquitard within the principal aquifer, the Pleistocene "E"-Clay (Croft, 1972), underlies the western portion of the northern half of the Arvin-Edison Management Area and the northern portion of the southern half of the Management Area (Figure HCM-6). The “E”-Clay or “Corcoran Clay” is one of several flood-basin, lacustrine and marsh deposits that exist within the southern San Joaquin Valley and is often referred to as “blue clay” in well driller logs (Croft, 1972). The “E”-Clay dips generally southwestward, and beneath the Management Area the base of the "E"-Clay ranges in elevation from approximately 200 ft msl in the east to -200 feet ft msl in the southwest (Croft, 1972). The depth to top of the Corcoran Clay (“E”-Clay) ranges from approximately 400 ft bgs in its most northeastern extent beneath the Management Area to approximately 250 ft bgs in the southwestern portion (DWR, 2008). The “E”-Clay, where present, acts as a confining unit for the underlying groundwater; above the “E”-Clay (and where the “E”-Clay does not exist) groundwater occurs under unconfined conditions (Croft, 1972). Another similar regional aquitard unit, the “A”-Clay, exists at shallower depths to the west of the Management Area but does not underlie it (see Figure HCM-6). The “A”-Clay is likely the cause of perched groundwater conditions observed in this area (Croft, 1972).

Physical Properties of Aquifer(s) and Aquitard(s)

Given the range of lithologies and grain sizes within the formations that comprise the principal aquifer (i.e., ranging from gravels and sands, to silts and clays, generally poorly-sorted and interbedded), the physical properties of the aquifer vary widely both laterally and with depth. In general, wells drilled into the principal aquifer tap into sufficient coarse-grained material to be productive enough to support overlying agricultural demands. AEWSD periodically measures the specific capacity of its wells and the most recent available data indicates specific capacity ranging from 3 to 145 gallons per minute per foot of drawdown (gpm/ft) with an average of 29.6 gpm/ft and a median of 23 gpm/ft. Wood and Dale (1964) developed a map of “yield factors” for the Edison-Maricopa area. The yield factor is defined as the specific capacity per 100 feet of aquifer screened by a well (i.e., units of gpm/100ft²). The Wood and Dale (1964) map (Figure HCM-7) shows that most of the northern portion of the Management Area has yield factors of between 11 and 50 gpm/100ft², with a small area of yield factor greater than 50 gpm/100ft². The southern portion of the Management area has lower yield factors in the range of 6 to 10 gpm/100ft².

While the yield factors of Wood and Dale (1964) provide insight into the relative productivity of wells, they do not directly translate into aquifer hydraulic properties. Multiple-well aquifer pumping test data which is necessary to accurately determine hydraulic conductivity and storage parameters is generally not available. Another potential source of information regarding hydraulic properties is extraction of parameters from calibrated numerical groundwater models, although this information must be used with caution, particularly in areas such as Wheeler Ridge-Maricopa Management Area where the model
parameters are not based on local calibration.\textsuperscript{34} The DWR’s California Central Valley Surface Water-Groundwater Simulation model (C2VSim) is one such source of hydraulic property information. C2VSim has been developed over many years and iterations, and the most current “full release” of the model is the coarse-grid (CG) version R374, released June 2013\textsuperscript{35}. The new fine-grid (FG) version of C2VSim, released by DWR as a “beta” version (i.e., still under development) in May 2018, is undergoing further calibration with a full release expected in 2019.

As mentioned above, C2VSim-CG has three model layers: Layer 1 (top) represents the unconfined unit, Layer 2 (middle) represents the pumped portion of the confined unit, and Layer 3 (bottom) represents the unpumped portion of the confined unit (Brush et al., 2016). C2VSim-FG adds an additional fourth layer below the bottom of the three existing layers. Table HCM-2, below, shows a summary of hydraulic property information for C2VSim nodes in Layers 1 and 2 within the Arvin-Edison Management Area, based on the R374 version of the coarse model and the “beta” version of the fine grid model. Figure HCM-8 shows selected hydraulic property values for the 145 C2VSim-FG nodes within the Arvin-Edison Management Area, including hydraulic conductivity for Layers 1 and 2, specific yield for Layer 1, and specific storage for Layer 2.

Table HCM-2. Hydraulic Properties Extracted from C2VSim Models

<table>
<thead>
<tr>
<th>Parameter</th>
<th>C2VSim-CG (R374)</th>
<th>C2VSim-FG (Beta version)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Nodes within Arvin-Edison Management Area</td>
<td>18</td>
<td>145</td>
</tr>
<tr>
<td><strong>Layer 1 Node Properties: Average (Minimum to Maximum)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic Conductivity (ft/day)</td>
<td>48.1 (34.3 to 69.2)</td>
<td>29.2 (8.2 to 49.2)</td>
</tr>
<tr>
<td>Specific Yield (-)</td>
<td>0.292 (0.114 to 0.400)</td>
<td>0.085 (0.074 to 0.094)</td>
</tr>
<tr>
<td>Specific Storage (-)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Layer 2 Node Properties: Average (Minimum to Maximum)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic Conductivity (ft/day)</td>
<td>46.2 (20.7 to 98.6)</td>
<td>15.2 (2.6 to 38.6)</td>
</tr>
<tr>
<td>Specific Yield (-)</td>
<td>0.122 (0.122 to 0.124)</td>
<td>0.081 (0.071 to 0.097)</td>
</tr>
<tr>
<td>Specific Storage (-)</td>
<td>2.5E-05 (8.8E-06 to 4.6E-05)</td>
<td>0.0014 (0.0002 to 0.0021)</td>
</tr>
</tbody>
</table>

Abbreviations:
- \textit{ft/day} = feet per day
- \textit{NA} = not applicable

As shown in the table above, the upper unconfined zone, represented by Layer 1 in both the coarse-grid and (uncalibrated) fine-grid versions of C2VSim, is somewhat more permeable than the confined zone.

\textsuperscript{34} Numerical models that are regional (i.e., large scale) in extent should be assumed to possess a high degree of uncertainty with respect to local parameter values. Nonetheless, where local measurements are not available, such model parameters can serve as an approximation for unknown values.

\textsuperscript{35} \url{http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/index_C2VSim.cfm}
represented by Layer 2. Both the specific yield of Layer 1 and the specific storage of Layer 2 are much greater in the Arvin-Edison Management Area in C2VSim-CG than in C2VSim-FG; however, these values may change in C2VSim-FG upon completion of model calibration.

Another numerical groundwater model that covers the entire Central Valley is the U.S. Geological Survey’s Central Valley Hydrologic Model (CVHM) (Faunt, ed., 2009). The CVHM model is based on the USGS’ MODFLOW software package and simulates integrated subsurface and surface water flow processes, including agricultural water demand based on climate and land use information, for the period from October 1961 through September 2003. Hydraulic properties for each 1 square mile model grid cell were assigned based on the kriged distribution of coarse-grained deposits which was ascertained through review and lithologic coding of thousands of well logs. Figure HCM-9 shows the distribution of coarse-grained (i.e., more permeable) deposits in the CVHM model layers 3, 4, 6, and 8 which correspond, respectively and approximately, to (Layer 3) the upper unconfined, saturated portion of the principal aquifer, (Layer 4) the Corcoran Clay, and (Layers 6 and 8), the confined portion of the principal aquifer. As shown on Figure HCM-9, this distribution shows a relatively coarse area in the north-central portion of the Arvin-Edison Management Area, finer materials to the northeast of the Edison Fault, and moderate to fine materials in the southern portion (Faunt, ed., 2009). This pattern is generally consistent with the “yield factor” map of Wood and Dale (1964), shown on Figure HCM-7. Although the Layer 4 (Corcoran Clay) appears to have a high percent coarse in Figure HCM-9, in the model the texture-based estimated hydraulic conductivity for this layer is reduced by a factor of 100 in the horizontal direction and 500 in the vertical direction to simulate impedance to flow (Faunt, ed., 2009).

From the information discussed above, it is clear that considerable uncertainty exists in the values for aquifer properties including hydraulic conductivity and specific yield. This is not unexpected, given the heterogeneous nature of the KRF. As a further indication of the variability in these parameters, Dale et al. (1966) provided estimates of permeability (analogous to hydraulic conductivity) of the various types of continental deposits in the Kern River alluvial fan area, and they range over several orders of magnitude. Permeability for gravel and clay is stated in Dale et al. (1966) to range between 10 and 100 gallons per day per foot squared (gpd/ft²)\(^{36}\), for fine sand and silt from 0.001 to 10 gpd/ft², for medium and coarse sand from 100 to 1,000 gpd/ft², and for the gravel (dominated) lentil from 1,000 to 10,000 gpd/ft². As such, an accurate spatial distribution of hydraulic properties remains a significant data gap, although one that may be filled via further local investigation and/or model calibration.

Structural Properties of the Basin that Restrict Groundwater Flow Within the Principal Aquifer(s)

The White Wolf Fault that forms the southern border of the Arvin-Edison Management Area and the Kern Subbasin is known to act as a significant barrier to (lateral) groundwater flow from the White Wolf Subbasin northwards into the Kern Subbasin, especially at lower groundwater levels (Erler & Kalinowski, Inc., 2016). Groundwater level information (discussed further below in Section 8.2 Groundwater Elevations and Flow Direction) suggests that the Edison Fault in the northeastern portion of the Arvin-Edison Management Area may also create a "barrier" effect on flow in the deeper portions of the principal aquifer, even though the fault, which was active during the Miocene and possibly Pliocene era, likely does

\(^{36}\) One gpd/ft² is equal to 0.133 ft/day.
not extend vertically up through the entire KRF. As discussed above, the “E”-Clay acts as a regional aquitard that limits vertical flow to some extent between the unconfined and confined portions of the aquifer in the western portion of the Management Area. It should be noted, however, that many wells are screened through this aquitard and therefore serve as a hydraulic connection between the two zones.

**General Water Quality of the Principal Aquifer(s)**

General groundwater quality within most of the Arvin-Edison Management Area was categorized by Wood and Dale (1964) as "transition" waters (see Figure HCM-10). A small area on the far eastern side is categorized as “waters of the older rocks”. The Wood and Dale (1964) groundwater quality categories reflect differences in the chemical characteristics of streams that recharge groundwater and differences in the rock types through which groundwater moves. The “transition” waters represent the transition from water emanating chiefly from the Sierra Nevada Mountains to the east and “axial” and “west-side” waters whose chemical composition reflects geochemical processes occurring in the central and western San Joaquin Valley, respectively. The “transition” waters have bicarbonate as the predominant anion and an intermediate cation composition. The “waters of the older rocks” are of a sodium or sodium calcium bicarbonate type (Wood and Dale, 1964). Further discussion of specific constituents of particular relevance to the beneficial uses within the Management Area, including maps of the distribution of these constituents, is provided in Section 8.5 Groundwater Quality below.

**Primary Uses of Each Aquifer**

The predominant use of groundwater from the principal aquifer in the Arvin-Edison Management Area is for irrigated agriculture. This includes groundwater pumped by individual landowners for use on their crops, as well as groundwater banked by AEWSD and subsequently recovered for distribution to AEWSD customers and others on a second priority basis (i.e., water management programs with third parties). Groundwater is also used by ACSD and MCWD as a source municipal & industrial (M&I) water supply, by a small number of private commercial entities for industrial use (i.e., food processing), and to supply an unknown number of private domestic wells. Figure HCM-11 shows the distribution of wells within the Management Area by well type (i.e., irrigation, domestic/municipal and industrial [M&I], monitoring, recovery, and unknown).

**7.1.5. Data Gaps and Uncertainty**

Key data gaps and uncertainties identified during development of this HCM for the Arvin-Edison Management Area include:

- Uncertainty in hydraulic properties (hydraulic conductivity, specific yield) of the principal aquifer;
- Uncertainty in the degree of hydraulic connection between the unconfined and confined zones of the principal aquifer where the “E”-Clay is present; and
- Uncertainty about well construction details for many in-District wells (i.e., many available well logs are old and no longer legible, or the well logs cannot be accurately mapped to the correct well location).
7.2. Cross-Sections

Three hydrogeologic cross-sections (A-A’, B-B’ and C-C’) were developed for this HCM (see Figure HCM-13, Figure HCM-14, and Figure HCM-15, respectively). The locations of the cross-sections with respect to the surficial geology are shown on Figure HCM-12. The cross-sections extend laterally slightly beyond the boundaries of the Arvin-Edison Management Area and extend vertically down to an elevation of -3,600 ft msl. As such the cross-sections include the entire thickness of aquifer materials that are or could reasonably be tapped for groundwater supply purposes (i.e., down through the Pliocene and younger continental/alluvial deposits of the Kern River Formation and ending at the base of the Mio-Pliocene Chanac Formation) and includes the entire zone above the Page (1973) base of fresh water surface. The cross-sections include the following:

- Land surface elevation extracted from the U.S. Geological Survey 10-meter digital elevation model (DEM);
- Surficial geologic units after California Division of Mines and Geology (1964), discussed further below;
- Water supply wells proximal to the cross-section lines, showing the perforated/screened interval and generalized lithologic information (i.e., fine, medium or coarse intervals) derived from inspection of well logs. The locations of water supply wells included on the cross-sections are shown on inset maps in the cross-section figures;
- DOGGR oil wells proximal to the cross-section lines from which the elevations of various stratigraphic markers were extracted from well records. The locations of DOGGR oil wells used in the development of the cross-sections are shown on inset maps in the cross-section figures;
- Subsurface geologic units, informed by Bartow (1984) and Croft (1972), and DOGGR oil well information;
- Groundwater levels from Fall 2016;
- Approximate depths of C2VSim-CG model layers; and
- Base of fresh water, after Page (1973).

As shown on the cross-sections and discussed previously, most groundwater supply wells within the Arvin-Edison Management Area are screened in the top 1,400 feet, whereas the base of fresh groundwater (after Page, 1973) and the KRF extend significantly deeper. Wells are typically not drilled deeper than needed to obtain the desired quantity of water. Therefore, while usable groundwater may be present below the depths currently tapped by groundwater wells, it may not be economical to do so, especially given that water quality tends to be poorer at greater depths, even above the nominal base of fresh water.

---

37 Data were included within a 0.5-mile distance from the section line for cross-sections A-A’ and C-C’ and within a 1-mile distance for cross-section B-B’.
Cross-Section A-A’

Cross-sections A-A’ extends for approximately 20 miles in a northwest-southeast direction along the axis of the northern portion of the Arvin-Edison Management Area. The cross-section starts at the Kern River (outside of the Management Area) and crosses into AEWSD about five miles south. In this far northern portion outside of AEWSD, the cross-section cuts through the topographically elevated area where the surficial geologic unit is Plio-Pleistocene non-marine (“Qp”). Further south, the surficial geologic unit is Pleistocene non-marine (“Qc”), and then transitions into the Recent Alluvium (“Qf”) near where the cross-section crosses Caliente Creek. Towards the southern end the land surface begins to rise again. The subsurface geologic units include mostly the KRF, underlain by the (Miocene) Chanac and Santa Margarita formations in the northern portion and the Chanac and basement granite in the southern portion. On the northern end of the section line, the southern limb of the Bakersfield Arch causes the Miocene and older beds to dip southward. In the area around Caliente Creek, the Edison Fault causes a large offset of these deeper units, bringing them closer to the land surface on the southern/eastern side of the fault. The “E”-Clay is intersected for about two miles just south of Caliente Creek. Water well screen and lithologic data show that along the section line well depths vary from less than 200 ft bgs to about 1,000 ft bgs. The fall 2016 groundwater elevation surface is higher in the north and gradually decreases towards the south. The Page (1973) base of fresh ranges from about -2,000 ft msl to -2,700 ft msl in this area, although data is limited to the northern portion of the cross-section.

Cross-Section B-B’

Cross-sections B-B’ extends roughly 22 miles along the axis of the southern portion of the Arvin-Edison Management Area. The land surface is elevated at both ends — on the west by Wheeler Ridge and on the east by the Tehachapi Mountain foothills. Elevations are lowest, around 400 ft msl, in the middle of the section. The predominant surficial geologic unit is the Recent Alluvium (“Qf”). Underlying this alluvium and extending to depths of at least 4,000 ft bgs in this area, is the KRF, undifferentiated with the Tulare Formation. The “E”-Clay is intersected for approximately 10 miles and dips to the west. On the far northeast side of the cross-section line, the Chanac Formation and underlying granite dip steeply to the southwest. Water wells along this section line range from roughly 500 to 1,200 ft bgs, with some screened below the “E”-Clay and others screened across it. DOGGR well logs in this area extend to depths well over 15,000 ft bgs. The fall 2016 groundwater elevation surface is higher in the southwest and decreases to the northeast, reaching below 0 ft msl. The Page (1973) base of fresh water is at approximately -3,600 ft msl in this area.

Cross-Section C-C’

Cross-section C-C’ is perpendicular to cross-section A-A’ and extends roughly 16 miles through the northern portion of the Arvin-Edison Management Area in a direction roughly parallel to the stratigraphic dip direction. The western five miles are outside of the Arvin-Edison Management Area. Land surface slopes to the west from a high point of approximately 1,100 ft msl in the east to approximately 400 ft msl at the AEWSD boundary. The surficial geologic units include the Pleistocene non-marine deposits (“Qc”), overlain to the west by Recent Alluvium (“Qf”) and Basin deposits (“Qb”) in the far western portion of the section. Similar to cross-section A-A’, subsurface geologic units include predominantly the KRF which is underlain by the Chanac and Santa Margarita formations. The “E”-Clay is present beneath the western eight miles of the section and dips to the west. The Edison Fault offsets the Miocene Chanac and Santa Margarita formations and extends possibly into the KRF to some degree. DOGGR well logs help define the depth at which the basement bedrock (mostly schist in this area) is encountered. Groundwater elevation
contours show a substantial steepening in the area overlying the Edison Fault which suggests a barrier effect is occurring. Water wells along this section line range in depth from approximately 300 to 700 ft bgs. The Page (1973) base of fresh water is deeper it the southwest at about -4,000 ft msl elevation and rises along the section line to the northeast.

7.3. Physical Characteristics

7.3.1. Topographic Information

Figure HCM-16 shows the topography within the Arvin-Edison Management Area. Topography generally slopes to the southwest in the northern half of the Management Area and to the north and northwest in the southern half. Elevations within the Management Area range from approximately 330 ft msl in the central low spot to 1,100 ft msl in the northeastern highlands. Where Caliente Creek enters the Management Area from the northeast it has formed a broad entrenched floodplain area approximately 1 to 2-mile wide which is lower than the surrounding lands to the south and north by approximately 20 to 80 feet. Aeolian processes have also formed a linear ridge of dune sand deposits on the north side of the Caliente Creek channel which is up to 100 feet higher than the lands to the north and up to approximately 180 feet higher than the entrenched Caliente Creek floodplain to the south.

7.3.2. Surficial Geology

Figure HCM-12 shows the surficial geology within the Arvin-Edison Management Area, based on the Geologic Map of California, Bakersfield Sheet (CDMG, 1964) and associated map explanation. The predominant surficial geologic unit covering approximately three-quarters of the Management Area is "Qf" (i.e., Recent alluvial fan deposits in the Great Valley). These deposits were deposited by streams entering the San Joaquin Valley from the uplands to the east. In the northern quarter of the Management Area, the predominant surficial geologic unit is "Qc", Quaternary (Pleistocene) non-marine deposits. These deposits consist of older alluvium, including slightly consolidated and dissected fan deposits. Other minor units in the area include "Qs", Recent Dune sand, in a thin strip along the north side of Caliente Creek (as discussed above) and southwest of the City of Arvin; and "QP", Quaternary (Pliocene-Pleistocene) non-marine deposits that include the KRF. These deposits outcrop in several small areas including on the far northeastern boundary, along the western boundary north of Lamont, and along the eastern boundary south of Caliente Creek. As shown on cross-sections A-A', B-B', and C-C', these Pliocene-Pleistocene KRF deposits underlie the Recent Alluvium throughout the Management Area.

Further to the west outside of the Arvin-Edison Management Area is an area of Recent “basin” deposits (“Qb”), which are relatively less permeable, were deposited under lower-energy floodplain or marsh environments, and which may contribute to local perched water conditions in that area in the very shallow subsurface (i.e., approximately the top 20 feet). These perched zones, however, are often poor quality (CVRWQCB, 2009) and do not yield significant or economic quantities of water to wells, springs, or surface water systems, and therefore are not considered part of the principal aquifer.
7.3.3. **Soil Characteristics**

Soils within the Arvin-Edison Management Area are shown on Figure HCM-17, based on the U.S Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Soil Survey Geographic Database (SSURGO) for western Kern County. Soils are generally coarse-textured, with the predominant types being sandy loam and loamy sand with lesser amounts of loam, sandy clay loam, fine sandy loam, and other. Textures are generally coarser to the east near the foothills and finer to the west. As shown on Figure HCM-18, soils are predominantly in the A and B Hydrologic Soil Groups, indicating high and above average infiltration rates, respectively, and low and moderately low runoff potential, respectively. The northernmost portion of the Management Area, underlain by "Qc" (Pleistocene non-marine deposits) has soils belonging to the C Hydrologic Soil Group, with below average infiltration rate and moderately high runoff potential. Saturated vertical hydraulic conductivity of soils is generally in the range of 0 to 30 inches per hour (0 to 60 ft/day), with some areas near the foothills and along the channels of Caliente Creek and the Tejon Creek fan with higher values.

7.3.4. **Recharge and Discharge Areas**

Figure HCM-19 shows the existing and potential recharge and discharge areas within the Arvin-Edison Management Area. The groundwater system underlying the Management Area is recharged from several sources, including spreading grounds, deep percolation of excess irrigation water applied to agricultural lands (i.e., due to inherent irrigation inefficiency and leaching of salts from the root zone), and seepage from natural surface water channels entering the Arvin-Edison Management Area from the uplands. It should be noted that irrigation evaluations performed by the Resource Conservation District’s mobile lab have regularly shown very high irrigation efficiencies in AEWSD. Recharge of precipitation via deep percolation likely occurs primarily during particularly wet time periods and less so during normal and dry periods. Treated wastewater effluent is disposed of by ACSD via application to approximately 240 acres of agricultural lands at agronomic rates south of the City of Arvin (CVRWQCB, 2000); due to irrigation inefficiency a portion of this treated effluent likely percolates below the root zone of crops and becomes recharge to groundwater. Discharge of groundwater is predominantly through groundwater pumping from wells. Because water levels are far below the land surface, no significant springs, seeps, or wetlands exist within AEWSD.

AEWSD operates three spreading grounds including the North Canal Spreading Works, Sycamore Spreading Works, and Tejon Spreading Works. The North Canal Balancing Reservoir, used to balance imported water inflows prior to distribution to AEWSD customers, also is operated for spreading (recharge) in wetter periods. The first AEWSD recharge facilities, the Sycamore Spreading Works, were constructed starting in 1964 and received water for the first time in 1966 (AEWSD, 2015). The Sycamore Spreading Works was expanded twice, and now consists of 75 ponds with a combined area of 551 acres; the Tejon Spreading Works was constructed in 1972, consists of 72 ponds with a combined area of 447 acres; the North Canal Spreading Works was constructed in 1999 and consists of 12 ponds with a combined area of 300 acres; and the North Canal Balancing Reservoir was constructed in 2000 and consists of 2 ponds with an area of 54 acres (AEWSD, 2015). The Spillway Basin at the end of the South Canal, used as a regulation basin, is un-lined and some recharge occurs there as well.
Between July 1966 and September 2015, a total of over 2.2 million acre-feet (AF) of water has been delivered to these facilities, an average of approximately 44,200 acre-feet per year (AFY). Net percolation for the same time period was approximately 2.13 million AF, averaging approximately 42,700 AFY. All canals have concrete lining, but some canal seepage occurs. In addition to these existing spreading grounds, a new parcel in the west-central portion of the Arvin-Edison Management Area was recently acquired by AEWSD, in partnership with KDWD, for future use as a spreading grounds (see further discussion in Section 17 Projects and Management Actions). AEWSD operates a total of 82 recovery wells to recover the groundwater previously stored via spreading.

**SAGBI Soil Recharge Potential**

Figure HCM-20 shows groundwater recharge suitability on agricultural lands within the Arvin-Edison Management Area based on the UC Davis California Soil Resource Lab’s Soil Agricultural Groundwater Banking Index (SAGBI) dataset. This dataset ranks agricultural lands for groundwater recharge suitability based on soil types and five key factors: deep percolation potential, root zone residence time, topography, chemical limitations, and soil surface conditions. The SAGBI dataset ranks a majority of lands within the Arvin-Edison Management Area as having “Excellent” to “Very Good” suitability for groundwater recharge, including nearly all the central and southwestern portions of the Management Area. As mentioned above and further discussed in Section 17 Projects and Management Actions, AEWSD has initiated development of a new spreading grounds facility (the “Sunset Spreading Works”) in the west central portion of the Management Area, which is ranked as having “Excellent” to “Very Good” suitability for groundwater recharge. Soils ranked as having “Moderately Good”, “Moderately Poor”, or “Poor” groundwater recharge suitability are located primarily in the northern portion of the Management Area as well as in a small section in the south-central portion. Any additional future groundwater recharge facilities proposed within the Management Area will be screened against the SAGBI dataset along with other local sources of information to determine their potential suitability for groundwater recharge operations.

### 7.3.5. Surface Water Bodies

Surface water bodies significant to the management of the Arvin-Edison Management Area include both natural surface water features as well as man-made features. Figure HCM-21 shows the natural surface water features in the vicinity of the Arvin-Edison Management Area. To the east of the Management Area approximately 707 square miles of upland watershed area drains into the area, providing occasional surface water inflows and likely some shallow subsurface inflow. The primary named creeks include Walker Basin Creek and Tehachapi Creek which join Caliente Creek before entering AEWSD; Sycamore Creek, Comanche Creek, and Tejon Creek. Several smaller unnamed watersheds along the eastern valley margin also drain into the Management Area. In addition, several other watersheds and creeks, including El Paso Creek, Pastoria Creek, Grapevine Creek, and Tecuya Creek drain into the White Wolf Subbasin which ultimately drains into the Kern Subbasin.

Based on observations of ungauged flows and limited historical stream gauging data from Caliente Creek outside of the Arvin-Edison Management Area, surface water inflows to the area occur seasonally with some frequency. Storm-related flooding along the larger streams (i.e., Caliente Creek and Tejon Creek) is

---

38 https://waterdata.usgs.gov/nwis/inventory/?site_no=11196400
common in some areas such as Lamont and Arvin, as well as near AEWSD’s spreading works and the David Road and Sebastian Road areas. Due to the intermittent nature of streamflows in the creeks draining into the Management Area, there are only a couple of these streams with reported water applications and permits issued from the SWRCB (i.e., Tejon Creek, Grapevine Creek) with no current action taken from the remainder. There are no instream flow requirements established for any of the creeks draining into the Management Area.

As discussed above, AEWSD operates three main spreading works as part of its in-District water banking program. The District’s Balancing Reservoir is also a full-fledged banking facility capable of recharge and extraction operations. In addition to these spreading basin facilities, AEWSD moves water throughout its service area via a network of conveyance canals and pipelines, discussed below. AEWSD also has recharge partners outside its service area, both within and outside of the Kern Subbasin.

7.3.6. Source and Point of Delivery for Imported Water Supplies

AEWSD conjunctively manages its surface water and groundwater supplies. AEWSD has a contract for 40,000 AFY of Class 1 water and 311,675 AFY of Class 2 water from the Friant Division of the Central Valley Project (CVP) (AEWSD, 2015) plus various other water supplies from the San Joaquin River. Pursuant to transfer agreements with partner agencies, AEWSD has also obtained imported water from other sources such as the State Water Project (SWP), the Kern River, and the westside CVP including Cross Valley contractors. Figure HCM-22 shows AEWSD’s facilities and infrastructure used for the conveyance and distribution of imported water supplies. Most of AEWSD’s imported water supply is brought in through AEWSD’s Intake Canal which starts near the terminus of the CVP Friant-Kern Canal in Bakersfield and runs south and then east through the Forrest Frick Pumping Plant, then entering the AEWSD service area at a point along the northwest boundary. Through this gravity canal and associated pumping infrastructure, AEWSD has the flexibility to access supplies from the Cross-Valley Canal (SWP, CVP and groundwater) and to exchange water with the neighboring Kern Delta Water District. Once in AEWSD, the imported water generally flows southward through AEWSD’s North Canal and South Canal, feeding into branches of AEWSD’s distribution system and also into the three main spreading grounds and the Balancing Reservoir discussed above. AEWSD also has a bi-directional turnout connection at its southern end to the California Aqueduct at Milepost 277.20 through which it can either deliver water to or receive water from the California Aqueduct.
Arvin-Edison Water Storage District
Arvin-Edison Management Area

Abbreviations
AEWSD = Arvin-Edison Water Storage District
CSD = Community Services District
DWR = California Department of Water Resources

Notes
1. All locations are approximate.
2. Hatched portion of the AEWSD Service Area is the Arvin-Edison Management Area.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DWR groundwater basins are based on the boundaries defined in California’s Groundwater, Bulletin 118 - 2016 Update.
Legend

- Arvin-Edison Water Storage District
- Base of Fresh Water (ft msl)

Groundwater Subbasin

- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Abbreviations

- DWR = California Department of Water Resources
- ft msl = feet above mean sea level
- USGS = United States Geological Survey

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DWR groundwater basins are based on the boundaries defined in California’s Groundwater, Bulletin 118 - 2016 Update.

Base of Fresh Groundwater Based on Page, 1973 (USGS)

Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure HCM-2
Legend

- Arvin-Edison Water Storage District
- DOGGR Oil Field
- XX Base of Fresh Groundwater (ft bgs)

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Abbreviations

- DWR = California Department of Water Resources
- DOGGR = California Division of Oil, Gas, and Geothermal Resources
- ft bgs = feet below ground surface

Notes

1. All locations are approximate.
2. Base of Fresh Groundwater according to DOGGR field data sheets (* when based on high Boron concentrations).

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2016 Update.
Legend
- Arvin-Edison Water Storage District
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Groundwater Subbasin

Depth to Bottom of Layer 2 (feet bgs)
- <1,100
- 1,100 - 1,200
- 1,200 - 1,300
- 1,300 - 1,400
- 1,400 - 1,500
- 1,500 - 1,600
- 1,600 - 1,700
- >1,700

Abbreviations
C2VSim-FG = California Central Valley Groundwater-Surface Water Simulation Model - Fine Grid
CNRA = California Natural Resources Agency
DWR = California Department of Water Resources
ft bgs = feet below ground surface

Notes
1. All locations are approximate.
2. Total thicknesses of Layers 1 and 2 of C2VSim-FG Model are shown.
3. Layer 1 and 2 total depths range from 1,150 to 1,650 ft bgs in C2VSim-FG Model within AEWSD Management Area.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. C2VSim-FG Model data obtained from CNRA website:
   https://data.cnra.ca.gov/dataset/c2vsimfg-beta-model

Thickness of Layers 1 and 2 in C2VSim-FG Model (Beta Version)
Arvin-Edison Water Storage District
Kern County, California
December 2019
860064.01
Figure HCM-4
Abbreviations
BOS = bottom of screen
ft bgs = feet below ground surface

Notes
1. Well screen data is based on digitized well records of 196 wells in the Arvin-Edison Management Area.
2. When BOS depth was not available, completed depth or drilled depth were used, in that order of priority.

Summary of Well Screen Depth Data
Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure HCM-5
Contour Map of Base Elevation of "E" - Clay and "A" - Clay Layers

Notes:
1. All locations are approximate.
2. Overlay map shows elevation contours (red lines) of the base of the "E" - Clay and "A" - Clay. The contour interval is 100 feet and the datum is mean sea level.

Sources:
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2016 Update.

Abbreviations:
DWR = California Department of Water Resources
Figure HCM-7

Arvin-Edison Water Storage District
Groundwater Subbasin

Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Yield Factor (gpm/ft per 100 feet of aquifer)

< 1
1 - 5
6 - 10
11 - 50
> 50

Legend

Abbreviations
DWR = California Department of Water Resources
gpm/ft = gallons per minute per foot

Notes
1. All locations are approximate.
2. Yield factor is in gallons per minute per foot of drawdown per 100 feet of saturated materials penetrated by irrigation wells.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.

Yield Factors Based on Wood & Dale, 1964 (USGS)

Arvin-Edison Water Storage District
Kern County, California
December 2019
860064.01
Figure HCM-7
Abbreviations

- AEWSD = Arvin-Edison Water Storage District
- C2VSim-FG = California Central Valley Groundwater-Surface Water Simulation Model - Fine Grid
- CNRA = California Natural Resources Agency
- DWR = California Department of Water Resources
- ft = feet
- ft/day = feet per day

Notes

1. All locations are approximate.
2. Layers 1 and 2 are the representative "pumped layers" of C2VSim-FG Model.
3. Layer 1 and 2 total depths range from 1,150 to 1,650 ft bgs in C2VSim-FG Model within AEWSD Management Area.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DWR groundwater basins are based on the boundaries defined in California’s Groundwater, Bulletin 118 - 2016 Update.

Hydraulic Properties in C2VSim-FG Model (Beta Version)

Arvin-Edison Water Storage District
Kern County, California
December 2019

Figure HCM-8
Abbreviations

CVHM = Central Valley Hydrologic Model
DWR = California Department of Water Resources
USGS = United States Geological Survey

Notes
1. All locations are approximate.
2. Percent coarse is used to approximate hydrogeologic properties of each layer in the CVHM model.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. CVHM percent coarse data were acquired from Faunt, C.C., ed., 2009, Groundwater Availability of the Central Valley Aquifer, California: USGS Professional Paper 1766, 225 p.

CVHM Percent Coarse
Layers 3, 4, 6 and 8

Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure HCM-9
Figure HCM-10

Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01

Legend

- Arvin-Edison Water Storage District
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

General Groundwater Quality

- Probable boundary between groundwater subtypes
- Consolidated rocks bordering the valley
- Groundwater barrier (querried where uncertain)

Abbreviations
DWR = California Department of Water Resources

Notes
1. All locations are approximate.
2. Map shows areas of different water quality (shading, hatching, and stippling), as shown by labels, and chemical composition of major ions (pie charts) the sizes of which are scaled by the total mineral concentration (excluding silica).

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.

East-side waters
Axial waters
Waters of the older rocks
Transition waters
West-side waters
In-District Well Locations

Abbreviations
DWR = California Department of Water Resources
M&I = Municipal and Industrial

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Well information received from AEWSD on 17 November 2017.
Legend

Surficial Geology and Cross-Section Locations

Legend

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Geologic Units
- Recent alluvium
- Recent dune sand
- Quaternary lake deposits
- Pleistocene nonmarine
- Recent fan deposits
- Plio-Pleistocene nonmarine
- Pleistocene nonmarine terrace deposits
- Middle and/or lower Pliocene nonmarine
- Undivided Miocene nonmarine
- Lower Miocene marine
- Mesozoic granitic rocks
- Pre-Cretaceous metamorphic rocks

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
FORMATION MARKERS FROM DOGGR OIL WELL RECORDS INCLUDE: Ch (CHANAC), SM (SANTA MARGARITA), Olc (OLCSE), Ed (EDISON), Jw (JEWETT), Vd (VEDDER), Sch (SCHIST) AND Gr (GRANITE).

FORMATION MARKERS FROM DOGGR OIL WELL RECORDS INCLUDE: Ch (CHANAC), SM (SANTA MARGARITA), Olc (OLCSE), Ed (EDISON), Jw (JEWETT), Vd (VEDDER), Sch (SCHIST) AND Gr (GRANITE).

TOTAL DEPTH
Qc   - PLEISTOCENE NON-MARINE     Qp   - PLIO-PLEISTOCENE NON-MARINE
Qf    - RECENT FAN DEPOSITS
Qsc - RECENT STREAM CHANNEL DEPOSITS

NOTES:
1. API NUMBER
2. SURFICIAL GEOLOGY AS SHOWN ON CDMG (1964). SURFICIAL GEOLOGIC UNITS SYMBOLS ARE:

LEGEND:
...
Figure HCM-16

Arvin-Edison Water Storage District

Groundwater Subbasin

Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Elevation Contour

Land Surface Elevation (ft msl)

High : 1100
Low : 330

Legend

Abbreviations

DWR = California Department of Water Resources
ft msl = feet above mean sea level
NED = National Elevation Dataset
USGS = United States Geological Survey

Notes

1. All locations are approximate.
2. Color scale is based on maximum and minimum elevations within the Arvin-Edison Management Area.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Surface elevation data obtained from USGS NED (https://viewer.nationalmap.gov/basic/).
Figure HCM-17

Abbreviations
DWR = California Department of Water Resources
SSURGO = Soil Survey Geographic Database

Notes
1. All locations are approximate.
2. Map units extracted from SSURGO data.
3. Only the soil units of greatest extent are labeled.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Soil data from SSURGO (https://gdg.sc.egov.usda.gov/GDGOrder.aspx#).
Arvin-Edison Water Storage District

Groundwater Subbasin

- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Hydrologic Soil Groups

A
B
C
D

Figure HCM-18

Legend

Notes

1. All locations are approximate.
2. Hydrologic soil groups extracted from SSURGO data.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Soil data from SSURGO (https://gdg.sc.egov.usda.gov/GDGOrder.aspx#).

Abbreviations

DWR = California Department of Water Resources
SSURGO = Soil Survey Geographic Database
Recharge and Discharge Areas

Kern County, California
December 2019

Legend
- Arvin-Edison Water Storage District
- Irrigated Lands
- Spreading Basin
- Stream/River
- Urban Lands

Groundwater Subbasins
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Well Type
- Green: Agricultural
- Red: Domestic / M&I
- Gray: Other / Unknown
- Blue: AEWSD Recovery Well

Abbreviations
AEWSD = Arvin-Edison Water Storage District
M&I = Municipal and Industrial
NHD = National Hydrography Dataset

Notes
1. All locations are approximate.
2. Existing recharge areas include irrigated lands (light green), AEWSD spreading basins, and natural surface water channels entering AEWSD area. Existing discharge areas include groundwater wells (shown by type).
3. Potential recharge areas are the same as existing recharge areas.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. Surface water features from NHD (https://viewer.nationalmap.gov/basic/).

Figure HCM-19

Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Abbreviations
DWR = California Department of Water Resources
SAGBI = Soil Agricultural Groundwater Banking Index

Notes
1. All locations are approximate.
2. The SAGBI dataset is a spatial mapping of a suitability index for groundwater recharge on agricultural land, based on five key factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface condition.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. SAGBI data from https://casoilresource.lawr.ucdavis.edu/sagbi/.

Soil Recharge Potential
Based on SAGBI Dataset
Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure HCM-20
References

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Surface water features and watersheds from NHD website: (https://viewer.nationalmap.gov/basic/).

Abbreviations

DWR = California Department of Water Resources
NHD = National Hydrography Dataset

Notes

1. All locations are approximate.
2. Pastel filled areas are watersheds draining into the Arvin-Edison Management Area.
3. Labels are shown for named surface water streams entering the Arvin-Edison Management Area.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Surface water features and watersheds from NHD website: (https://viewer.nationalmap.gov/basic/).
Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
SWSA = Surface Water Service Area

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. AEWSD units and facility locations obtained from AEWSD on 3 March 2017.
8. CURRENT AND HISTORICAL GROUNDWATER CONDITIONS

This section presents information on historical and current groundwater conditions within the Arvin-Edison Management Area based on available data. Sources of data used to inform the current conditions assessment are described within each data topic section and include data from AEWSD records, various state and federal databases, and other reports.

For the purposes of this assessment, “current conditions” refers to conditions in calendar year 2015 (i.e., the effective date of SGMA), which is consistent with how “current” is defined by the KGA in the Umbrella GSP. For historical conditions, two periods are relevant. The first is from 1994 through 2015 which is the period being used by KGA and its member entities for historical water budget development. As discussed further below, this period is climatically close to normal/average, but includes a significantly dry (drought) period between 2012 and 2015, as well as other drier and wetter than normal years. The second historical period discussed herein is the period from 1966 through 2015 which corresponds to the period since AEWSD began its water importation operations up to “current”. Consideration of this longer period allows assessment of the long-term effects of AEWSD operations and various sustainability indicators (i.e., groundwater levels, storage, and water quality). In some cases, certain other historical periods are also discussed in this section when either (a) the discussion is constrained by the time periods of available datasets (e.g., for land subsidence), or (b) the groundwater conditions characterization is improved by incorporation of data from other representative time periods.

8.1. Data Sources and Compilation

Per the GSP Emergency Regulations (23 CCR § 352.6), each GSA “shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin”. In support of GSP development (i.e., HCM development, analysis of groundwater conditions, water budget development, and Plan Area information) a substantial number of data sources were compiled, organized, and processed, and stored within a District-specific DMS. The data compiled, which are described in greater detail in the sections that follow, included:

- Seasonal water level measurements for in-District wells, 2004-2016
- Historical spring and fall water level measurements for in-District wells, 1994-2003\(^{39}\)
- Survey of in-District wells and associated Geographic Information System (GIS) shapefiles
- GIS shapefiles of District facilities, surface-water infrastructure and service areas
- District operations records, including surface water imports, deliveries to spreading basins, and wellfield extractions on an annual basis, 1966-2016

\(^{39}\) The 1994-2003 data was provided as either “spring” or “fall”, without exact dates. For the purposes of hydrograph preparation, the water levels for spring and fall were assumed to be collected on April 1 and October 1 of each year, respectively.
• 2015 District-wide land use survey and associated GIS shapefiles
• Historic rainfall data at the District office station, 1974-2016
• Climate data at the District office station, 2013-2015
• Groundwater quality data from the District’s 2016 well sampling effort
• Kern County Water Agency (KCWA) Water Supply Reports, 2002-2011
• Kern River Watershed Coalition Authority (KRWCA) 2017 Groundwater Trend Report and Monitoring Network Plan
• AEWSD 2016 Water Balance, maintained by P&P
• List and map of potential in-District land subsidence monitoring points, maintained by P&P
• Well Log records from California Department of Water Resources (DWR) (well and lithology information were subsequently digitized by AEWSD, to the extent possible given the legibility of the records)
• Topographic data from U.S. Geological Survey’s (USGS) National Elevation Dataset (NED)
• Surficial geology maps from the California Geological Survey (CGS; previously known as the California Division of Mines and Geology)
• Soils data from National Resources Conservation Service’s (NRCS) Soil Survey Geographic Database (SSURGO)
• Historical water level data for Kern County from DWR’s Water Data Library and CASGEM databases, 1960-2017
• GIS shapefiles of watershed boundaries and surface water features from National Hydrography Dataset (NHD)
• Aquifer parameter information from California Central Valley Groundwater-Surface Water Simulation Model (C2VSim) (for model nodes within District boundaries)
• Locations of known contamination sites and plumes from the State Water Resources Control Board (SWRCB) GeoTracker database
• Water quality data for monitoring wells within GeoTracker’s Groundwater Ambient Monitoring and Assessment (GAMA) database
• Crop evapotranspiration (ETc) data by year type from Cal-Poly Irrigation Training and Research Center (ITRC)
• Climate data from California Irrigation Management Information System (CIMIS) Arvin climate station
• Division of Oil, Gas, and Geothermal Resources (DOGGR) oil field reports for the Arvin-Edison area
• California water agency administrative boundary shapefiles from DWR
• GSA administrative boundary shapefiles from DWR\textsuperscript{40}
• Various regional geologic surveys, cross-sections, and reports covering the Arvin-Edison Management Area; and encompassing the AOI, including, but not limited to:
• Various land subsidence studies

All geospatial data were integrated into the ArcGIS software platform as a “geodatabase”, a composite file structure (.gdb) which packages attribute data with associated geospatial information in a user-defined coordinate system.

Much of the data compiled for GSP development and analyses needed at least some pre-processing before the data could be integrated into ArcGIS. These pre-processing tasks included digitization, georeferencing, filtering, and linking georeferenced datasets to associated attribute data from other sources. For example, water level information in some instances did not have any coordinate or elevation information attributed to individual wells. To bring water level information into ArcGIS and create groundwater elevation maps, unique well identifiers based on the Public Land Survey System (PLSS) township information were assigned and then used to link water level records with their associated well coordinates derived from the well survey.

The result of these processing steps is a series of compiled spreadsheets containing, to the extent the information was available: (1) Well IDs, coordinates, and elevation information; (2) well construction information; (3) lithology information provided in the DWR well log records; (4) seasonal water level measurements for the period of collection provided in the AEWSD water levels dataset (1994-2016); and (5) water quality information from the 2016 well sampling effort conducted by the District. These data were subsequently brought into ArcGIS and stored in a geodatabase created for the District along with other geospatial data sources used for HCM development and further assessment of groundwater conditions. Last, selected data types (i.e., water level and water quality data at wells) were brought into a Microsoft Access database. Together these spreadsheets, geodatabase files, and Microsoft Access database comprise the working DMS for the District. Efforts to develop a coordinated Kern Subbasin DMS are planned as part of Plan Implementation (see Section 18.1 Plan Implementation Activities).

8.2. Groundwater Elevations and Flow Direction

\textbf{23 CCR § 354.16(a)}

Groundwater elevation data have been collected and compiled from AEWSD monitoring records, datasets from other neighboring entities (i.e., Wheeler Ridge-Maricopa Water Storage District, Kern Delta Water District, Kern County Water Agency), and the DWR’s California Statewide Groundwater Elevation Monitoring (CASGEM) database. The multiple datasets were reconciled and processed for quality assurance/quality control prior to analysis for groundwater conditions. These “data cleaning” efforts included removal of erroneous data points identified through examination of hydrographs and removal of very shallow depth-to-water data points (less than 20 ft bgd) suspected of being affected by perched conditions to the west of the Arvin-Edison Management Area. The resulting dataset used to inform this discussion of groundwater elevation conditions consists of a total of 24,102 groundwater elevation data points from 890 wells over the period from 1945 to spring 2018. For the purposes of this analysis the

\text{GSA boundaries are subject to change, and are changing frequently.}\n
\textsuperscript{40}
periods of Spring and Fall 2015 are used to represent seasonal high and low conditions under current land and water use, which is consistent with how other Management Area Plans under the KGA Umbrella GSP and other GSPs within the Kern Subbasin (i.e., Kern River GSA’s GSP) are being prepared.

**Lateral Gradients**

Lateral gradients are discussed below in the context of groundwater elevation contour maps.

**Vertical Gradients**

Vertical gradients between the different zones within the principal aquifer (i.e., the unconfined zone above the “E”-Clay versus the confined zone below the “E”-Clay, where it exists) may develop due to variability in proximity to recharge sources and the intensity of groundwater pumping. Vertical gradients may also vary in time as the factors affecting water levels are also temporally variable. Evaluation of vertical gradients can be accomplished by examination of water levels in well pairs where one well is representative of the upper, unconfined zone and the other well is representative of the lower, confined zone. This approach requires water level information from wells that: (a) have known well construction information, (b) are screened in different depth zones, (c) have contemporaneous measurements (i.e., water levels measured at least in the same year and season), and (d) are in close spatial proximity to each other (i.e., to minimize the influence of lateral gradients in water level). At this time, data that meets all of the above criteria has not been identified, and thus this issue represents a data gap in the groundwater conditions assessment.

**Groundwater Elevation Contour Maps**

Groundwater elevation contour maps for “current conditions” – Spring 2015 and Fall 2015 – are presented on Figure GWC-1 and Figure GWC-2, respectively. The following generalities can be made based on groundwater elevation data compiled for wells within the Arvin-Edison Management Area.

- Groundwater levels are consistently highest in the northeast area near the foothills and east of the Edison Fault and lowest in the south-central portion of the Arvin-Edison Management Area, to the south and east of the City of Arvin.

- Assuming groundwater flow is perpendicular to groundwater elevation contours, flow directions are generally to the southwest in the northeastern portion, and northwest across the White Wolf Fault. Groundwater flows into the Arvin-Edison Management Area from the west across both the northwestern and southwestern boundaries.

- Average lateral groundwater gradients across the northwestern and southwestern Arvin-Edison Management Area boundaries were extracted using GIS analysis. The estimated lateral gradients across the northwestern boundary were 0.00065 feet per foot (ft/ft) and 0.0015 ft/ft for spring and fall 2015, respectively, in an into-District direction. Across the southwestern boundary, the estimated lateral gradient in spring and fall 2015 were greater – 0.006 ft/ft and 0.0027 ft/ft, respectively – also in an into-District direction.

- An area of relatively high groundwater levels exists to the west of the Arvin-Edison Management Area, which may be due to a combination of factors including disposal of treated wastewater effluent to irrigated lands in this area, less groundwater pumping due to the availability of recycled water, and potentially the impact of finer-grained “basin” deposits. The “A” clay and its equivalent
under the old Kern Lake bed and the sloughs and swamp and over-flowed land connected to it are another factor.

The relative highs and lows within the Arvin-Edison Management Area appear to be controlled, at least in part, by the distribution of groundwater pumping versus surface water deliveries; areas within AEWSD’s Surface Water Service Area (SWSA) (see Figure GWC-3) tend to exhibit higher groundwater elevations than areas outside of the SWSA that rely exclusively on groundwater. As discussed above, the "barrier" effects of White Wolf Fault and Edison Fault also tend to cause higher groundwater levels on the upgradient sides, due to "backing up" of water. Groundwater gradients are steepest in the vicinity of the Edison Fault, although spatial water level data coverage in that area is limited.

**Depth to Groundwater**

As shown on Figure GWC-4, depth to groundwater for “current conditions” in Spring 2015 within the Arvin-Edison Management Area varies from 149 to 535 ft bgs. Most of the Arvin-Edison Management Area had depths to water of between 300 and 400 ft bgs, with relatively greater depths in the east-central area where the land surface rises, and lesser depths in the far southwest and far northeast. The shallowest depth to water, 149 ft bgs, was measured in a well near Caliente Creek, which may be indicative of recharge occurring in this area but may also be influence by barrier effects of the Edison Fault. Even for this shallowest measurement, the relatively deep depths to water in the principal aquifer system indicate that interconnected surface water and groundwater-dependent ecosystems are unlikely to occur in the Arvin-Edison Management Area. These topics are discussed further below in Section 8.7 Interconnected Surface Water Systems and Section 8.8 Groundwater Dependent Ecosystems, respectively.

**Long-Term Groundwater Elevation Trends**

- **23 CCR § 354.16(a)(2)**

Long-term trends in groundwater levels were evaluated based on examination of hydrographs for 14 wells throughout the Arvin-Edison Management Area. Wells were selected for hydrograph analysis based on the length of record, their distribution throughout the Arvin-Edison Management Area, and their representativeness of conditions in their area. Hydrographs were developed for two periods: a long-term period from 1945 through spring 2018 which captures the entire operational history of AEWSD through the most recent available data (Figure GWC-5), and the more recent period from 1994 through 2015 which is consistent with the KGA period of interest (Figure GWC-6). As shown on Figure GWC-5, for most wells in the northern, eastern, and southern portions the Arvin-Edison Management Area, groundwater levels have increased over the long-term, reflecting the increased storage resulting from the AEWSD’s importation of surface water starting in 1966. This trend is in contrast to the large rates of groundwater level decline (approximately 8 to 10 feet per year [ft/yr]) that were occurring prior to the surface water importation. Wells within the central and western areas show either long-term stability or a long-term decline (i.e., well 31S29E34A001M located near the City of Arvin). Wells located in close proximity to AEWSD’s spreading basins show larger fluctuations than other wells as a result of focused recharge and recovery pumping. The effects of drought cycles are also apparent, with greater declines during dry periods and recovery during wet periods. As shown on Figure GWC-6, over the more recent period from

---

41 It should be noted that 2015 was the fourth year of a significant drought which led to zero surface water allocations on the Friant Kern system, thereby putting greater than normal demands on the groundwater system.

42 Figure GWC-6 shows data from 1994 through the most recent available data which is either fall 2017 or spring 2018. For the purposes of water level trend calculation, only the data from 1994 through 2015 (i.e., the KGA period of interest) were used.
1994 to spring 2018, the same general behavior and spatial patterns are apparent, except that the long-term increase in water levels due to surface water importation is largely obscured.

To evaluate long-term water level trends, linear regression of the water level data was used (recognizing that this method can be slightly biased by the data’s temporal frequency and distribution). Based on hydrographs for 14 wells, over the period from 1966 (i.e., the start of surface water imports) through spring 2018, long-term water level trends range from increasing at up to 3.9 ft/yr to decreasing at up to 2.5 ft/yr. Of the 14 wells, six showed a decreasing trend over this time period and eight had an increasing trend. Over the period from 1994 through 2015 (i.e., the KGA period of interest), trends ranged from increases of 1.0 ft/yr to decreases of 4.1 ft/yr, with 12 wells decreasing and two wells increasing.

**Table GWC-1** below shows the DWR Water Year Hydrologic Classification Index for the San Joaquin Valley (i.e., water year type)\(^{43,44}\). Based on the DWR San Joaquin Valley Water Year Index for the 21 Water Years from 1995 through 2015, the period included five "critical" (dry) years (24%), four dry years (19%), two below normal years (10%), three above normal year (14%), and seven wet years (33%). The first third of this period was relatively wet, the middle third was a mix of wet and dry years, and the last third of the period was extremely dry. This climatic factor is reflected in the hydrographs which tend to exhibit water level increases in the 1990s, relative stability in the early 2000s, and then greater decreases starting in the late 2000s.

**Table GWC-1. Summary of DWR Water Year Types, 1995 - 2015**

<table>
<thead>
<tr>
<th>Water Year</th>
<th>WY Index</th>
<th>Water Year</th>
<th>WY Index</th>
<th>Water Year</th>
<th>WY Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>Wet</td>
<td>2002</td>
<td>Dry</td>
<td>2009</td>
<td>Below Normal</td>
</tr>
<tr>
<td>1996</td>
<td>Wet</td>
<td>2003</td>
<td>Below Normal</td>
<td>2010</td>
<td>Above Normal</td>
</tr>
<tr>
<td>1997</td>
<td>Wet</td>
<td>2004</td>
<td>Dry</td>
<td>2011</td>
<td>Wet</td>
</tr>
<tr>
<td>1998</td>
<td>Wet</td>
<td>2005</td>
<td>Wet</td>
<td>2012</td>
<td>Dry</td>
</tr>
<tr>
<td>1999</td>
<td>Above Normal</td>
<td>2006</td>
<td>Wet</td>
<td>2013</td>
<td>Critical</td>
</tr>
<tr>
<td>2001</td>
<td>Dry</td>
<td>2008</td>
<td>Critical</td>
<td>2015</td>
<td>Critical</td>
</tr>
</tbody>
</table>

\(^{43}\) [http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST](http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST)  
\(^{44}\) DWR defines a Water Year as extending from October 1 of the previous year to September 30 of the year in question. For example, Water Year 2005 extends from 1 October 2004 through 30 September 2005.
8.3. Change in Groundwater Storage

Change in groundwater storage was estimated based on data for selected periods of interest. The method used to estimate storage change for these periods used water level data collected at the start and end of each period, spatially-variable specific yield information, and the following relationship, applied in a distributed manner:

\[
\text{Change in Storage} = (\text{Ending Water Level} - \text{Starting Water Level}) \times \text{Specific Yield} \times \text{Area}
\]

Specifically, this approach was implemented by: (1) interpolating groundwater elevations for both years onto a 100-ft grid of pixels using the geostatistical spatial interpolation method known as kriging, (2) similarly interpolating the specific yield values from C2VSim-FG node data\(^{45}\), (3) calculating the water level difference at each pixel, (4) multiplying the water level difference from (3) by the specific yield at each pixel, (5) multiplying the result from (4) by the area of each pixel (i.e., 100 ft x 100 ft = 10,000 ft\(^2\)), and (5) summing all calculated values. To avoid errors caused by comparison of interpolated data that is based on different well points, a paired-well approach was used, wherein wells were selected for inclusion only if they were present in both datasets or if they were in close proximity (less than 1 mile) to a well in both datasets.

Table GWC-2, below, presents the results of this storage change estimation. As shown in Table GWC-2, the total change in storage from 1966 through 2017 (i.e., since the start of AEWSD water imports through the latest available data) was -20,420 AF or approximately -400 AFY. The total change in storage from 1994 through 2015 (i.e., the recent KGA period of interest) was -161,749 AF or approximately -7,702 AFY. To put this annual change in storage value into context, it represents approximately 5.7 percent of the average annual rate of groundwater pumping within the Arvin-Edison Management Area over that same period (approximately 144,000 AFY; discussed further below in Section 9.3.2 Historical Water Budget).

---

\(^{45}\) As discussed previously, specific yield values in the C2VSim-FG model used in this calculation may change upon completion of the model calibration by DWR.
Table GWC-2. Change in Storage for Selected Time Periods

<table>
<thead>
<tr>
<th>Period</th>
<th>Relevance of Time Period</th>
<th>Total Change in Storage (AF)</th>
<th>Annual Rate of Change in Storage (AFY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 1966 – Fall 2017</td>
<td>Entire period of AEWSD Operations</td>
<td>-20,420</td>
<td>-400</td>
</tr>
<tr>
<td>Spring 1994 – Spring 2015</td>
<td>KGA water budget period of interest</td>
<td>-161,749</td>
<td>-7,702</td>
</tr>
<tr>
<td>Spring 1994 – Spring 2007</td>
<td>Longer normal/wet period</td>
<td>359,216</td>
<td>27,632</td>
</tr>
<tr>
<td>Spring 2009 – Spring 2011</td>
<td>Shorter wet period</td>
<td>39,744</td>
<td>19,872</td>
</tr>
<tr>
<td>Spring 2007 – Spring 2015</td>
<td>Longer dry period</td>
<td>-560,197</td>
<td>-70,025</td>
</tr>
<tr>
<td>Spring 2014 – Spring 2015</td>
<td>Short dry period</td>
<td>-144,219</td>
<td>-142,219</td>
</tr>
</tbody>
</table>

Figure GWC-7 shows the distribution of storage change throughout the Arvin-Edison Management Area for the periods from Fall 1966 through Fall 2016 and Spring 1994 through Spring 2015. As shown on Figure GWC-7, since 1966 AEWSD’s importation of water has resulted in increases in groundwater storage since 1966 in the SWSA, but a loss in storage occurred outside of the SWSA (i.e., in the west-central portion of the Arvin-Edison Management Area). Over the recent period from 1994 through 2015, changes in groundwater storage have been variable, with increases in storage in the vicinity of AEWSD’s spreading basins, near zero storage change in the southwestern portion of the Management Area, and slight decreases in the remaining portion.

Determination of the change in storage on a yearly basis using the method described above is more difficult due to a lack of consistent water level monitoring data. To address this issue, annual change in storage estimates were extracted from the output of the water budget model, described further in Section 9 Water Budget Information below. A graph of estimated annual change in storage between seasonal water level highs (i.e., from March of each year to March of the following year), is presented on Figure GWC-8. Also shown on Figure GWC-8 is the Water Year type based on DWR’s San Joaquin Valley Water Year Index.

As shown on Figure GWC-8, annual change in storage within the Arvin-Edison Management Area ranged from an increase of 155,000 AF for the period from March 2010 – February 2014. The period from Fall 2017 through early 2019 was wetter than normal, and AEWSD was able to add a total (net) of 13,000 AF to banked storage in 2018 and anticipates a total (net) addition of approximately 90,000 AF in 2019.

The seasonal high groundwater condition occurs typically in late winter or spring and for the purposes of Figure GWC-8 is assumed to occur in March. March groundwater levels are affected by both the amount of pumping during the prior summer (i.e., previous DWR Water Year) as well as the amount of precipitation during the winter months of the current DWR Water Year. In Figure GWC-8, the color of each bar is based on the Water Year type for the year the begins in the October between the March and February represented by the bar.

---

46 The period from Fall 2017 through early 2019 was wetter than normal, and AEWSD was able to add a total (net) of 13,000 AF to banked storage in 2018 and anticipates a total (net) addition of approximately 90,000 AF in 2019.
47 The seasonal high groundwater condition occurs typically in late winter or spring and for the purposes of Figure GWC-8 is assumed to occur in March. March groundwater levels are affected by both the amount of pumping during the prior summer (i.e., previous DWR Water Year) as well as the amount of precipitation during the winter months of the current DWR Water Year. In Figure GWC-8, the color of each bar is based on the Water Year type for the year the begins in the October between the March and February represented by the bar.
2011 to a decrease of 185,000 AF for the period between March 2013 and February 2014. Change in storage tends to be more negative during dry Water Years and more positive during wet Water Years. Change in groundwater storage is discussed further below in Section 9.3.2 Historical Water Budget.

8.4. Seawater Intrusion

Because the Arvin-Edison Management Area is located far from coastal areas, seawater intrusion is not considered to be an issue.

8.5. Groundwater Quality

8.5.1. Groundwater Quality Constituents of Concern

Groundwater quality constituents that may affect the supply and beneficial uses of groundwater in the Arvin-Edison Management Area were identified by comparing measured concentrations detected during a 2016 District-wide sampling event to applicable screening levels for the various beneficial uses (i.e., Maximum Contaminant Levels [MCLs] for domestic/M&I use and various thresholds for irrigated agricultural use). Constituents for which at least 20 percent of samples exceeded the applicable screening level include nitrate, arsenic, TDS, boron, iron, and manganese, as discussed below.

- Nitrate was detected above the primary MCL\(^{48}\) of 10 mg/L (as N) in 160 (32%) of 497 samples collected in 2016. Higher concentrations were measured in locations along the western edge of the northern half of the Arvin-Edison Management Area, as well as in the southern portion both north and south of the White Wolf Fault (Figure GWC-9). Relative to 1966, nitrate concentrations have increased in most portions of the Management Area except in the vicinity of the spreading basins and in the northern part of the SWSA. The southern half of the Arvin-Edison Management Area had some of the most significant increases. Increasing nitrate concentrations are likely a legacy of historical intensive use of fertilizers on overlying agricultural lands. Addressing impacts from nitrate is one of the focuses of the Irrigated Lands Regulatory Program, with which AEWSD is directly involved as part of the Kern River Watershed Coalition Authority.

- Arsenic above the primary MCL of 10 micrograms per liter (ug/L) in 152 (31%) of 497 samples collected in 2016, with most MCL exceedances in the northern half of the Arvin-Edison Management Area (Figure GWC-10). Arsenic concentration varies over short distances, with values above the MCL in close proximity to “non-detect” values. Arsenic is naturally-occurring in this area, derived from the granitic source rocks whose eroded sediments comprise the alluvial KRF (Thiros, 2010). The highest concentrations, ranging from 100 to 1,200 ug/L occur in the far northern portion of AEWS (Township 30S Range 29E). The Regional Board has issued a compliance order to ACSD requiring the municipal water supplier to address arsenic contamination in its older wells above the MCL. ACSD is implementing an Arsenic Mitigation Program to replace the older wells with new wells that are to be drilled in areas believed to be less impacted by arsenic. Other ACSD efforts to

---

\(^{48}\) Primary MCLs are drinking water standards set by the USEPA and California Environmental Protection and Agency (CalEPA) based on human health considerations.
address arsenic include providing customers access to arsenic-free water from filling stations at selected locations, funded by a grant from DWR. The Community Water Center has also helped install 50 at-the-tap arsenic treatment systems using funds from a separate State Water Board grant (ACSD, 2016).

- TDS was detected above the recommended secondary MCL\(^{49}\) of 500 mg/L in 253 (51%) of 497 samples collected in 2016 and was present in most areas of the Arvin-Edison Management Area except the central portion (**Figure GWC-11**). TDS exceeded the upper secondary MCL of 1,000 mg/L in 55 (11%) of 2016 samples, primarily in the far northwest and far southwest of the Arvin-Edison Management Area. **Figure GWC-12** shows the change in TDS concentrations from 1966 through 2016. This water quality constituent is one of the more commonly measured parameters, and thus has a relatively complete dataset that enables evaluation of changes in water quality over time. As shown on **Figure GWC-12**, TDS concentrations between 1966 and 2016 showed variable amounts of change in both direction (i.e., increase or decrease) and magnitude. TDS concentrations showed relatively consistent pattern of significant increase in the northwestern portion of the Management Area and in some parts of the southern half of the area, whereas in much of AEWSD the changes were small and variable in direction. Decreases in TDS concentrations occurred in the vicinity of AEWSD’s spreading basin facilities and in the SWSA, especially in the northern half of the Management Area.

- Boron is detected at levels that may restrict a water’s use for irrigation (i.e., above 700 ug/L; Ayers and Westcot, 1985) in small areas in the central part of the northern half of the Arvin-Edison Management Area (**Figure GWC-13**). Boron was also cited as the cause of a base of fresh water determination for certain pools (Jeppi, Main Area) within the Edison oil field (DOGGR, 1988).

- Both iron and manganese exceeded their respective secondary MCLs (300 ug/L and 50 ug/L, respectively) in some locations. Iron exceeded its secondary MCL in 95 (19%) of 496 samples in 2016, and manganese exceeded its secondary MCL in 64 (13%) of 496 samples. Though these naturally-occurring constituents can impair the aesthetic quality of drinking water and at high enough concentrations can result in staining of fixtures or clothes washed therein, they are not likely to significantly affect beneficial uses of groundwater.

The AEWSD-wide 2016 sampling event, and other less comprehensive sampling events conducted by or for AEWSD in earlier years, included primarily inorganic constituents such as major ions and metals, but did not include volatile organic compounds (VOCs) or semi-volatile organic compounds (SVOCs). These constituents are typically not a concern for agricultural beneficial uses, but some are harmful to humans if consumed at high enough concentrations (often at parts per million or parts per billion concentrations) and are thus regulated by the California EPA (specifically the SWRCB) in drinking water sources. Some of these compounds are, or have been historically, used in agriculture as pesticides, herbicides, fungicides, and can be transported to groundwater by deep percolation of excess applied water, although this is more of a concern for the older “legacy” chemicals and less so for the current generation of chemicals that are designed to avoid deep percolation. One compound in particular, 1,2,3-trichloropropane (1,2,3-TCP),

---

\(^{49}\) Secondary MCLs are non-health related standards set by the State Water Resources Control Board based on aesthetic characteristics of drinking water such as taste, odor, and color. For four common constituents – TDS, specific conductance, chloride and sulfate – the SWRCB sets three levels of secondary MCLs for consumer acceptance, referred to as (lowest to highest concentration): “recommended”, “upper”, and “short term”. 
which is an industrial solvent that was also historically a component in a soil fumigant, was recognized in 2006 as a “constituent of special interest” in Kern County (Shelton et al., 2006), and was recently assigned a (primary) MCL of 0.005 ug/L (five parts per trillion) by the California EPA\(^\text{50}\), effective 14 December 2017. Data from the USGS Groundwater Ambient Monitoring and Assessment (GAMA) program (Shelton et al., 2006) indicate that 1,2,3-TCP was detected in 2006 in one location in the Arvin-Edison Management Area at a concentration of 0.40 ug/L, 80 times the MCL.

Historical water quality sampling data are limited both in spatial extent and temporal frequency within the Arvin-Edison Management Area, thus making any statistical analysis of water quality trends and their potential nexus to groundwater elevations difficult. The most regularly monitored constituents of concern within AEWSD include TDS, arsenic, and nitrate. For these constituents, time-series water quality data were plotted relative to groundwater level measurements for wells with at least ten historical water quality (for TDS and nitrate) and groundwater level records and for the five ACSD wells with available arsenic data\(^\text{51}\) (see Appendix H). For each constituent, there was no discernable relationship between groundwater levels and groundwater quality trends that could be consistently identified. Thus, additional data collection and analysis will be needed to further evaluate this potential relationship.

More generally, additional efforts to compile and characterize water quality data from additional data sources will continue as part of Plan Implementation. Appendix I includes a list and description of potential water quality datasets that may be analyzed to further assess groundwater quality conditions in the Arvin-Edison Management Area, including, for example, the CalEPA’s Regulated Site Portal, Cortese List, GeoTracker, Drinking Water Watch, GAMA-PBP, California Pesticide Information Portal, USEPA’s National Priorities List, and DOGGR’s CalStim’D and WellFinder datasets.

8.5.2. Groundwater Quality within the ACSD Well Network

The ACSD experience with water quality in the area to the south of the City of Arvin has shown that water quality for domestic purposes varies from wellsite to wellsite. Water quality sampling data from municipal supply wells in ACSD show that there are contaminants that exist in the upper level of the aquifer (e.g., nematicides), as well as state-regulated contaminants that exist primarily at deeper levels in the aquifer (e.g., arsenic), although there exist traces of both of these contaminants at mid-levels as well. In general, arsenic levels increase with depth, and nitrates and VOCs are present in the upper levels of the aquifer. Generally, domestic water quality improves with depth until arsenic is encountered. This is not a hard-and-fast rule, as exceptions occur where a contaminant normally found at depth (around 1,000 ft bgs) may be detected at higher elevations. Presently, water meeting state-mandated water quality standards can be produced only after test wells have been drilled to identify strata that contain these contaminants.

It has also been observed that water levels can influence produced water quality, offering a mix of upper and lower waters that varies with the water levels and thereby influencing the blend that is produced by the well. ACSD’s experience indicates that lowering water levels will generally reduce water quality within their well network, and it is suspected that there is a threshold below which certain contaminants will dominate the water quality. However, this threshold is likely to vary from well-to-well, and no direct correlation can be discerned between water levels and trends in Arsenic concentrations within the ACSD well network or elsewhere within the Management Area at this time (see Appendix H). Water quality in ACSD’s two new wells indicates that greater production from the deeper zones increases arsenic levels. It

---


\(^{51}\) Arsenic data for ACSD wells obtained from [https://sdwis.waterboards.ca.gov/PDWW/](https://sdwis.waterboards.ca.gov/PDWW/), accessed 17 July 2019.
has been observed that drawing water from both the shallower and deeper production zones creates a mixture that will meet water quality standards. This can go both ways, improving the blend of deeper contaminants by introduction of shallower water, but risking the introduction of the shallower contaminants that can increase the levels of these contaminants in the blend to unacceptable levels for domestic uses. For example, even a trace of certain contaminants such as 1,2,3-TCP will cause a violation of water quality standards and require treatment. Therefore, great care is taken in the preliminary wellsite evaluation process to determine the aquifer water quality at each prospective site.

8.5.3. **Point-Source Contamination Sites**

In addition to the relatively widespread non-point source groundwater quality constituents of concern, there are a small number of point-source contamination sites that historically or currently affect shallow (possibly perched) groundwater within the Arvin-Edison Management Area. These sites, shown on Figure GWC-14, are typically associated with certain industrial or commercial land uses (e.g., gas stations).

As shown on Figure GWC-14, there are a total of four active Cleanup Program sites and one active Leaking Underground Storage Tank (LUST) Cleanup sites within the Arvin-Edison Management Area. The LUST Cleanup site and two of the Cleanup Program sites are being managed under the oversight of the Central Valley Regional Water Quality Control Board (CVRWQCB). One Cleanup Program site is under the oversight of the California Department of Toxic Substances Control (DTSC) and another Cleanup Program site is a Superfund site under the oversight of the United States Environmental Protection Agency (USEPA). Both LUST Cleanup sites and one of the Cleanup Program sites have gasoline, diesel, or Benzene/Toluene/Ethylbenzene/Xylenes listed as potential contaminants of concern. The other three Cleanup Program sites have agricultural chemicals (i.e., insecticides, herbicides, pesticides, and/or fumigants) listed as potential contaminants of concern. Three of the Cleanup Program sites and one of the LUST Cleanup sites are under remediation, the other Cleanup Program site is listed as being in the site assessment phase, and the other LUST Cleanup site is listed as open, eligible for closure. In addition to the active/open sites discussed above, there are approximately 25 closed LUST Cleanup sites and three closed Cleanup Program sites within the Arvin-Edison Management Area, most of which are located in the more urbanized areas near the cities of Bakersfield and Arvin, and in or around the Interstate 5/Highway 99 corridor. Table GWC-3 below summarizes these six active sites within the Arvin-Edison Management Area.

---

52 ACSD has installed Emergency 1,2,3-TCP treatment at one of its production wells (Well 13). See Section 17.2.3 Projects to Improve Drinking Water Quality in ACSD Service Area for further details.
<table>
<thead>
<tr>
<th>Site ID (see Figure GWC-14)</th>
<th>Site Name</th>
<th>Site Type</th>
<th>Regulatory Oversight Agency</th>
<th>Potential Contaminants of Concern</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J. R. Simplot - Edison</td>
<td>Cleanup Program Site</td>
<td>DTSC</td>
<td>DBCP, fertilizer, pesticides, herbicides</td>
<td>Open, remediation</td>
</tr>
<tr>
<td>2</td>
<td>Ribier Market</td>
<td>LUST Cleanup Site</td>
<td>CVRWQCB</td>
<td>gasoline</td>
<td>Open, remediation</td>
</tr>
<tr>
<td>3</td>
<td>Brown &amp; Bryant - Arvin</td>
<td>Cleanup Program Site</td>
<td>USEPA</td>
<td>Pesticides, herbicides</td>
<td>Open, remediation</td>
</tr>
<tr>
<td>4</td>
<td>J &amp; J Crop Dusters</td>
<td>Cleanup Program Site</td>
<td>CVRWQCB</td>
<td>Toxaphene, other insecticides, pesticides, fumigants, herbicides</td>
<td>Open, site assessment</td>
</tr>
</tbody>
</table>

8.5.4. **Oil Field Injection Wells and Produced Water Ponds**

As described in Section 7.1.3 Bottom of the Basin, there are two oil fields in the vicinity of the Arvin-Edison Management Area – the Edison Oil Field and the Mountain View Oil Field. Figure GWC-15 shows the locations of active underground injection wells and produced water ponds used for oil field operations in these areas. A large majority of the injection wells within these oil fields are located outside the Arvin-Edison Management Area boundaries in the northernmost portion of the Edison Oil Field. Produced water ponds are scattered throughout both oil fields, most of which are inactive. In total there are 35 active injection wells and 9 active produced water ponds within the Arvin-Edison Management Area boundaries.

Underground injection wells used to dispose of wastewater from oil and gas development are regulated in California by the USEPA, DOGGR, and SWRCB (see California Health and Safety Code § 25159.10 et seq). As described in Section 7.1.3 Bottom of the Basin, injection wells within the Edison Oil Field inject wastewater into the deeper Vedder, Pyramid Hills Sands, Main Wicker Sands, Transition/Santa Margarita, and Chanac formations which are classified as “Exempted Aquifers” per the SWRCB “final concurrence” letters dated 19 October 2018 and 4 February 2019. Produced water discharges to ponds within the Arvin-Edison Management Area are under the purview of SWRCB and CVRWQCB regulatory oversight and are subject to regulation under individual and general Waste Discharge Requirements (WDRs) amongst other requirements to ensure adequate protection against impacts to underlying groundwater resources. Pursuant to SB 4 (2013), the SWRCB established a Regional Groundwater Monitoring Program[^53] to assess the potential effects on groundwater resources of well stimulation activities in oil and gas producing areas.

The Regional Monitoring Program has been implemented through cooperative efforts between the SWRCB and the USGS, including collection of groundwater quality samples in selected wells in proximity to oil fields within the Kern Subbasin (Dillon et al., 2017).

8.6. Land Subsidence

The Kern Subbasin has a documented history of subsidence, including historical and recent subsidence in the southern portion of the subbasin, south of the Kern River, which is within the Arvin-Edison Management Area (Lofgren, 1975; DWR, 2014). Subsidence in this area is caused primarily due to withdrawal of groundwater, with some areas in the Wheeler Ridge area also affected by hydro-compaction (Lofgren, 1975). Subsidence due to oil and gas production has also occurred in some areas but is secondary in importance. Figure GWC-16 depicts maps of historical (1949-2005) and recent (2015-2016) subsidence which are discussed below. The KGA Umbrella provides additional information on subsidence throughout the Kern Subbasin and over time, and with particular reference to critical delivery system infrastructure such as the California Aqueduct and the Friant-Kern Canal.54

Historical Subsidence

During the mid-20th century, when groundwater levels were declining rapidly before the importation of surface water supplies by AEWSD and others began, subsidence was widespread throughout the area, with the greatest amounts – over nine feet between 1926 and 1970 – occurring just south of Kern Lake Bed northwest of Mettler (Lofgren, 1975). Subsidence amounts tended to decrease in all directions from this central “hot spot”. The area just to the east of the City of Arvin also experienced somewhat greater subsidence than surrounding areas. This area of historical subsidence generally coincides with the presence of the regional “E”-Clay aquitard, which is also presumably an area that includes a greater proportion of other unnamed fine-grained compactible materials.

Between 1957 and 1965, the estimated rate of subsidence as a function of groundwater level decline ranged from approximately 0.01 to 0.03 feet of subsidence per foot of head decline in the Arvin-Edison Management Area (Lofgren, 1975).

Extending the historical record further into recent times, DWR has mapped subsidence in this portion of the Kern Subbasin between 1949 and 2005. Most areas within the Arvin-Edison Management Area are shown in this dataset as having subsidence over that period of between 0 and five feet and some areas in the western and southern portions having subsidence between five and 10 feet (see Figure GWC-16).

Recent Subsidence

Subsidence due to water level decline has continued in recent times of groundwater level decline associated with dry climatic conditions; between May 2015 and September 2016 most areas within the Arvin-Edison Management Area experienced between one and four inches of subsidence, with some areas between four and eight inches (see Figure GWC-16; based on Farr et al., 2016) The continued recent subsidence, occurring at a time when groundwater levels are not necessarily below their historic minima, demonstrates that subsidence can continue to occur even after water levels are partially recovered.

54 AEWSD relies heavily on the Friant-Kern Canal for its imported surface water supplies (see Section 9.2.1 Surface Water Inflows and Outflows).
through a lag mechanism resulting from the continued slow depressurization of compactible fine-grained materials (Lofgren, 1975). Also, as discussed further in Section 13 Undesirable Results, the localized areas of increased subsidence in the near-vicinity of AEWSD’s groundwater recharge and extraction facilities (and the well-documented impacts on subsidence on the Friant-Kern Canal) highlights the potential impacts of subsidence on critical infrastructure.

The above-mentioned regional maps of subsidence have been developed based on leveling surveys and synthetic aperture radar (SAR) techniques, and there are few continuous subsidence monitoring sites in the area. One such site [ARM1 (Arvin_Main1SCIGN) NAM08] is located approximately four miles west of the City of Arvin in the Arvin Maintenance Yard, which is outside the Arvin-Edison Management Area (see Figure GWC-17). Data from this continuous GPS monitoring station shows a decline in ground surface elevation of approximately 16 inches from 2000 through early 2018.

8.7. Interconnected Surface Water Systems

As discussed above, groundwater levels in the principal aquifer are far below the ground surface within the Arvin-Edison Management Area (i.e., depths to groundwater generally exceed 150 feet below ground surface), including at wells in close proximity to the natural surface water features within the Management Area (see Figure GWC-4, Figure GWC-18-19). Therefore, it is assumed there are no interconnected surface water systems within the Management Area. As such depletion of interconnected surface water is not considered to be an issue in this area.

8.8. Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are those natural communities that depend on near-surface groundwater as a source of water. Guidance for identification of GDEs developed by The Nature Conservancy (TNC) states that groundwater depths less than 30 feet below ground surface are “generally accepted as being a proxy” for confirming that potential GDEs are actually supported by groundwater (TNC, 2019)55. As discussed above, depths to groundwater in the principal aquifer are several hundred feet below ground surface, and it is therefore highly unlikely that any ecosystems depend on groundwater from this aquifer system.

DWR has developed a map of “Natural Communities Commonly Associated with Groundwater” (NCCAG) for use by GSAs in identifying potential GDEs. Figure GWC-18 and Figure GWC-19 show the distribution of NCCAG within the Arvin-Edison Management Area. As shown on Figure GWC-18 and Figure GWC-19, the primary area where NCCAG were identified is along Caliente Creek where it enters AEWSD from the east. Depth to groundwater at the nearest monitoring well (30S30E20D001M, located ~1,000 ft from the creek bed) is measured at 150 ft bgs as of Spring 2015. This serves to indicate that the vegetation communities surrounding Caliente Creek (i.e., mostly areas of scalebroom, with much smaller areas of quailbush and tamarisk) are likely not dependent on groundwater from the principal aquifer system, but rather may derive necessary moisture from relatively shallow, wet, water-retentive soils disconnected from and far

above the principal aquifer. Other potential GDE features identified by the NCCAG within the central portions of the Arvin-Edison Management Area are vegetation communities that generally line this District’s canal and spreading basin infrastructure, artificial reservoirs, ditches, or other small open water bodies. Based on groundwater level data collected from surrounding monitoring wells, depth to water is generally encountered below 300 ft bgs in these areas, indicating that these vegetation communities are not connected to the principal aquifer system and are therefore not considered to be GDEs. This judgment is consistent with the guidance developed by The Nature Conservancy (TNC, 2019).
Groundwater Elevations - Spring 2015

Arvin-Edison Water Storage District
Kern County, California
December 2019

Legend
- Arvin-Edison Water Storage District
- Spring 2015 Groundwater Elevation (50 ft interval)

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Spring 2015 Groundwater Elevation (ft msl)
- <0
- 0 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- >250

Abbreviations
DWR = California Department of Water Resources
ft = feet
ft msl = feet above mean sea level

Notes
1. All locations are approximate.
2. Groundwater elevation contours are based on kriged data and are less certain in areas with sparse data.

Sources
1. Basemap is ESRI’s ArcGIS Online world topographic map, obtained 22 November 2019.
2. Water level data provided by Arvin-Edison Water Storage District, Kern Delta Water District, and Wheeler Ridge-Maricopa Water Storage District.
Abbriviations

DWR = California Department of Water Resources
ft = feet
ft msl = feet above mean sea level

Notes

1. All locations are approximate.
2. Groundwater elevation contours are based on kriged data and are less certain in areas with sparse data.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Water level data provided by Arvin-Edison Water Storage District, Kern Delta Water District, and Wheeler Ridge-Maricopa Water Storage District.
Kern County, California
December 2019
B60064.01
Figure GWC-3
Arvin-Edison Water Storage District

Legend

Arvin-Edison Water Storage District

Groundwater Subbasin

Kern County (DWR 5-022.14)

White Wolf (DWR 5-022.18)

AEWSD Unit (SWSA)

Arvin

Caliente

Edison

Mettler

Tejon

White Wolf

Abbreviations

AEWSD = Arvin-Edison Water Storage District
SWSA = Surface Water Service Area

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world
   topographic map, obtained 22 November 2019.
2. AEWSD units and facility locations obtained from
   AEWSD on 3 March 2017.
Abbreviations

DWR = California Department of Water Resources

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Water level data provided by Arvin-Edison Water Storage District, Kern Delta Water District, and Wheeler Ridge-Maricopa Water Storage District.
Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
ft bgs = feet below ground surface
ft msl = feet above mean sea level

Notes
1. All locations are approximate.
2. Hydrographs show the reference point elevation in solid orange line. Water levels from 1994 through 2004 are based on “spring” and “fall” measurements, assumed to occur on April 1 and October 1 of each year, respectively.
3. Water levels that showed a rate of change between consecutive measurements greater than 50 ft in 60 days, or a significant change without a reasonable hydrological explanation, were removed from the hydrographs.
4. Hydrograph trendlines are based on linear regression and only consider data since 1966 (i.e., since AEWSD began importing surface water).

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Water level information obtained from AEWSD on 30 November 2017.
Abbreviations

- AEWSD = Arvin-Edison Water Storage District
- DWR = California Department of Water Resources
- ft bgs = feet below ground surface
- ft msl = feet above mean sea level
- KGA = Kern Groundwater Authority

Notes
1. All locations are approximate.
2. Hydrographs show the reference point elevation in solid orange line. Water levels from 1994 through 2004 are based on "spring" and "fall" measurements, assumed to occur on April 1 and October 1 of each year, respectively.
3. Water levels that showed a rate of change, between consecutive measurements points, greater than 50 ft in 60 days, or a significant change without a reasonable hydrological explanation, were removed.
4. Trendlines were based on linear regression and were calculated for the period 1994-2015, (i.e., the KGA period of interest).

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Water level information obtained from AEWSD on 30 November 2017.
Groundwater Storage Change (1966-2016)

Estimated Well Depth: 201-300 feet
42 Well Records

Estimated Well Depth: >300 feet
35 Well Records

Abbreviations
AEWSD = Arvin-Edison Water Storage District
C2VSim-FG = California Central Valley Groundwater-Surface Water Simulation Model-Fine Grid
DWR = California Department of Water Resources
ft = feet

Notes
1. All locations are approximate.
2. Groundwater storage change shown as feet change in each 100 ft by 100 ft cell. Groundwater elevation data and C2VSim-FG Layer-1 specific yield data were interpolated using kriging, and the difference in groundwater elevation was multiplied by specific yield to calculate groundwater storage change.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Groundwater elevation data provided by AEWSD staff.

Groundwater Storage Change (1994-2015)

Groundwater Storage Change (acre-feet/acre)
High: 15
Low: -12

Kern County, California
Arvin-Edison Water Storage District

Groundwater Subbasin
Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure GWC-7
Legend

DWR Water Year Type
- = Wet
- = Above Normal
- = Below Normal
- = Dry
- = Critical

Abbreviations
AFY = acre-feet per year

Notes
1. “Seasonal high” condition is defined as March – February of the following year.
3. The color of each bar is based on the Water Year type for the Water Year that begins in the October between the March and February represented by the bar.
Groundwater Quality - Nitrate (as NO3) Concentrations (2016)

Arvin-Edison Water Storage District
Kern County, California
December 2019

B60064.01

Figure GWC-9

Legend
Arvin-Edison Water Storage District
Groundwater Subbasin
Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Nitrate (as NO3) Concentration (mg/L)
ND (< 0.1)
0.1 - 10
10 - 30
30 - 45
> 45

Abbreviations
AEWSD = Arvin-Edison Water Storage District
CCR = California Code of Regulations
DWR = California Department of Water Resources
MCL = Maximum Contaminant Level
mg/L = milligrams per Liter
ND = Not Detected
NO3 = Nitrate

Notes
1. All locations are approximate.
2. CCR 22-4 Table 64431-A lists the Primary MCL for Nitrate (as NO3) as 45 mg/L.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. In-District water quality data obtained from AEWSD on 30 September 2017.

Notes
1. All locations are approximate.
2. CCR 22-4 Table 64431-A lists the Primary MCL for Nitrate (as NO3) as 45 mg/L.
Groundwater Quality - Arsenic Concentrations (2016)

Arvin-Edison Water Storage District
Kern County, California
December 2019

Figure GWC-10

Legend

Arvin-Edison Water Storage District
Groundwater Subbasin

Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Total Recoverable Arsenic Concentration (ug/L)

- ND (< 7.8)
- 7.8 - 10
- > 10

Abbreviations

AEWSD = Arvin-Edison Water Storage District
CCR = California Code of Regulations
DWR = California Department of Water Resources
GAMA = Groundwater Ambient Monitoring Program
MCL = Maximum Contaminant Level
PLSS = Public Land Survey System
ug/L = micrograms per liter
ND = Not Detected

Notes

1. All locations are approximate.
2. For a given well, reported water quality values represent the latest sample collected during the 2016 calendar year.
3. Circular wells indicate water quality data provided by AEWSD. Square wells indicate water quality data retrieved from GAMA.
4. GAMA data lack actual coordinates and are therefore plotted according to PLSS section, resulting in overlap of symbols. In these cases, the symbol shown represents the maximum concentration of all co-located points.
5. Arsenic measurements obtained using EPA-200.7 method, with a detection limit of 7.8 ug/L.
6. CCR 22-4 Table 64431-A lists the Primary MCL for Arsenic as 10 ug/L.

Sources

1. Basemap is ESRI’s ArcGIS Online world topographic map, obtained 22 November 2019.
2. In-District water quality data obtained from AEWSD on 3 April 2017; out-of-District water quality data obtained from GAMA database on 14 April 2017.

Total Recoverable Arsenic Concentration (ug/L)

- ND (< 7.8)
- 7.8 - 10
- > 10
Figure GWC-11

Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01

Groundwater Quality - Total Dissolved Solids Concentrations (2016)

Abbreviations
AEWSD = Arvin-Edison Water Storage District
CCR = California Code of Regulations
DWR = California Department of Water Resources
MCL = Maximum Contaminant Level
mg/L = milligrams per liter
TDS = Total Dissolved Solids

Notes
1. All locations are approximate.
2. For a given well, reported water quality values represent the latest sample collected during the calendar year.
3. TDS measurements obtained using EPA-160.1 method, with a detection limit of 33 mg/L.
4. CCR 22-4 Table 84449-B lists the "Upper" Secondary MCL for TDS as 1,000 mg/L.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. In-District water quality data obtained from AEWSD on 3 April 2017.

Legend
Arvin-Edison Water Storage District
Groundwater Subbasin
Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Total Dissolved Solids Concentration (mg/L)

- 0 - 200
- 200 - 500
- 500 - 1,000
- > 1,000

Notes
1. All locations are approximate.
2. For a given well, reported water quality values represent the latest sample collected during the calendar year.
3. TDS measurements obtained using EPA-160.1 method, with a detection limit of 33 mg/L.
4. CCR 22-4 Table 84449-B lists the "Upper" Secondary MCL for TDS as 1,000 mg/L.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. In-District water quality data obtained from AEWSD on 3 April 2017.
Groundwater Quality - Change in Total Dissolved Solids
(1966 - 2016)
Arvin-Edison Water Storage District
Kern County, California
December 2019

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. In-District water quality data obtained from AEWSD on 30 September 2017.
Figure GWC-13

Arvin-Edison Water Storage District
Kern County, California
December 2019

Legend

Arvin-Edison Water Storage District
Groundwater Subbasin
Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Notes
1. All locations are approximate.
2. For a given well, reported water quality values represent the latest sample collected during the 2016 calendar year.
3. Circular wells indicate water quality data provided by AEWSD. Square wells indicate water quality data retrieved from GAMA. In these cases, the symbol shown represents the maximum concentration of all co-located points.
5. Boron measurements obtained using EPA-200.7 method, with a detection limit of 10 ug/L.
6. Boron levels >700-2000 ug/L can exhibit slight to moderate restrictions on agricultural productivity, depending on crop type.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. In-District water quality data obtained from AEWSD on 3 April 2017; out-of-District water quality data obtained from GAMA database on 14 April 2017.

Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
GAMA = Groundwater Ambient Monitoring Program
PLSS = Public Land Survey System
ug/L = micrograms per liter
Legend

Arvin-Edison Water Storage District
Groundwater Subbasin

Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

GeoTracker Sites
- Cleanup Program Site, Open
- Cleanup Program Site, Closed
- LUST Cleanup Site, Open
- LUST Cleanup Site, Closed

Abbreviations
- DWR = California Department of Water Resources
- LUST = Leaking Underground Storage Tank
- SWRCB = State Water Resources Control Board

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
3. Active sites denoted with a number (1-5) are further described in Table GWC-3 of the GSP chapter text.
Locations of Oil Fields, Active Injection Wells, and Produced Water Ponds

Legend
- Arvin-Edison Water Storage District
- Groundwater Subbasin
  - Kern County (DWR 5-022.14)
  - White Wolf (DWR 5-022.18)
  - DOGGR Oil & Gas Fields
- Produced Water Ponds
  - Active
  - Inactive
- Injection Well Type (see Note 2)
  - INJ
  - Multi
  - SC
  - SF

Abbreviations
AEWSD = Arvin-Edison Water Storage District
DOGGR = Division of Oil, Gas, and Geothermal Resources
DWR = California Department of Water Resources

Notes
1. All locations are approximate.
2. Wells shown are listed as "Active" and include injection (INJ), Cyclic Steam (SC), Steam Flood (SF), and Multi (injection and production).

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DOGGR well data obtained 4 June 2019.
Legend

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Change in Ground Surface Elevation (inches) (May 2015 - September 2016)
- No data
- >12 to >8
- 8 to >4
- 4 to >1
- 1 to 1
- California Aqueduct
- Highway

Change in Ground Surface Elevation (feet) (1949 - 2005)
- -30 to -25
- -25 to -20
- -20 to -15
- -15 to -10
- -10 to -5
- -5 to 0
- California Aqueduct
- Highway

Abbreviations
DWR = California Department of Water Resources

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DWR groundwater basins are based on the boundaries defined in California’s Groundwater, Bulletin 118 - 2016 Update.
4. Historical subsidence data is from DWR’s Estimated Subsidence in the San Joaquin Valley between 1949-2005.
Abbreviations
DWR = California Department of Water Resources
SGMA = Sustainable Groundwater Management Act

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Data downloaded from SGMA Data Viewer on 6/28/2018
**Natural Communities Commonly Associated with Groundwater (DWR)**

**Kern County, California**

B60064.01

Figure GWC-18

Arvin-Edison Water Storage District

0 4 8 (Scale in Miles)

- Depth to water (DTW)
- California Department of Water Resources (DWR)
- feet below ground surface (ft bgs)
- Groundwater Dependent Ecosystem (GDE)
- Natural Communities Commonly Associated with Groundwater (NCCAG)

Notes:

1. All locations are approximate.

Sources:

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. DWR NCCAG dataset was obtained from NC Dataset Viewer (https://gis.water.ca.gov/app/NCDatasetViewer/)

**Legend**

- Arvin-Edison Water Storage District
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)
- NCCAG Vegetation
- NCCAG Wetland
- Removed NCCAG Vegetation or Wetland
- Natural Stream/River

**Spring 2015 Depth to Groundwater (ft bgs)**

- <100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- >500

**Abbreviations**

DTW = Depth to water
DWR = California Department of Water Resources
ft bgs = feet below ground surface
GDE = Groundwater Dependent Ecosystem
NCCAG = Natural Communities Commonly Associated with Groundwater
Natural Communities Commonly Associated with Groundwater (DWR) - Caliente Creek

Kern County, California
December 2019

Figure GWC-19

Arvin-Edison Water Storage District

Quailbush
Scalebroom

Legend

- Natural Stream/ River
- Removed NCCAG Vegetation or Wetland

Groundwater Subbasin

- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Spring 2015 Depth to Groundwater (feet)

- <100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- >500

Notes

1. All locations are approximate.

Sources

1. DWR NCCAG dataset was obtained from NC Dataset Viewer (https://gis.water.ca.gov/app/NCDatasetViewer/)
2. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
9. WATER BUDGET INFORMATION

All GSAs in the Kern County subbasin (Subbasin) coordinated and collaborated on the development of a groundwater model (Model) to evaluate historical, baseline and projected groundwater conditions. The GSAs entered into a Cost Share Agreement with the Kern River GSA who took the lead and contracted with Todd Groundwater to develop the Model on behalf of the Subbasin. The contract required that Todd Groundwater use the C2VSim model provided by DWR. Considerable effort and resources were expended to update the C2VSim model with local data to better represent Subbasin conditions. The process Todd Groundwater used to update C2VSim is more fully described in the Historical and Projected Future Water Budget Development (see Attachment H in Umbrella GSP). Basin-wide water budget results from the Model are provided in Attachment H and show the Subbasin, as a whole, has a total storage deficit of approximately 324,326 acre-feet per year (AFY) over the baseline period.

The Subbasin’s dynamic conjunctive use programs, water banking operations, and water transfers/exchanges made it necessary to coordinate a GSA level water accounting system (Checkbook) using Subbasin specific values for supply, demand and net results. The Model results reflect Subbasin-wide conditions and do not allocate water shortages/surpluses, nor do the results allocate the “ownership” of water. As a result, the GSAs, through a coordinated effort, developed the Checkbook that estimates current conditions for each GSA that are generally consistent with the Model results under baseline condition. The Checkbook and Model budgets are based upon best available information, recognizing however, each estimate includes data gaps and has varying degrees of accuracy and/or reliability in the interest of developing a Subbasin coordinated approach.

To ensure the individual water budgets reflected actual conditions, the KGA members developed the Checkbook budget and coordinated water accounting methodology. The result of that effort indicates a current baseline shortage/deficit for KGA members of approximately -256,281 AFY. This reflects the difference between a total demand for KGA members of 1,939,409 AFY, and a total supply of 1,683,128 AFY. Of the shortage/deficit of the KGA, the Arvin-Edison Management Area’s portion of the KGA shortage/deficit is -8,418 AFY. Or a difference in demand of 235,780 AFY and a water supply of 227,362 AFY.

As is mentioned above, each estimate includes data gaps and has varying degrees of accuracy and/or reliability. The Checkbook is complimentary to the Model and reflects the allocation of water supply benefits and obligations independent of geographic constraints within the Subbasin. This was important to recognize and ensure the coordination of the various groundwater banking projects and water management programs amongst the various GSA’s within the groundwater basin.

These two Basin-level water budgeting efforts (i.e., the Model and the Checkbook) are described in the Coordination Agreement and Appendices thereto. These two Basin-level efforts are supplemented by the

---

56 The “Model” is referred to elsewhere in this water budget discussion as the “numerical model”.

57 The water supplies available to each KGA member from the Pioneer and Kern Water Bank banking programs are incorporated into the listed total available supplies. Note that both programs only store surface supplies, and do not have consumptive demands that contribute to the listed shortages. For more detail on the banking projects, please see the respective management area plans.
local water budget information presented in this section for the Arvin-Edison Management Area. Consistent with DWR’s GSP Emergency Regulations and DWR’s Water Budget BMP (DWR, 2016b), this MA Plan-specific water budget information provides an accounting of the total annual volume of water entering and leaving the Management Area, for historical, current, and projected future conditions.

The Model, Checkbook and the local water budget assessment discussed in detail in this section provide a range of results. Table WB-1 below shows a comparison of results for change in groundwater storage from the three water budget approaches for several time periods. Change in groundwater storage is considered an appropriate term for comparison, as it amounts to an integration of all of the other inflow and outflow terms and represents the overall quantitative balance of the system.

The range of change in groundwater storage results shown in Table WB-1 is due to several reasons. These include:

- Slight differences in the spatial area considered by each method (i.e., due to the fact that the model’s grid cells/elements do not exactly align with the boundaries of the Arvin-Edison Management Area);
- Slight differences in the way that project and management actions are implement over time;
- Inherently different levels of spatial resolution between methods, affecting the parameterization and subsequent calculation of subsurface flow across boundaries;
- Slight differences in the way in which land surface processes are treated (i.e., evapotranspiration demand, precipitation);
- Differences in the apportionment of native/natural water supplies stemming from the different perspectives and objectives of the multiple methods (i.e., the Model and local [analytical spreadsheet] model consider water supplies from a purely physical perspective whereas the Checkbook utilized a water accounting approach that assumes for management purposes a uniform Basin distribution).\(^5\)

Despite these differences, each approach provides valuable information that can support effective groundwater management within the Basin and the Arvin-Edison Management Area. As part of Plan Implementation, AEWSD will continue to refine the water budget parameters based on additional data and modeling (see Section 18.1 Plan Implementation Activities).

---

\(^5\) Nothing in this water budget information presented herein results or is intended to be a determination of water rights.
### Table WB-1. Comparison of Change in Groundwater Storage Estimates from Three Water Budget Estimation Methods

<table>
<thead>
<tr>
<th>Period / Scenario</th>
<th>Basin-wide Numerical Model</th>
<th>Local Analytical Spreadsheet Model</th>
<th>Basin-wide “Checkbook” Water Accounting Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Period (WY 1995 – 2014)</td>
<td>18,208 (a)</td>
<td>1,364 (b)</td>
<td>NA</td>
</tr>
<tr>
<td>Current Period (WY 2015)</td>
<td>-112,364 (a)</td>
<td>-164,385 (b)</td>
<td>NA</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070) Baseline with no Projects</td>
<td>2,750 (c)</td>
<td>1,660 (d)</td>
<td>-8,418 (e)</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070) 2030 Climate Change with no Projects (2)</td>
<td>-782 (f)</td>
<td>-31,586 (d)</td>
<td>NA</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070) 2030 Climate Change with Projects (2)</td>
<td>26,503 (g)</td>
<td>343 (h)</td>
<td>NA</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070) 2030 Climate Change with no Projects (2)</td>
<td>-8,695 (i)</td>
<td>-56,333 (d)</td>
<td>NA</td>
</tr>
<tr>
<td>Projected Period (50 years; 2021 – 2070) 2030 Climate Change with Projects (2)</td>
<td>17,855 (j)</td>
<td>28 (h)</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Abbreviations**

NA = not applicable

**Notes:**

1. All values are in AFY.
2. The Projected Period is 50 years in length. For the 2030 Climate Change scenarios, the Basin-wide numerical model approach includes a 20-year (2021-2040) “implementation period” and a 30-year (2041-2070) “sustainability period”. The Analytical Spreadsheet Model results assumes projects and management actions are fully implemented for the entire 50-year projected period.

**Sources:**

(a) Table 1A of “FINAL_AEWSD-Hist-WB.xlsx”, received from Todd, 7 May 2019.
(b) Table WB-6
(c) Table 1 of “AEWSD-Baseline-Nov14-FINAL.xlsx”, received from Todd, 18 November 2019.
(d) Table WB-7
(e) “SKM_C258191111413180.pdf”, received from KGA on 14 November 2019.
(f) Table 1 of “AEWSD-2030-Nov14-FINAL.xlsx”, received from Todd, 18 November 2019.
(g) Table 1 of “AEWSD-2030_Projects-Nov14-FINAL.xlsx”, received from Todd, 18 November 2019.
(h) Table WB-8
(i) Table 1 of “AEWSD-2070-Nov14-FINAL.xlsx”, received from Todd, 18 November 2019.
(j) Table 1 of “AEWSD-2070_Projects-Nov14-FINAL.xlsx”, received from Todd, 18 November 2019
9.1. Water Budget Methods and Data Sources

- 23 CCR § 354.18(d)
- 23 CCR § 354.18(e)

This District-level water budget uses a spreadsheet model approach that quantifies each flow component and enforces mass balance principles for each “subdomain” that collectively comprise the water budget domain (Arvin-Edison Management Area). Details of this approach and the corresponding data sources employed within the water budget model are described further below.

9.1.1. Spreadsheet Model Approach

The spreadsheet model approach was developed for AEWSD to serve as an independent estimate of local historical, current, and projected water budget conditions within the Arvin-Edison Management Area. The spreadsheet model approach uses a variety of data and analytical methods to quantify each water budget flow component. Processes and groups of processes are grouped into “subdomains” and “flow components”. These water budget flow components are quantified on a monthly timestep for the period from January 1994 through December 2015.

Water Budget Subdomains

The water budget is divided into six internal subdomains, each influenced by a number of flow components and within which mass-balance is enforced (i.e., the sum of inflow components is balanced by the sum of outflow components and/or a change in storage component). Figure WB-1 shows the water budget domain, and the following internal subdomains:

- Artificial Channels;
- Spreading Grounds;
- Agricultural Lands;
- Urban Lands;
- Natural Channels; and
- Groundwater System.

In addition to the six internal subdomains, several external subdomains are incorporated into the spreadsheet model. These include the watersheds that contribute streamflow to streams entering the Arvin-Edison Management Area, the atmosphere which is a source of precipitation and sink for evapotranspiration, the adjacent and connected portions of the groundwater basin, and the external surface water sources including out-of-basin and in-basin (but outside of AEWSD) storage “accounts”. The spreadsheet model does not explicitly account for the vadose (unsaturated) zone between the land surface and the (saturated) groundwater system, but instead incorporates temporal lag factors to account for the movement of water through this zone. An implicit assumption in this approach, therefore, is that the vadose zone does not experience any change in storage over time.

Water Budget Flow Components

Within and between each subdomain are 36 water budget flow components that route water through the Arvin-Edison Water Management Area. Figure WB-2 shows a conceptual diagram of the individual water
budget flow components between subdomains as well as flow components that are external to the overall water budget domain (i.e., serve only as an inflow or outflow to the entire system, rather than a flow between subdomains).

Certain components are based on “raw” data which are directly measured and based on historical records. These “raw” components are considered to have a relatively high degree of certainty. Other components are estimated using a variety of analytical methods (e.g., Darcy’s Law to calculated subsurface flows across the domain’s external boundaries) and are thus subject to uncertainty based on the parameters used in their estimation. Some components (i.e., groundwater pumping for agricultural use) constitute major proportions of the overall water budget and have thus been given significant attention. Others are relatively minor in magnitude (e.g., seepage from artificial channels) and are, to some degree, less significant to the overall water budget and less well defined. Details of the methods and data used in the spreadsheet model approach are provided in Appendix J.

**Arvin-Edison / Wheeler Ridge-Maricopa Overlap Lands**

WRMWSD supplies surface water to certain lands within the portion of its service area that overlaps with the AEWSD service area. The total acreage of overlap lands within the Kern Subbasin is approximately 5,318 acres, and WRMWD serves surface water to approximately 3,186 acres in this area. Although the overlap lands are being covered by AEWSD for SGMA monitoring and management purposes, WRMWD will continue in the future to serve surface water to those lands within the overlap area that have historically received WRMWD supplies in accordance with WRMWD’s water delivery contracts with landowners. The Checkbook accounting exercise appropriately considered the supply and demands within the overlap lands included in the Arvin-Edison Management Area.

### 9.1.2. Data Sources

- **23 CCR § 354.18(d)**
- **23 CCR § 354.18(e)**

Per 23 CCR § 354.18(e), the best-available data were used to evaluate the water budget for the Arvin-Edison Management Area and include the following:

- **Precipitation Records** from the various local climate stations including:
  - Four additional climate stations maintained by the National Oceanic and Atmospheric Administration (NOAA)\(^{59}\), *Monthly resolution, January 1971 – December 2015 (data availability varies by station)*

- **Satellite Evapotranspiration (ET) Data** from the Cal Poly Irrigation Training and Research Center’s “Mapping Evapotranspiration at High Resolution with Internalized Calibration” (ITRC-METRIC)

---

\(^{59}\) See Appendix J for a detailed description of how climate stations are used to estimate precipitation on AEWSD lands and surrounding watersheds.
Study, funded by the Kern Groundwater Authority (KGA)\textsuperscript{60}; \textit{Monthly, January 1993 -December 2015}\textsuperscript{61}

- **AEWSD Land Use Surveys** from AEWSD’s internal land use records and agricultural consulting reports; \textit{Seasonal, Spring 1994 – Fall 2015 (data availability varies by season)}

- **AEWSD Surface Water Imports Records** from AEWSD’s internal operations records; \textit{Monthly [January 1966 – December 2015]}

- **AEWSD Spreading Records** from AEWSD’s internal operations records, \textit{Monthly [January 1966 – December 2015]}

- **AEWSD Recovery Well Pumping Records** from AEWSD’s internal operations records, \textit{Monthly [January 1966 – December 2015]}

- **Historical Groundwater Level Records** from selected wells within AEWSD; \textit{Seasonal resolution, Spring 1940 – Fall 2015 (data availability varies by well)}

- **Streamflow Records** for Caliente Creek (USGS stream gauge 11196400), \textit{Monthly, October 1961 – February 1983}

9.1.3. **Intended Purpose of Water Budget**

The local water budget spreadsheet model described herein (as well as the basin-wide Model approach to water budget estimation described in the Coordination Agreement and Appendices thereto) was designed to assess the water budget from a purely quantitative, physical perspective, which is consistent with SGMA and the GSP Emergency Regulations (i.e., CWC § 10720.5 and 23 § CCR 354.18(a)). With the exception of explicit accounting for AEWSD’s water banking operations, the local spreadsheet model does \textbf{not} consider water rights. As discussed above, the Checkbook “water accounting” approach attempts to evaluate the water budget using certain management assumptions (e.g., a uniform “native yield” component to all lands within the Basin). \textit{However, nothing in this water budget information results in or is intended to be a determination of water rights within the Arvin-Edison Management Area.}

9.2. **Water Budget Results**

Results are presented below in terms of both annual values during the historical water budget period (DWR Water Years [WY] 1995 – 2014)\textsuperscript{62}, as well as long-term averages over that period. As such, some

\textsuperscript{60}Howes, D. 2017. 1993-2015 ITRC-METRIC ETc for Kern County. prepared for the Kern Groundwater Authority on behalf of the Cal Poly Irrigation Training and Research Center.

\textsuperscript{61}There is no ITRC satellite ET data for calendar year 2012, as the LANDSAT satellite system employed in the ITRC-METRIC analysis was non-operational during this period. See Appendix J for further details.

\textsuperscript{62}DWR Water Years run from October of the previous year to September of the current year (e.g. DWR Water Year 2015 is October 2014 – September 2015.
information presented here aligns with the requirements of the historical water budget described under Section 9.3 *Current and Historical Water Budget* below and is not repeated there.

### 9.2.1. Surface Water Inflows and Outflows

Table WB-1 presents an annual summary of the total surface water inflows to and outflows from the Arvin-Edison Management Area between WY 1995 – 2015. These inflows include imported surface water, natural streamflow into the area, and precipitation. Figure WB-3 shows the total surface water inflows by type. Total surface water inflows to the Management Area average approximately 253,000 AFY over WY 1995 – 2014 but have varied widely from year to year. On average, 69% of surface water inflows are from imported water supplies, 29% are from direct precipitation, and 2% are from intermittent streamflow from surrounding watersheds.

**Imported Water Supplies**

AEWSD has been importing water into the Arvin-Edison Management Area since 1966. Annual surface water imports (District-wide) during that time have ranged from 31,000 to over 305,000 AFY, and cumulatively a total of 7.89 million AF have been imported through February 2018 (see Figure WB-4). AEWSD’s primary source of imported water is the Friant Division of the USBR’s Central Valley Project (CVP). AEWSD has contracts for 40,000 AFY of Class 1 water and 311,675 AFY of Class 2 water from the Friant Division. Over the historical period (WY 1995 – 2014), imports of Friant Division water have averaged approximately 102,400 AFY.

In addition to its CVP contracts, AEWSD actively and regularly pursues additional water supplies through transfers, purchases, exchanges, and banking programs. Over the past 21 years, AEWSD has obtained roughly 1.50 million AF of additional water supplies through agreements with over 70 entities. Furthermore, AEWSD has invested in surface water infrastructure that gives it great flexibility to move water into (and out of) its service area to facilitate water exchanges (see Figure HCM-22). AEWSD categorizes its imported surface water by source type according to the specific conveyance facility through which the water passes, as follows:

- Friant-Kern Canal;
- Cross Valley Canal;
- California (CA) Aqueduct (through its Intertie Pipeline);
- Kern River;
- Deliveries from Wheeler Ridge-Maricopa Water District (originating from the CA Aqueduct) to WRMWSD lands that overlap AEWSD lands; and
- “Other” infrequent supply sources, including wheeled surface water and groundwater from the adjacent Kern Delta Water District.

**Figure WB-5** and **Figure WB-6** present an annual summary and long-term average breakdown of surface water imports by source from WY 1995 – 2014. Imported surface water supplies have averaged

---

63 [https://www.usbr.gov/mp/cvp-water/docs/latest-water-contractors.pdf](https://www.usbr.gov/mp/cvp-water/docs/latest-water-contractors.pdf)
approximately 174,000 AFY over WY 1995 – 2014 but vary substantially from year to year. As discussed below, a portion of these surface water imports is exported to customers in the White Wolf Subbasin.

**Natural Streamflow**

As discussed in **Section 7.3.5 Surface Water Bodies**, several creeks drain into the Arvin-Edison Management area from watersheds to the east and south (see Figure HCM-21). There are no currently active stream gauges on these creeks; however, one stream gauge on Caliente Creek above Tehachapi Creek (USGS stream gauge 11196400), located approximately 10 miles east of the AEWS boundary, has a period or record from October 1961 through February 1983, and data from this gauge was used as a proxy for all contributing watersheds. During this gauge’s period of record, average monthly discharge at this location ranged from 0.39 cubic feet per second (cfs) in July and September to 16 cfs in February. Annual average discharge ranged from 0.263 cfs in 1966 to 33.5 cfs in 1978 (no data for 1983). Annual peak flows ranged from a minimum of 2.2 cfs in 1966 to a maximum of 15,500 cfs in 1983 (the stream gauge was apparently rendered inoperable by the 1983 peak flow and has not been repaired). These data indicate a highly seasonal pattern in streamflow at this location as well as substantial variability from year to year. It is expected that most creeks in this area exhibit this same behavior. As noted in **Section 7.3.5 Surface Water Bodies**, Caliente Creek occasionally discharges into the Arvin-Edison Management Area during storm events and has caused flooding in the downstream town of Lamont. Similar flooding has also occurred on Tejon Creek. While Tejon Creek flooding does not affect any downstream communities, it has on occasion caused damage to AEWS’s Tejon Spreading Works facility.

**Precipitation**

Precipitation on lands within the Arvin-Edison Management contributes some water to the overall water budget and is grouped herein with “surface water inflows”. Precipitation and other climate variables are measured at the CIMIS station #125 located in the City of Arvin. AEWS also operates three rainfall measurement stations. Data from AEWS’s rain gauges are similar in magnitude and temporal pattern. Annual rainfall at the CIMIS station #125 over the period of WY 1995 – 2014 ranged from approximately 4.3 inches in WY 2008 to over 20 inches in WY 1998, with an average of 8.2 inches per year. Overall, an average of approximately 72,400 AFY of precipitation fell on lands within the Arvin-Edison Management Area during this period. This water serves to wet the near surface soil and then either evaporates, contributes to crop water demand, or (when a rainfall event is intense enough or long enough) percolates through the root zone to eventually recharge groundwater. “Effective precipitation”, i.e. the volume of precipitation that ultimately contributes to meeting evapotranspirative demands within the root zone, is estimated to be approximately 37,000 AFY (or 51% of total precipitation) within the Arvin-Edison Management Area.

**Surface Water Outflows**

As shown in **Table WB-1** and **Figure WB-7**, natural surface water outflows from the Arvin-Edison Management Area are essentially zero. Total surface water outflows averaged approximately

---

64 Imported surface water supplies are affected not only by hydrology (i.e., water year type) but also by non-hydrological factors in the decisions of those running the state and federal water projects.

65 https://waterdata.usgs.gov/ca/nwis/inventory/?site_no=11196400

66 Based off the U.S. Department of Agriculture-Soil Conservation Service method (USDA-SCS, 1970); see **Appendix J**. Ungauged flood flows originating from Caliente Creek have been observed during large storm events in Lamont, west of the Arvin-Edison Management Area.
39,800 AFY between WY 1995 – 2014, 65% of which were in the form of deliveries to Arvin-Edison’s service area in the White Wolf Subbasin and the remaining 35% as exports to the Metropolitan Water District (MWD) through the CA Aqueduct (via the Intertie Pipeline; see Figure HCM-22).

It should be noted that AEWSD uses its canal and pipeline delivery network to convey recovered groundwater from banking operations in addition to delivering imported surface water supplies. Therefore, all surface water outflows leaving the Arvin-Edison Management Area via AEWSD’s pipeline and canal network have been blended upstream and may include a variable percentage of recovered groundwater depending on the given season and Water Year type.

**Out-of-District Groundwater Storage**

As described in Section 5.2.3 Conjunctive Use in the Arvin-Edison Management Area, AEWSD also participates in several out-of-District groundwater storage and recovery programs both within and outside the Kern Subbasin. As an example, and as of February 2019, AEWSD has 77,590 AF of imported water supplies banked and available to withdraw in various locations outside the Arvin-Edison Management Area, including:

- 58,886 AF in the RRBWSD water bank;
- 10,704 AF in the Westside Mutual Water Company water bank; and
- 8,000 AF in the Kaweah Delta WCD water bank.

These banked imported water supplies are not included in the quantification of total surface water inflows into the Arvin-Edison Management Area or in the subsequent determination of change in groundwater storage, as they are currently being physically stored outside the Management Area boundaries. However, these banked supplies contribute to the overall storage within the Kern Subbasin. AEWSD maintains rights to recover these banked supplies in the future per the contract terms specified in the individual agreements with the entities mentioned above.

### 9.2.2. Groundwater Inflows and Outflows

- **23 CCR § 354.18(b)(2)**
- **23 CCR § 354.18(b)(3)**

Table WB-3 and Figure WB-8 provide an annual summary of inflows to and outflows from the groundwater system by water source type for Water Years 1995 – 2014. As evident from these two exhibits (as well as the groundwater hydrographs shown in Figure GWC-5 and Figure GWC-6), the groundwater system is highly sensitive to climatic conditions and AEWSD operations. As such, annual inflows and outflows vary widely depending on availability of surface water supplies to meet irrigation demands and to sustain groundwater banking operations. Sources of inflow to the groundwater system include:

- Recharge from groundwater banking operations;
- Subsurface inflows across AEWSD’s western boundary (from west to east) and across the White Wolf Fault (from south to north);
- Infiltration of applied water;
- Infiltration of precipitation; and
Infiltration from surface water systems (e.g., seepage from streams and channels).

**Figure WB-9** provides a summary of long-term (WY 1995 – 2014) annual average inflows to and outflows from the groundwater system. Total inflows to the groundwater system averaged approximately 145,500 AFY. Approximately 40% of total inflows to the groundwater system were supplied by infiltration of applied water, 35% by recharge from spreading basins, 13% from subsurface groundwater inflows, 9% from infiltration from surface water systems, and 3% from infiltration of precipitation.

Due to AEWSD’s position at the southwestern edge of the Kern Subbasin (near pre-development discharge areas) and the resulting low hydraulic heads which are further drawn down by pumping, there are virtually no subsurface outflows, losses to surface water systems, or evapotranspirative losses occurring from the groundwater system (see **Figure GWC-1**). As shown on **Figure WB-9**, total outflows from the groundwater system averaged approximately 143,800 AFY over WY 1995 – 2014 and were entirely related to groundwater extraction. Of this value, approximately 61% of groundwater extraction can be attributed to private agricultural pumpage, 37% to pumpage from AEWSD wells related to its groundwater banking and recovery operations, and the remaining 2% to pumpage from municipal and industrial customers, including ACSD.

### 9.2.3. Change in Groundwater Storage

- **23 CCR § 354.18(b)(4)**

**Figure WB-10, Figure WB-11, and Table WB-4** present the annual and cumulative change in groundwater storage between seasonal high conditions, which are defined in this chapter to be March through February of the following year. Note that this time window is distinct from DWR’s definition of the “Water Year”, which runs from October of the previous year to September of the current year (e.g. DWR Water Year 2014 is October 2013 – September 2014); thus the values presented in **Table WB-4** are slightly different than the annual and cumulative change in storage estimates provided for DWR Water Years 1995 – 2014 in **Table WB-3, Table WB-5, and Table WB-6**.

Annual change in groundwater storage under the Arvin-Edison Management Area averaged approximately -2,700 AFY between seasonal high conditions for the period of March 1994 – February 2015, with a cumulative change in storage equating to -57,000 AF over the same period of record. However, as seen in **Figure WB-10** and **Figure WB-11**, change in storage varied widely between years, from a -185,000 AF decrease in storage to a 155,000 AF increase in storage.

### 9.2.4. Overdraft Conditions

- **23 CCR § 354.18(b)(5)**

The Kern Subbasin is designated by DWR in its latest version of **Bulletin 118 – California’s Groundwater** as being in a condition of critical overdraft (DWR, 2016c). With respect to overdraft conditions and basins subject to those conditions, DWR has made the following statements:

- “A basin is subject to critical conditions of overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts.” (DWR, 1980)

- Groundwater overdraft is “… the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin
over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. If overdraft continues for a number of years, significant adverse impacts may occur, including increased extraction costs, costs of well deepening or replacement, land subsidence, water quality degradation, and environmental impacts.” (DWR, 2003)

- “Overdraft occurs where the average annual amount of groundwater extraction exceeds the long-term average annual supply of water to the basin. Effects of overdraft result can include seawater intrusion, land subsidence, groundwater depletion, and/or chronic lowering of groundwater levels”.  

In evaluating basins for critical overdraft conditions in its most recent Bulletin 118 update, DWR considered the time period from WY 1989 – 2009. This period excludes the recent drought which began in 2012, includes both wet and dry periods, is at least 10 years in length, and includes precipitation close to the long-term average; these were all criteria used in selecting the time period.

The historical water budget information discussed herein covers the period from WY 1995 - 2014 (i.e., it does not cover the entire period used in DWR’s evaluation). However, within the period covered by this water budget, the timeframe between WY 1997 - 2009 (October 1996 through September 2009) meets all of the same criteria. During this 13-year period, the cumulative departure in statewide average precipitation increased by approximately 9% (DWR, 2016c Figure 1), indicating that, on average, each year was less than 1% wetter than the long-term average. Over this time period, the cumulative change in storage within the Arvin-Edison Management Area increased by approximately 32,500 AF, averaging 2,500 AFY. Therefore, based on local historical water budget information, the Management Area as a whole does not show a deficit. According to the results of the “checkbook” water accounting approach for the projected baseline condition, the Management Area has a projected annual deficit of -8,418 AFY. The District has developed a suite of Projects and Management Actions (see Section 17 Projects and Management Actions) whose intended benefit is to prevent or eliminate any future overdraft condition by the statutory deadline. As discussed in Section 9 above, however, significant uncertainty exists regarding the actual magnitude of projected water budgets, and the water budget will be refined over time as additional data is collected. In the meantime, the planned P/MA’s will be implemented according to the implementation plan outlined Section 18 AEWSD Plan Implementation.

9.2.5.   Water Year Types

[23 CCR § 354.18(b)(6)]

Table WB-5 presents the annual total supplies, total demands, and change in groundwater storage in the Arvin-Edison Management Area along with the DWR Water Year type (October – September) for the period from WY 1995 through 2015. Also shown on Table WB-5 are the averages for total supplies, total

---

69 This timeframe is consistent with the water budgeting timeframes incorporated into basin-level modeling efforts for the Kern Subbasin.
70 It should be noted that groundwater conditions vary spatially through the Kern Subbasin and even within the Arvin-Edison Management Area, and broad generalizations over large areas can lead to mischaracterization of conditions on a local scale. For this reason, its imperative (and SGMA requires) that conditions be evaluated locally on a management area or Representative Monitoring Site basis.
demands and change in groundwater storage for each of the five Water Year types. Figure WB-12 and Figure WB-13 present the change in groundwater storage versus Water Year type on an annual and cumulative basis, respectively. The Water Year type is based on DWR’s San Joaquin Valley Water Year Index. These exhibits depict a clear relationship between Water Year type and change in groundwater storage, whereby change in storage is more positive during wet and above normal Water Years and more negative during below normal, dry and critical Water Years. This variability can be traced largely to differences in supplies during different Water Year types, as the total demands are relatively constant. The net benefit of a “wet” period on groundwater conditions is especially evident in Water Years 1995–2000, whereas the impact of a severe multi-year drought becomes increasingly evident in WYs 2012–2015.

Section 8.3 Change in Groundwater Storage, in the Groundwater Conditions section of this MA Plan, reports values for change in storage based on interpolated groundwater levels and specific yield values (see Table GWC-2). Those water level-based change in storage values were used in the calibration of the water budget spreadsheet model71. Figure WB-14 shows a comparison of the spreadsheet model-based transient change in storage against the water level-based change in storage values for the entire AEWSD service area as well as for the Arvin-Edison Management Area. As shown on Figure WB-14, the spreadsheet model matches the water level-based estimates well; the root-mean squared error (RMSE) for the annual rate of change for the three long-term periods (1994–2007, 2007–2015, 1994–2015) is 5,800 AFY, which is a small fraction (<2%) of the overall groundwater subdomain water budget magnitude (e.g., average annual groundwater inflows and outflows of approximately 145,500 AFY and 143,800 AFY, respectively).

9.2.6. Sustainable Yield

 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” (CWC § 10721(w)). DWR’s Water Budget BMP (DWR, 2016b), further states that “Water budget accounting information should directly support the estimate of sustainable yield for the basin and include an explanation of how the estimate of sustainable yield will allow the basin to be operated to avoid locally defined undesirable results. The explanation should include a discussion of the relationship or linkage between the estimated sustainable yield for the basin and local determination of the sustainable management criteria (sustainability goal, undesirable results, minimum thresholds, and measurable objectives).”

A key part of the codified definition and the BMP statement is the avoidance of Undesirable Results, defined as “significant and unreasonable” effects for any of the six SGMA sustainability indicators. For example, with regard to groundwater levels, declining levels during a drought do not constitute and Undesirable Result for Chronic Lowering of Groundwater Levels if extractions and groundwater recharge are managed as necessary to ensure that reduction in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods (CWC § 10721(x)(1)). Therefore, while the water budget should provide support for sustainable yield, determination of the

71 The water budget spreadsheet model calibration was completed for the entire AEWSD service area, inclusive of the area within the White Wolf Subbasin.
sustainable yield for the Arvin-Edison Management Area ultimately depends upon whether Undesirable Results are avoided within the time-frames required by SGMA.

A conservative estimate of the sustainable yield of the groundwater system underlying the Arvin-Edison Management Area can be made by adding the average annual change in storage, minus any temporary groundwater surplus resulting from out-of-District entitlements (e.g., the MWD groundwater banking “return obligation” described in Section 9.4.3 Additional Surface Water Supply Adjustments), to the average annual private and M&I groundwater extraction (i.e., excluding all AEWSD groundwater banking recovery pumping). This simplified approach provides a sustainable yield number corresponding to the volume of groundwater that, if pumped over the water budget period of interest, would have resulted in zero change in storage – a reasonable metric for sustainability. Based on the average annual change in groundwater storage over the water budget period from WY 1995 – 2014 (i.e., +1,400 AFY), the average annual private and M&I groundwater extraction rate (i.e., 90,500 AFY), and the average annual MWD surplus (7,700 AFY), using this simple method the sustainable yield is conservatively estimated to be at a minimum approximately 84,200 AFY under current supply and demand conditions. This equates to an acreage-normalized sustainable yield of approximately 0.80 AFY/acre over the (105,630 acre) Arvin-Edison Management Area.

This number is conservative because SGMA itself does not require that the basin or any particular management area to be balanced at any particular point in time, as discussed above. As mentioned above, this number does not include the additional 53,200 AFY of AEWSD pumping occurring from its groundwater banking and recovery operations. The sustainable yield estimate also does not factor in the additional 77,600 AF (~3,900 AFY) of imported AEWSD supplies currently stored within other groundwater banking facilities outside the District but within the Kern Subbasin (see Section 9.2.1 Surface Water Inflows and Outflows).

This sustainable yield number is also inherently conservative in that it is based on a pumping rate that, under similar hydrologic conditions as the historical period, would result in no decrease in storage. As discussed in Section 13.1 Undesirable Results for Chronic Lowering of Groundwater Levels and Section 13.2 Undesirable Results for Reduction of Groundwater Storage, the locally defined criteria for what constitutes an Undesirable Result for groundwater levels and change in storage is not strictly limited to a zero net decrease; rather, those criteria allow for some operation of the basin at groundwater levels and storage levels below current conditions. For the other relevant sustainability indicators (i.e., water quality degradation and land subsidence), a sustainable yield value that amounts to a zero change in storage would also be expected to avoid Undesirable Results. Therefore, this sustainable yield estimate takes into account Undesirable Results, as required by CWC § 10721(w).

Moreover, as described earlier in this section, AEWSD has also participated in a Basin-wide numerical modeling effort in addition to developing a more refined local water budget for their Management Area. Results of the C2VSim-FG historical water budget model extracted from the model elements most closely corresponding to the Arvin-Edison Management Area jurisdictional boundaries indicate an average annual groundwater extraction rate of approximately 150,600 AFY for the historical period of WY 1995 – 2014, and an average annual change in storage of +18,200 AFY during that same period. Under the same approach as described above, the C2VSim-FG historical water budget results indicate a sustainable yield

---

72 The acreage-normalized sustainable yield values presented herein should not be viewed as an “allocation” but rather is presented herein to facilitate comparisons to commonly-used agronomic quantities (e.g., crop water demands in AFY/acre).
estimate of 107,900 AFY within the Management Area, or 1.02 AFY/acre. It is important to note that this model is intended to be a Basin-wide assessment of groundwater conditions and, unlike the local water budget described above, is not specifically calibrated to the AEWSD service area. Additional reconciliation of basin water budgeting efforts is a high priority for basin GSAs as part of GSP implementation.

9.3. Current and Historical Water Budget

9.3.1. Current Water Budget

This section presents results for the “current” water budget, based on values extracted from the spreadsheet model for WY 2015. This is consistent with how “current” is being defined by the KGA in the Umbrella GSP.

WY 2015 was classified as the third consecutive “Critical” (dry) Water Year and fourth consecutive “Dry” or “Critical” Water Year within the San Joaquin Valley and is thus representative of perhaps the worst drought condition in recent history within the region.

Table WB-6 and Figure WB-15 provide a summary of total inflows and outflows to the Arvin-Edison Management Area for WY 2015, while Table WB-3 and Figure WB-16 provide a summary of groundwater inflows and outflows.

Total inflows to the Arvin-Edison Management Area amounted to 142,000 AF in WY 2015, comprised of 46% precipitation, 35% surface water imports, 16% subsurface inflows, and 2% natural surface water inflows. This resulted in a total inflow to the groundwater system of approximately 85,200 AF, comprised of 60% infiltration of applied water, 27% subsurface inflow, 8% infiltration from surface water systems, 4% infiltration of precipitation, and 2% from recharge from spreading basins.

Total outflows from the Arvin-Edison Management Area amounted to 311,400 AF in WY 2015, comprised of 70% evapotranspiration (consumptive use by vegetation), 27% surface water exports and deliveries to the White Wolf Subbasin, and 3% municipal and industrial (M&I) consumptive use. This resulted in a net outflow from the groundwater system of approximately 251,500 AF, 100% of which is due to groundwater extraction.

As evident from these water budget values, the Arvin-Edison Management Area (like nearly all areas in the Kern Subbasin and San Joaquin Valley as a whole) was impacted significantly by the extreme drought condition and allocation decisions made by the USBR in WY 2015, resulting in a net loss of approximately -164,400 AF of groundwater storage during this timeframe. However, as evidenced by the recovery of water levels and storage following previous dry periods, the groundwater system is resilient, and the “current” (WY 2015) conditions are not indicative of a normal condition but rather represent the late stages of a major drought period from which the groundwater system has already started to recover (see Figure GWC-6).

9.3.2. Historical Water Budget

Water budget results are presented for the historical water budget period in Section 9.2 Water Budget Results, including associated figures and tables, and are not repeated here. Rather, this section focuses
on providing: (a) a quantitative evaluation of historical surface water availability and reliability (23 CCR § 354.18(d)(2)(A)), (b) a quantitative assessment of the historical water budget (23 CCR § 354.18(d)(2)(B)), and (c) a description of how historical conditions have impacted the ability of the Arvin-Edison Management Area to be operated within its sustainable yield (23 CCR § 354.18(d)(2)(C)).

**Historical Surface Water Availability and Reliability**

<table>
<thead>
<tr>
<th>23 CCR § 354.18(c)(2)(A)</th>
</tr>
</thead>
</table>

As described above, AEWSD’s only contracted source of surface water supply is its Class 1 and Class 2 contracts for CVP (Friant Division) water, at 40,000 AFY and 311,675 AFY respectively. AEWSD has been granted its full Friant Class 1 allocation a total of 38 times in the 54 years since deliveries began in 1966, and in 16 out of 20 years over the historical water budget period of record (WY 1995 – 2014). The average annual volume of Class 1 Friant water allocated to AEWSD over WY 1995 – 2014 is 35,700 AFY, and the total average volume of Friant water delivered (including Class 2 and other supplies) is 98,000 AFY. Figure WB-17 presents an annual breakdown of total imported Friant-Kern supplies relative to AEWSD’s existing Class 1 and Class 2 contract volumes.

This large inter-annual variability in supply indicates that, while Friant water remains the primary and most important source to AEWSD, its reliability is variable, and has been impacted significantly in recent years due to: (1) the 2006 San Joaquin River Restoration settlement and subsequent federal legislation, which has reduced deliveries from the Friant Division, and (2) subsidence, which has significantly impacted conveyance capacity of the Friant-Kern Canal to AEWSD. For this reason, AEWSD actively and regularly pursues additional water supplies through transfers, purchases, exchanges, and banking programs (e.g., its long-standing banking programs with MWD and RRBWSD, among others), as well as supporting efforts to increase yields from, and the conveyance capacity of, the Friant Division of the CVP.

**Quantitative Assessment of Historical Water Budget**

<table>
<thead>
<tr>
<th>23 CCR § 354.18(c)(2)(B)</th>
</tr>
</thead>
</table>

Based on the DWR San Joaquin Valley Water Year Index for the 20-year period from WY 1995 - 2014, this period included four "critical" (dry) years, four dry years, two below normal years, three above normal year, and seven wet years. The first third of this period was relatively wet, the middle third was a mix of wet and dry years, and the last third of the period was extremely dry. This climatic factor is clearly reflected in the water budget for the Arvin-Edison Management Area, whereby the groundwater system shows consistent increases in storage with “wetter” conditions and decreases in storage under “drier” conditions (see Figure WB-12, Figure WB-13, and Table WB-5).

Table WB-6 and Figure WB-18 provide a tabular and graphical breakdown of total inflows and outflows to the Arvin-Edison Management Area for WY 1995 – 2014, with a summary of average annual total inflows and outflows provided in Figure WB-19. Table WB-3 and Figure WB-8 provide a tabular breakdown of inflows and outflows to the groundwater system underlying Arvin-Edison Management Area for WY 1995 – 2014, with a summary of average annual groundwater inflows and outflows provided in Figure WB-9.

Total inflows to the Arvin-Edison Management Area amounted to an average of 271,600 AFY for WY 1995 – 2014, comprised of 64% surface water imports, 27% precipitation, 7% subsurface inflows, and 2% natural surface water inflows. This resulted in an average net inflow to the groundwater system of approximately 145,500 AFY, comprised of 40% groundwater recharge from spreading basins, 35% infiltration of applied
water, 13% subsurface inflow, 9% infiltration from surface water systems, and 3% infiltration of precipitation.

Total annual outflows from the Arvin Edison Management Area amounted to 269,800 AFY for WY 1995 – 2014, comprised of 83% evapotranspiration (consumptive use by vegetation), 15% surface water exports and deliveries to the White Wolf Subbasin, and 2% municipal and industrial consumptive use. This resulted in a net outflow from the groundwater system of approximately 143,800 AF, 100% of which caused by groundwater extraction.

**Operation Within Sustainable Yield**

The average annual change in groundwater storage within the Arvin-Edison Management Area amounted to +1,400 AFY between WY 1995 – 2014 (i.e., a cumulative change in groundwater storage of +27,300 AF within this period). This small cumulative storage change over a 20-year historical record, that includes the recent severe drought, indicates that the groundwater system is in a state of relative balance, and not a state of significant overdraft. Although the overall net change during this period is slightly negative, the calculated transient change in storage and water levels measured in wells within the Arvin-Edison Management Area (see Figure WB-21, Figure GWC-5, and Figure GWC-6) demonstrate that the groundwater system is sensitive to climatic variability and AEWSD operations, with decreases in storage during drought and/or regulatory restrictions followed by increases in storage during wet periods.

As discussed previously and shown on Figure WB-4, AEWSD has imported over 7.89 million AF of water into the Arvin-Edison Management Area since it began operations in 1966. Since that time, the groundwater system has experienced a long-term change in storage of approximately -20,400 AF, or -400 AFY (see Table GWC-2) and groundwater elevations have increased in areas where imported surface water is delivered (see Figure GWC-5). This shows how AEWSD operations have resulted in a net balance to the groundwater supply beneath the Arvin-Edison Management Area, demonstrating successful groundwater management.

### 9.4. Projected Water Budget

Projected water budgets are required as a way to estimate future conditions of water supply and demand within a basin, as well as the aquifer response to implementation of the Plan over the planning and implementation horizon. To develop the projected water budget, the same tools and methodologies that were used for the historical and current water budget were used, with updated inputs for climate variables (i.e., precipitation and ET) and water supply assumptions (i.e., imported water supplies). The chief purpose of this projected water budget analysis is to assess the magnitude of the net water supply deficit that would need to be addressed through Projects and Management Actions to prevent Undesirable Results (discussed further in Section 13 Undesirable Results and Section 17 Projects and Management Actions) and achieve the Sustainability Goal. This section describes the development and results of the projected water budget for the Arvin-Edison Management Area.
## 9.4.1. Development of 50-Year Analog Period

- **23 CCR § 354.18(c)(3)(A)**
- **23 CCR § 354.18(c)(3)(B)**
- **23 CCR § 354.18(c)(3)(C)**

Per 23 CCR § 354.18(c)(3)(A), the projected water budgets must use 50 years of historical precipitation, evapotranspiration, and streamflow information as the basis for evaluating future conditions under baseline and climate-modified scenarios. The process by which a 50-year period of precipitation, evapotranspiration and streamflow information was developed is based on the process adopted by all GSAs within the Basin, as described in the KGA Umbrella GSP and the Coordination Agreement and Appendices thereto. That process is briefly summarized here.

To develop the required 50 years’ worth of hydrologic input information, first an “analog period” was created from the 20 years’ worth of historical information (WY 1995-2014) by combining the years in a specific way that, on average, maintained the long-term average hydrologic conditions. This approach, which was used for both the spreadsheet water budget model approach and the basin-wide C2VSim-FG modeling approach, allowed for the creation of a complete 50-year period to inform the projected water budget analysis, even when certain component datasets were not available for that length of time. The sequence of actual years that were combined to create the 50-year analog period is as follows:

- **Analog Years 1-12:** Based on actual years 2003-2014
- **Analog Years 13-32:** Based on actual years 1995-2014
- **Analog Years: 33-50:** Based on actual years 1995-2012

The above mapping of actual years to analog years within the required 50-year projected water budget period applies to precipitation and ET datasets. It also applies to datasets of imported surface water and exports to MWD with some additional modifications as described in the following section.

## 9.4.2. Development of Projected Water Budget Scenarios

- **23 CCR § 354.18(c)(3)(A)**
- **23 CCR § 354.18(c)(3)(B)**
- **23 CCR § 354.18(c)(3)(C)**

Using the 50-year analog period, three projected water budget scenarios were developed for this analysis: a baseline scenario, and 2030 climate change scenario, and a 2070 climate change scenario. Development of the three scenarios was done consistent with the agreed-upon process being used basin-wide. Details of the scenario development are contained within in the KGA Umbrella GSP and the Coordination Agreement and Appendices thereto, and are briefly summarized here.

**Baseline Scenario**

Per 23 CCR § 354.18(c)(3)(C), the projected water budgets must use “the most recent water supply information as the baseline condition for estimating future surface water supply”. Consistent with the process applied basin-wide, the information used to inform the baseline conditions for CVP supplies is from the Friant Water Authority (FWA) modeling projections (FWA, 2018), specifically the “2015.c projection”. Similarly, the latest available information used to inform the baseline conditions for SWP supplies is based on information published by and/or obtained from DWR, including data from DWR’s...
CalSim water resources planning model, historical SWP operations data, and impacts from new operations regulations pursuant to the 2008/2009 Long-Term Operations Criteria and Plan (OCAP) Biological Opinion (BO). As part of the basin-wide approach to Baseline Scenario development, certain substitutions and/or adjustments to years were made to the 50-year analog period for certain water supplies because the available datasets did not cover the entire historical water budget time period (WY 1995-2014). These substitutions included the following:

- Replacing years 2004-2014 with years 1951-1961 for Friant Division (CVP) supplies;
- Adjusting years 2004-2007 for SWP supplies to account for the recent regulatory changes to SWP operations made effective in 2008 and 2009 (i.e., the OCAP BO);
- Replacing years 1995-2003 for SWP supplies with values from DWR’s 2030-level CalSim study, increased by 3.03%, again to account for the OCAP BO; and

The above substitutions and adjustments were made by KGA GSA consultants based upon their analysis of the FWA and DWR (CalSim) studies and were provided to all Districts as a basis for development of projected water budgets. As such, the information used for this analysis is consistent with the basin-wide approach.

**2030 Climate Change Scenario**

In order to estimate the potential effects on the projected water budget of climate change during the GSP implementation period (i.e., between 2020 and 2040), a water budget scenario based on 2030 climate change factors published by DWR was developed. For this scenario, precipitation and ET were both adjusted based on the change factors published by DWR. CVP water supplies were taken from the FWA projections under the “2030.c scenario.” (FWA, 2018). SWP supply projections were taken from the DWR 2030-Level CalSim studies, except for years 2004-2007 which were taken as the actual SWP data, adjusted for the OCAP BO and reduced by 3.03%, and years 2008-2014 which were taken as the actual SWP data, reduced by 3.03%. Again, the assumptions upon which this scenario was based are from the KGA consultant.

---


75 Consistent set of CalSim operations studies at current, 2030 and 2070 climate levels for Bay Delta Conservation Plan evaluation provided by DWR Bay Delta Office staff.
consultant’s analysis of FWA and DWR information and are therefore consistent with the basin-wide approach.

**2070 Climate Change Scenario**

In order to estimate the potential effects on the projected water budget of climate change towards the end of the planning and implementation horizon (i.e., 50 years out into the future), a water budget scenario based on 2070 “central tendency” climate change factors published by DWR was developed. It should be noted that estimates of climate change impacts on water supplies this far into the future have significant uncertainty. For this scenario, precipitation and ET were both adjusted based on the 2070 “central tendency” change factors published by DWR. CVP water supplies were taken from the FWA projections under the “2070.c scenario”. SWP supply projections were taken from the DWR 2070-Level CalSim studies, except for years 2004-2007 which were taken as the actual SWP data, adjusted for the OCAP BO and reduced by 8.09%, and years 2008-2014 which were taken as the actual SWP data, reduced by 8.09%. Again, the assumptions upon which this scenario was based are from the KGA consultant’s analysis for FWA and DWR (CalSim) information and are therefore consistent with the basin-wide approach.

**9.4.3. Additional Surface Water Supply Adjustments**

As described in Section 9.2.1 Surface Water Inflows and Outflows, in addition to its CVP contracts, AEWSD actively and regularly pursues additional surface water supplies through transfers, purchases, exchanges, and banking programs as a means of increasing supply reliability during extended periods of drought and/or regulatory restrictions. From DWR Water Years 1995 - 2015, AEWSD has obtained roughly 1.50 million AF of additional water supplies through agreements with over 70 entities, comprising approximately 41% of total surface water imports to AEWSD during that period (Figure WB-6).

Given the considerable uncertainty surrounding the future availability of non-CVP water supplies to AEWSD, AEWSD has taken a conservative approach by applying a 50% reduction to the initial estimates of projected SWP and Kern River imports through the Cross-Valley Canal, Intertie Pipeline, and Kern River conveyance systems entering the District under the Baseline, 2030, and 2070 scenarios described above. This adjustment was made to reflect the possibility that under SGMA implementation, AEWSD may not be able to fully secure additional, non-CVP water supplies via transfers, exchanges, and/or purchases to the extent that they have been able to achieve historically. This approach therefore provides a more conservative estimate of the potential future impacts of reduced surface water supply reliability to AEWSD, and is subsequently used to inform the development of Projects & Management Actions within the Arvin-Edison Management Area (see Section 17 Projects and Management Actions). In all cases AEWSD will continue to implement its policy of aggressively pursuing additional, non-CVP water supplies in order to maintain maximum availability and reliability of surface water imports going forward.

---

76 Alternative perspective on climate change impacts: [https://townhall.com/columnists/pauldriessen/2019/01/19/climate-hysteresis-skyrocket-n2539295](https://townhall.com/columnists/pauldriessen/2019/01/19/climate-hysteresis-skyrocket-n2539295)
9.4.4. **Groundwater Banking Return Obligation**

As described in **Section 5.2.3 Conjunctive Use in the Arvin-Edison Management Area**, AEWSD conducts banking and recovery operations within the Arvin-Edison Management Area for out-of-District entities including the Metropolitan Water District (MWD). As of May 2019, the “balance” in MWD’s water bank account within the Management Area is approximately 153,000 AF. Because the MWD water banking agreement expires in 2034, and assuming that MWD would opt to have its entire balance recovered/returned by that time, the return obligation over the next 15 years to MWD is approximately 10,200 AFY. MWD/AEWSD could also mutually agree to extend the agreement. This return obligation can be met through delivery to MWD of groundwater or an equivalent volume of surface water supplies. This return obligation of banked water to MWD will be fulfilled, if possible, with wet period supplies, transfers/exchanges of surface waters, and otherwise with normal year supplies.

9.4.5. **Projected Water Budget Results**

Results of the projected water budget analysis are summarized in **Table WB-7** for both the entire water budget domain and for the groundwater subdomain, as well as in **Figure WB-22**. As shown in **Table WB-7**, water budget components are presented as averages over the 20-year historical period and averages over the 50-year analog period for the Baseline, 2030 Climate Change, and 2070 Climate Change scenarios. Water budget components are grouped into inflows and outflows, relative to the domain or subdomain they pertain to (also see **Figure WB-2**). Also shown in **Table WB-7** is the average annual change in groundwater storage for the historical period and each projected scenario. Results from **Table WB-7** were subsequently used to inform the development of Projects and Management Actions (P/MAs) as further described in **Section 17 Projects and Management Actions**. Implementation of the P/MAs described in **Section 17** were then input into the 2030 and 2070 projected water budget model scenarios to assess their estimated impacts to the groundwater balance within the Arvin-Edison Management Area. Results of this exercise are presented in **Table WB-8** and briefly mentioned below.

**Baseline Scenario**

In the Baseline Scenario, the water budget components that are not dependent on surface water imports differ only slightly from the historical period. The percent difference from the historical average period to the Baseline Scenario ranges from approximately -1.2% for natural surface water inflows to +3.5% for M&I consumptive use. This demonstrates that the 50-year analog period is a good representation of the historical conditions.

The water budget components that are dependent on surface water imports differ more significantly from the historical averages, due to the different assumptions about imported surface water availability under the Baseline Scenario, as discussed above. Though the total surface water imports component is only 1.2% lower under the Baseline Scenario than it is under the historical period, the supply source portfolio changes considerably relative to historical conditions within AEWSD. In particular, CVP supplies increase by approximately 35.3%, largely stemming from the assumptions incorporated by FWA (2018) to reflect the San Joaquin River Restoration Program (SJRRP) implementation, in particular the estimate of SJRRP Paragraph 16(b) “Recovered Water Account” supplies. This estimated increase in CVP deliveries is fully offset by a projected decrease in SWP and Kern River supplies, which are assumed to decrease by 57.7% and 56%, respectively, after applying the adjustments described in **Sections 9.4.2 and 9.4.3** above.

Overall, the **Baseline Scenario** indicates a net “surplus” (i.e., inflows greater than outflows) of approximately +1,700 AFY. If imported surface water supplies are assumed to be limited only to the CVP
source for which AEWSD has a contract (i.e., removing all future SWP and Kern River imports), the projected water budget for the Baseline Scenario indicates a net deficit (i.e., outflows greater than inflows) of approximately -13,900 AFY. Conversely, if imported SWP and Kern River supplies are assumed to occur in proportions similar to the historical period (i.e., only incorporating the Baseline change factors described in Section 9.4.2 Development of Projected Water Budget Scenarios), then the Baseline Scenario indicates a net surplus of +16,800 AFY.

2030 Climate Change Scenario

Under the 2030 Climate Change Scenario, changes in precipitation, natural surface water inflows, and M&I consumptive use relative to the Baseline Scenario are all relatively small (i.e., relative changes of 0.8% to 2.9% and absolute changes of approximately 100 AFY to 600 AFY). The most significant changes relative to the Baseline Scenario is a reduction in surface water imports of approximately -32,000 AFY (-18.6%). Associated surface water exports and deliveries to the White Wolf Subbasin are also reduced on a proportional basis by approximately -4,100 AFY (-10.7%). Evapotranspiration is greater by approximately 6,000 AFY (+2.7%).

Overall, the 2030 Climate Change Scenario indicates a net deficit of approximately -31,600 AFY. Consistent with the approach being used by all KGA GSA members (and other GSAs in the basin), this estimated net deficit under the 2030 Climate Change Scenario is the amount that the Projects and Management Actions are targeted to address by the GSP implementation deadline (i.e., January 2040). It should be noted that, in addition to this net deficit, AEWSD will need to fulfill the groundwater banking return obligation to MWD discussed in Section 9.4.4 Groundwater Banking Return Obligation above. If imported surface water supplies are limited only to the CVP source, the projected water budget for the 2030 Climate Change Scenario indicates a net deficit of approximately -46,500 AFY. Conversely, if imported surface water supplies are to include full (climate-adjusted) SWP and Kern River supplies, the projected water budget for the 2030 Climate Change Scenario indicates a net deficit of approximately -17,500 AFY.

As shown on Table WB-8 and further described in Section 17.1.4 Implementation Glide Path and in Table PMA-2, AEWSD has proposed to address approximately 70% of the projected deficit of -31,600 AFY by the GSP implementation deadline (i.e., January 2040) through adoption of supply augmentation projects (i.e., ~22,400 AFY), and may address the remaining 30% of the projected deficit (i.e., ~9,600 AFY) through adoption of demand reduction management actions as necessary in order to achieve and maintain the sustainability goal within the Management Area.

It should be noted that the results from the numerical model show that, upon implementation of the planned Projects and Management Actions, the Arvin-Edison Management Area is projected to achieve its sustainability goal (i.e., avoids Minimum Thresholds and Undesirable Results and achieve Measurable Objectives for Chronic Lowering of Groundwater Levels) (see Section 17.8.2 Evaluation Relative to Water Level Sustainability Criteria).

2070 Climate Change Scenario

Under the 2070 Climate Change Scenario, changes in precipitation, natural surface water inflows, and M&I consumptive use relative to the Baseline Scenario are somewhat greater than in the 2030 Climate Change Scenario, but still not significant (i.e., relative changes of -2.1% to 6.9% and absolute changes of approximately 500 AFY to -1,500 AFY). Surface water imports are lower by approximately -58,400 AFY (-33.9%). Surface water exports and deliveries to the White Wolf Subbasin are also lower by approximately -15,500 AFY (-40.9%). Evapotranspiration is greater by approximately +13,300 AFY (+6.0%).
Overall, the 2070 Climate Change Scenario indicates a net deficit of approximately -56,300 AFY. If imported surface water supplies are limited only to the CVP source (i.e., removing all future SWP and Kern River Imports), the projected water budget for the 2070 Climate Change Scenario indicates a net deficit of approximately -68,800 AFY. Conversely, if imported surface water supplies are to include full (climate-adjusted) SWP and Kern River supplies, the projected water budget for the 2070 Climate Change Scenario indicates a net deficit of approximately -44,000 AFY.

As shown on Table WB-8 and further described in Section 17.1.4 Implementation Glide Path and in Table PMA-2, AEWSD has proposed to address approximately 72% of the projected deficit of -56,300 AFY by the end of the 50-year GSP planning and implementation horizon (i.e., January 2070) through adoption of supply augmentation projects (i.e., ~40,800 AFY), and may address the remaining 28% of the projected deficit (i.e., ~15,700 AFY) through adoption of demand reduction management actions as necessary in order to achieve and maintain the sustainability goal within the Management Area.

It should be noted that the results from the numerical model show that, upon implementation of the planned Projects and Management Actions, the Arvin-Edison Management Area is projected to achieve its sustainability goal (i.e., avoids Minimum Thresholds and Undesirable Results and achieve Measurable Objectives for Chronic Lowering of Groundwater Levels) (see Section 17.8.2 Evaluation Relative to Water Level Sustainability Criteria).
TABLE WB‐2
Annual Surface Water Inflows and Outflows by Source Type
Arvin‐Edison Water Storage District
Kern Subbasin Management Area
INFLOWS [AFY]
Surface Water Imports
DWR Water
Year
Friant‐Kern
(Oct ‐ Sept)
Canal

Cross
Valley
Canal

California
WRMWSD
Aqueduct
Deliveries
Kern River
(via Intertie
to Overlap
Pipeline)
Areas

Natural Inflows

Other
(b)

1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
TOTAL
AVERAGE
%

203,813
207,698
155,854
149,995
77,790
104,806
40,650
34,716
92,993
39,878
208,155
182,882
22,132
31,039
73,088
163,675
194,718
32,013
19,925
11,918
2,047,738
102,387
40%

16,435
19,460
1,768
13,389
101,359
150,957
57,624
41,008
62,810
50,736
5,870
35,185
57,535
21,795
2,811
69,725
26,521
75,534
16,048
16,668
843,238
42,162
17%

0
0
0
0
0
0
0
2,772
12,894
9,092
4,467
5,719
4,122
156
1,280
19,419
25,427
38,430
12,499
0
136,277
6,814
3%

8,241
30,548
79,127
65,326
58,243
3,663
2,520
1,693
1,154
0
8,846
16,367
300
14,955
18,209
1,547
0
0
868
0
311,607
15,580
6%

7,102
8,842
10,282
6,446
7,849
8,406
6,315
6,639
6,101
6,965
6,097
6,518
7,702
6,114
6,195
5,742
5,698
6,669
6,629
4,920
137,229
6,861
3%

0
0
0
0
0
0
0
0
0
0
397
103
0
0
0
0
0
0
0
11,666
12,166
608
0%

2015
%

2,001
2%

12,489
10%

0
0%

0
0%

4,478
4%

31,002
26%

Total
Imported
Surface
Water

Direct
Streamflow
Precipitation into District

Total
Natural
Surface
Water
Inflows

TOTAL
SURFACE
WATER
INFLOWS

Historical Water Budget (DWR WY 1995 ‐ 2014)
352,724
235,591
103,801
13,332
117,133
343,332
266,548
71,124
5,660
76,784
331,891
247,031
78,694
6,165
84,860
428,106
235,156
176,666
16,283
192,949
320,422
245,241
69,364
5,818
75,182
315,438
267,832
42,956
4,650
47,606
175,119
107,109
60,737
7,273
68,010
127,616
86,828
37,499
3,290
40,788
261,954
175,952
77,638
8,364
86,002
175,466
106,671
63,554
5,241
68,795
326,333
233,832
81,071
11,431
92,502
321,501
246,774
69,012
5,716
74,727
162,832
91,791
67,339
3,702
71,041
116,037
74,059
37,411
4,568
41,979
164,171
101,583
60,385
2,203
62,588
360,217
260,108
95,947
4,161
100,109
365,037
252,364
104,662
8,011
112,673
206,338
152,646
48,150
5,542
53,692
118,503
55,969
59,329
3,206
62,535
89,662
45,172
43,570
919
44,490
3,488,255
1,448,909
125,535 1,574,444 5,062,699
253,135
174,413
72,445
6,277
78,722
69%
29%
2%
31%
‐
Current Water Budget (DWR WY 2015)
119,553
49,970
65,315
4,269
69,583
42%
55%
4%
58%
‐

Surface Water Exports (c)
Deliveries
Exports to
to White
Total
Metro‐
Wolf
Surface
politan
Subbasin
Water
Water
Customers
Exports
District

OUTFLOWS [AFY]
Natural Outflows
Streamflow
Runoff of
Out of
Excess
District
Precip.
(d)

Total
Natural
Outflows

TOTAL
SURFACE
WATER
OUTFLOWS

27,297
32,646
24,574
21,937
24,103
29,253
25,294
27,380
26,626
28,043
23,227
25,102
25,774
27,268
25,007
23,822
22,627
25,399
26,593
24,568
516,542
25,827
65%

2,816
0
0
2,308
30
0
0
0
12,380
11,573
13,939
0
7,609
42,615
43,080
56,229
16,065
10,010
15,111
45,195
278,960
13,948
35%

30,113
32,646
24,574
24,245
24,133
29,253
25,294
27,380
39,006
39,616
37,166
25,102
33,383
69,883
68,087
80,051
38,692
35,409
41,704
69,763
795,502
39,775
100%

0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0%

0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0%

0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0%

30,113
32,646
24,574
24,245
24,133
29,253
25,294
27,380
39,006
39,616
37,166
25,102
33,383
69,883
68,087
80,051
38,692
35,409
41,704
69,763
795,502
39,775
‐

17,202
20%

67,142
80%

84,344
100%

0
0%

0
0%

0
0%

84,344
‐

Abbreviations
AEWSD
= Arvin‐Edison Water Storage District
AFY
= acre‐feet per year
DWR
= California Department of Water Resources
Precip.
= precipitation
WRMWSD = Wheeler Ridge‐Maricopa Water Storage District
Notes
(a) All values reported in acre‐feet per year (AFY).
(b) "Other" import sources include wheeled surface water and groundwater from Ken Delta Water District.
(c) Surface water exports are blended in AEWSD's delivery network within the Kern Subbasin and thus cannot be distinguished by source type. On certain years, a proportion of deliveries to White Wolf Subbasin customers and/or exports to
Metropolitan Water District may come from groundwater inputs from recovery banking operations into AEWSD's delivery network within the Kern Subbasin.
(d) On exceptionally wet years there is anecdotal knowledge of the City of Lamont (west of the AEWSD boundary) being briefly flooded by runoff waters from Caliente Creek. These surface water "outflows" from the AEWSD Management
Area are difficult to quantify and have thus been noted as existing data gap within the currrent water budget.

December 2019

Page 1 of 1

Arvin-Edison Water Storage District
Kern Management Area Plan


TABLE WB‐3
Annual Inflows to and Outflows from the Groundwater System, and Change in Groundwater Storage
Arvin‐Edison Water Storage District
Kern Subbasin Management Area
INFLOWS [AFY]

OUTFLOWS [AFY]
Groundwater Extraction

DWR Water
Year
Subsurface
Infiltration of
(Oct ‐ Sept) Groudwater
Precipitation
Inflow

Infiltration
Infiltration
from Surface
of Applied
Water
Water
Systems

Recharge
from
Spreading
Basins

1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
TOTAL
AVERAGE
%

18,158
18,373
18,451
16,964
16,344
17,783
17,400
17,448
17,751
16,441
17,078
17,608
17,283
19,116
20,615
19,644
19,987
21,069
20,365
21,798
369,676
18,484
13%

5,410
4,249
4,648
9,302
3,150
2,512
3,310
2,074
3,146
3,599
3,847
3,633
3,297
2,138
3,117
4,754
5,976
2,183
3,149
2,177
75,669
3,783
3%

56,754
63,649
68,321
56,370
66,154
60,822
60,830
58,899
58,190
62,518
46,785
56,864
54,396
52,632
53,854
51,532
56,193
57,859
60,678
55,443
1,158,742
57,937
40%

31,092
31,104
7,744
26,177
13,311
17,132
15,018
11,932
15,904
10,677
15,986
17,841
9,044
12,518
8,013
9,096
8,308
8,505
3,506
3,469
276,377
13,819
9%

70,233
78,246
50,013
91,857
76,794
78,378
63,496
3,818
42,552
7,215
96,703
85,581
22,037
4,109
32,789
70,011
113,373
35,316
3,176
3,919
1,029,615
51,481
35%

2015
%

22,676
27%

3,153
4%

51,042
60%

6,932
8%

1,397
2%

TOTAL
INFLOWS TO Pumpage
Pumpage
GROUND‐ from District
from Private
WATER
Wells
Wells
SYSTEM
(b)

M&I
Pumpage

Historical Water Budget (DWR WY 1995 ‐ 2014)
181,647
14,191
85,494
1,547
195,621
1,095
109,613
2,200
149,177
0
46,401
2,307
200,670
245
45,441
2,126
175,751
915
70,801
2,540
176,627
2,119
92,954
2,740
160,054
100,648
83,063
2,573
94,171
86,879
116,542
2,696
137,544
30,906
96,780
2,772
100,450
75,399
121,478
2,948
180,399
25,104
62,064
2,731
181,526
174
82,702
2,925
106,056
101,517
93,406
3,178
90,512
141,081
92,396
2,958
118,387
128,043
88,842
3,147
155,037
37,081
53,987
2,969
203,837
445
55,598
2,911
124,932
43,589
136,345
2,781
90,874
123,971
115,329
2,992
86,806
151,371
107,228
2,865
2,910,079
1,064,773
1,756,463
53,907
145,504
53,239
87,823
2,695
‐
37%
61%
2%
Current Water Budget (DWR WY 2015)
85,200
136,187
113,001
2,333
‐
54%
45%
1%

CHANGE IN STORAGE

TOTAL
Cumulative
Annual
OUTFLOWS
Change in
Discharge to
Change in
FROM
Subsurface
Evapo‐
Groundwater
Surface
transpiration Groundwater GROUND‐ Groundwater
Storage Since
Water
Storage [AFY]
WATER
Outflow
(c)
WY 1995 [AF]
Sources
SYSTEM
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0%

0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0%

0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0%

101,232
112,908
48,708
47,812
74,256
97,813
186,285
206,117
130,458
199,825
89,899
85,801
198,101
236,435
220,032
94,037
58,954
182,715
242,293
261,463
2,875,144
143,757
‐

69,322
77,044
100,450
142,140
104,357
75,242
‐19,684
‐107,490
4,925
‐100,046
91,449
90,534
‐95,972
‐150,702
‐102,677
64,333
155,838
‐53,645
‐150,593
‐167,556
27,270
1,364
‐

69,322
146,366
246,817
388,957
493,314
568,557
548,873
441,383
446,307
346,262
437,711
528,245
432,273
281,570
178,893
243,226
399,065
345,420
194,827
27,270
27,270
‐
‐

0
0%

0
0%

0
0%

251,521
‐

‐164,385
‐

‐
‐

Abbreviations
AF
= acre‐feet
AFY
= acre‐feet per year
DWR
= California Department of Water Resources
ITRC
= Cal Poly Irrigation Training & Research Center
WY
= Water Year
Notes
(a) All values reported in acre‐feet per year (AFY), except cumulative change in storage (reported in acre‐feet).
(b) This value includes all groundwater extractions from AEWSD wells for its long‐term groundwater banking and recovery program. On certain years, this value also includes minor groundwater inputs to the District delivery
system from private wells that have elected to participate in the District's groundwater "pump‐in" program to augment delivery supplies in times of drought.
(c) There are years for which ITRC‐measured evapotranspiration from non‐irrigated lands exceeds the total measured rainfall to these lands. In these cases, residual water demands on non‐irrigated lands are accounted for
as a reduction in total infiltration ("inflows") rather than an explicit groundwater "outflow" due to evapotranspiration. This is based on the understanding that the groundwater table is fully disconnected from the root
zone under the District. ITRC‐measured residual water demands on non‐irrigated lands are likely caused in part by evaporation from local surface water bodies (e.g., storage ponds) and/or are met by a reduction of root
zone soil moisture, which is not explicitly accounted for in the water budget spreadsheet model.

December 2019

Page 1 of 1

Arvin-Edison Water Storage District
Kern Management Area Plan


### TABLE WB-4
Annual and Cumulative Change in Groundwater Storage between Seasonal Highs (Mar - Feb)
Arvin-Edison Water Storage District
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>Period of Reference [m/yy]</th>
<th>Annual Change in Groundwater Storage [AFY]</th>
<th>Cumulative Change in Groundwater Storage [AF]</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/94 - 2/95</td>
<td>-45,655</td>
<td>-45,655</td>
</tr>
<tr>
<td>3/95 - 2/96</td>
<td>125,796</td>
<td>80,141</td>
</tr>
<tr>
<td>3/96 - 2/97</td>
<td>53,388</td>
<td>133,529</td>
</tr>
<tr>
<td>3/97 - 2/98</td>
<td>114,017</td>
<td>247,547</td>
</tr>
<tr>
<td>3/99 - 2/00</td>
<td>96,004</td>
<td>487,570</td>
</tr>
<tr>
<td>3/00 - 2/01</td>
<td>108,878</td>
<td>596,448</td>
</tr>
<tr>
<td>3/01 - 2/02</td>
<td>-103,469</td>
<td>492,979</td>
</tr>
<tr>
<td>3/02 - 2/03</td>
<td>-99,893</td>
<td>393,086</td>
</tr>
<tr>
<td>3/03 - 2/04</td>
<td>13,779</td>
<td>406,865</td>
</tr>
<tr>
<td>3/04 - 2/05</td>
<td>-114,825</td>
<td>292,040</td>
</tr>
<tr>
<td>3/05 - 2/06</td>
<td>123,293</td>
<td>415,334</td>
</tr>
<tr>
<td>3/06 - 2/07</td>
<td>83,037</td>
<td>498,371</td>
</tr>
<tr>
<td>3/07 - 2/08</td>
<td>-164,012</td>
<td>334,359</td>
</tr>
<tr>
<td>3/08 - 2/09</td>
<td>-143,666</td>
<td>190,693</td>
</tr>
<tr>
<td>3/09 - 2/10</td>
<td>-75,062</td>
<td>115,631</td>
</tr>
<tr>
<td>3/10 - 2/11</td>
<td>155,063</td>
<td>270,694</td>
</tr>
<tr>
<td>3/11 - 2/12</td>
<td>126,733</td>
<td>397,428</td>
</tr>
<tr>
<td>3/12 - 2/13</td>
<td>-120,764</td>
<td>276,664</td>
</tr>
<tr>
<td>3/13 - 2/14</td>
<td>-185,285</td>
<td>91,379</td>
</tr>
<tr>
<td>3/14 - 2/15</td>
<td>-148,324</td>
<td>-56,945</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>-56,945</strong></td>
<td><strong>-56,945</strong></td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td><strong>-2,712</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations**

AF = acre-feet
AFY = acre-feet per year
DWR = California Department of Water Resources
# TABLE WB-5
Supplies, Demands, and Change in Groundwater Storage vs. DWR Water Year Type
Arvin-Edison Water Storage District
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>DWR Water Year (Oct - Sept)</th>
<th>DWR Water Year Type (a)</th>
<th>Total Supplies [AFY] (b)</th>
<th>Total Demands [AFY] (c)</th>
<th>Annual Change in Groundwater Storage [AFY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>W</td>
<td>370,882</td>
<td>278,693</td>
<td>69,322</td>
</tr>
<tr>
<td>1996</td>
<td>W</td>
<td>361,705</td>
<td>291,434</td>
<td>77,044</td>
</tr>
<tr>
<td>1997</td>
<td>W</td>
<td>350,342</td>
<td>255,873</td>
<td>100,450</td>
</tr>
<tr>
<td>1998</td>
<td>W</td>
<td>445,070</td>
<td>287,270</td>
<td>142,140</td>
</tr>
<tr>
<td>1999</td>
<td>AN</td>
<td>336,766</td>
<td>236,134</td>
<td>104,357</td>
</tr>
<tr>
<td>2000</td>
<td>AN</td>
<td>333,220</td>
<td>239,617</td>
<td>75,242</td>
</tr>
<tr>
<td>2001</td>
<td>D</td>
<td>192,519</td>
<td>236,118</td>
<td>-19,684</td>
</tr>
<tr>
<td>2002</td>
<td>D</td>
<td>145,064</td>
<td>239,618</td>
<td>-107,490</td>
</tr>
<tr>
<td>2003</td>
<td>BN</td>
<td>279,705</td>
<td>265,938</td>
<td>4,952</td>
</tr>
<tr>
<td>2004</td>
<td>D</td>
<td>191,907</td>
<td>299,965</td>
<td>-100,046</td>
</tr>
<tr>
<td>2005</td>
<td>W</td>
<td>343,412</td>
<td>252,967</td>
<td>91,449</td>
</tr>
<tr>
<td>2006</td>
<td>W</td>
<td>339,109</td>
<td>244,496</td>
<td>90,534</td>
</tr>
<tr>
<td>2007</td>
<td>C</td>
<td>180,115</td>
<td>281,537</td>
<td>-95,972</td>
</tr>
<tr>
<td>2008</td>
<td>C</td>
<td>135,153</td>
<td>285,796</td>
<td>-150,702</td>
</tr>
<tr>
<td>2009</td>
<td>BN</td>
<td>184,786</td>
<td>286,081</td>
<td>-102,777</td>
</tr>
<tr>
<td>2010</td>
<td>AN</td>
<td>379,861</td>
<td>280,999</td>
<td>64,833</td>
</tr>
<tr>
<td>2011</td>
<td>W</td>
<td>385,024</td>
<td>243,176</td>
<td>155,888</td>
</tr>
<tr>
<td>2012</td>
<td>D</td>
<td>227,407</td>
<td>297,455</td>
<td>-69,972</td>
</tr>
<tr>
<td>2013</td>
<td>C</td>
<td>138,868</td>
<td>286,311</td>
<td>-150,593</td>
</tr>
<tr>
<td>2014</td>
<td>C</td>
<td>111,460</td>
<td>283,614</td>
<td>-167,556</td>
</tr>
<tr>
<td>2015</td>
<td>C</td>
<td>142,229</td>
<td>311,403</td>
<td>-164,385</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Year Type (a)</th>
<th>Number of Years During WY 1995 - 2015 Period</th>
<th>Average Total Supplies [AFY] (b)</th>
<th>Average Total Demands [AFY] (c)</th>
<th>Average Annual Change in Groundwater Storage [AFY]</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>5</td>
<td>141,565</td>
<td>289,732</td>
<td>-145,842</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>189,224</td>
<td>274,165</td>
<td>-84,930</td>
</tr>
<tr>
<td>BN</td>
<td>2</td>
<td>232,246</td>
<td>276,009</td>
<td>-43,763</td>
</tr>
<tr>
<td>AN</td>
<td>3</td>
<td>349,949</td>
<td>252,250</td>
<td>91,341</td>
</tr>
<tr>
<td>W</td>
<td>7</td>
<td>370,792</td>
<td>264,844</td>
<td>103,925</td>
</tr>
</tbody>
</table>

**Abbreviations**

AFY = acre-feet per year  
DWR = California Department of Water Resources  
WY = Water Year

**Notes:**

(a) DWR Water Year Types are as follows: W = wet, AN = above normal, BN = below normal, D = dry, C = critical
(b) Total supplies equal the sum of inflow terms (see Table WB-6 for individual inflow components).
(c) Total demands equal the sum of outflow terms (see Table WB-6 for individual outflow components).
(d) The apparent residual of water-budget calculated change in groundwater storage to [Total Inflows - Total Outflows] can be attributed to the deep percolation lag effect in the water budget spreadsheet model, which serves to delay infiltration from reaching the groundwater system. See “Appendix E - Methods & Data Used in the Water Budget Spreadsheet Model Approach” for further details on how monthly storage change is calculated within the water budget spreadsheet model.

**Sources:**

(1) DWR Water Year Type is from DWR’s Water Year Hydrologic Classification Indices for the San Joaquin Valley  
<http://cdec.water.ca.gov/reportapp/javareports?name=W$\text{SHIST}$.>
## TABLE WB-6
Annual Total Inflows, Outflows, and Change in Groundwater Storage
Arvin-Edison Water Storage District
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>DW Water Year (Oct - Sept)</th>
<th>Subsurface Groundwater Inflow</th>
<th>Outflow [AFY]</th>
<th>Change in Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Precipitation</td>
<td>Surface Water Imports</td>
<td>Natural Surface Water Inflows</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>1995</td>
<td>18,158</td>
<td>103,801</td>
<td>235,591</td>
</tr>
<tr>
<td>1996</td>
<td>18,373</td>
<td>71,124</td>
<td>246,548</td>
</tr>
<tr>
<td>1997</td>
<td>18,451</td>
<td>76,694</td>
<td>247,031</td>
</tr>
<tr>
<td>1998</td>
<td>16,964</td>
<td>176,666</td>
<td>335,156</td>
</tr>
<tr>
<td>1999</td>
<td>16,344</td>
<td>69,364</td>
<td>245,241</td>
</tr>
<tr>
<td>2000</td>
<td>17,783</td>
<td>42,956</td>
<td>267,832</td>
</tr>
<tr>
<td>2001</td>
<td>17,400</td>
<td>60,737</td>
<td>107,109</td>
</tr>
<tr>
<td>2002</td>
<td>17,448</td>
<td>14,699</td>
<td>80,828</td>
</tr>
<tr>
<td>2003</td>
<td>17,751</td>
<td>77,638</td>
<td>175,952</td>
</tr>
<tr>
<td>2004</td>
<td>16,441</td>
<td>63,554</td>
<td>106,671</td>
</tr>
<tr>
<td>2005</td>
<td>17,078</td>
<td>89,071</td>
<td>230,832</td>
</tr>
<tr>
<td>2006</td>
<td>17,608</td>
<td>69,012</td>
<td>246,774</td>
</tr>
<tr>
<td>2007</td>
<td>17,283</td>
<td>67,339</td>
<td>91,781</td>
</tr>
<tr>
<td>2008</td>
<td>19,116</td>
<td>37,411</td>
<td>74,059</td>
</tr>
<tr>
<td>2009</td>
<td>20,615</td>
<td>60,385</td>
<td>101,983</td>
</tr>
<tr>
<td>2010</td>
<td>19,644</td>
<td>95,947</td>
<td>260,108</td>
</tr>
<tr>
<td>2011</td>
<td>19,987</td>
<td>104,462</td>
<td>252,364</td>
</tr>
<tr>
<td>2012</td>
<td>21,069</td>
<td>48,130</td>
<td>152,648</td>
</tr>
<tr>
<td>2013</td>
<td>20,365</td>
<td>59,329</td>
<td>155,969</td>
</tr>
<tr>
<td>2014</td>
<td>21,798</td>
<td>43,570</td>
<td>45,172</td>
</tr>
<tr>
<td>TOTAL</td>
<td>369,676</td>
<td>1,448,909</td>
<td>3,488,255</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>18,484</td>
<td>72,442</td>
<td>174,478</td>
</tr>
</tbody>
</table>

### Abbreviations
- AF = acre-feet
- AFY = acre-feet per year
- DWR = Department of Water Resources
- M&I = municipal & industrial
- WY = Water Year

### Notes
- (a) All values reported in acre-feet per year (AFY), except cumulative change in storage (reported in acre-feet).
- (b) "Evapotranspiration" includes all estimated crop and vegetative evapotranspirative demands as well as evaporation of excess rainfall and from open water bodies within the District.
- (c) M&I Consumption Use includes evapotranspiration on Urban Lands (no other consumptive uses specified within the District), which is in part due by precipitation.
- (d) Apparent residual of water-budget calculated change in groundwater storage to [Total Inflows - Total Outflows] can be attributed to the deep percolation lag effect in the water budget spreadsheet model, which serves to delay infiltration from reaching the groundwater system. See "Appendix E - Methods & Data Used in the Water Budget Spreadsheet Model Approach" for further details on how monthly storage change is calculated within the water budget spreadsheet model.
### Total Water Budget Domain

<table>
<thead>
<tr>
<th>Water Budget Category</th>
<th>Water Budget Component</th>
<th>Historical Period (WY 1995-2014)</th>
<th>Baseline (50-year Synthetic Hydrologic Period)</th>
<th>Projected 2030 Climate (scaled from Baseline Period)</th>
<th>Projected 2070 Climate (scaled from Baseline Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflows</strong></td>
<td>(Net) Subsurface Inflow</td>
<td>18,484</td>
<td>18,519</td>
<td>18,519</td>
<td>18,519</td>
</tr>
<tr>
<td></td>
<td>Precipitation</td>
<td>72,445</td>
<td>72,060</td>
<td>72,653</td>
<td>70,549</td>
</tr>
<tr>
<td></td>
<td>Surface Water Imports</td>
<td>174,413</td>
<td>172,134</td>
<td>140,188</td>
<td>113,784</td>
</tr>
<tr>
<td></td>
<td>Natural Surface Water</td>
<td>6,277</td>
<td>6,200</td>
<td>6,327</td>
<td>6,183</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL INFLOWS</strong></td>
<td><strong>271,619</strong></td>
<td><strong>268,913</strong></td>
<td><strong>237,688</strong></td>
<td><strong>209,035</strong></td>
</tr>
<tr>
<td></td>
<td>Evapotranspiration</td>
<td>223,340</td>
<td>222,533</td>
<td>228,532</td>
<td>235,809</td>
</tr>
<tr>
<td></td>
<td>M&amp;I Consumptive Use</td>
<td>6,715</td>
<td>6,951</td>
<td>7,153</td>
<td>7,429</td>
</tr>
<tr>
<td><strong>Outflows</strong></td>
<td>Surface Water Exports &amp; Deliveries to White Wolf Subbasin</td>
<td>39,775</td>
<td>37,996</td>
<td>33,912</td>
<td>22,453</td>
</tr>
<tr>
<td></td>
<td>Natural Surface Water Outflows</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Subsurface Groundwater Outflow</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL OUTFLOWS</strong></td>
<td><strong>269,830</strong></td>
<td><strong>267,480</strong></td>
<td><strong>269,597</strong></td>
<td><strong>265,691</strong></td>
</tr>
<tr>
<td><strong>Change in Groundwater Storage</strong></td>
<td>Equivalent to &quot;Deficit&quot;</td>
<td>1,364</td>
<td>1,660</td>
<td>-31,586</td>
<td>-56,333</td>
</tr>
</tbody>
</table>

### Groundwater Subdomain

<table>
<thead>
<tr>
<th>Water Budget Category</th>
<th>Water Budget Component</th>
<th>Historical Period (WY 1995-2014)</th>
<th>Baseline (50-year Synthetic Hydrologic Period)</th>
<th>Projected 2030 Climate (scaled from Baseline Period)</th>
<th>Projected 2070 Climate (scaled from Baseline Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groundwater Inflows</strong></td>
<td>(Net) Subsurface Inflow</td>
<td>18,484</td>
<td>18,519</td>
<td>18,519</td>
<td>18,519</td>
</tr>
<tr>
<td></td>
<td>Infiltration of Precipitation</td>
<td>3,783</td>
<td>3,857</td>
<td>3,853</td>
<td>3,704</td>
</tr>
<tr>
<td></td>
<td>Infiltration of Applied Water</td>
<td>52,937</td>
<td>70,660</td>
<td>69,173</td>
<td>68,198</td>
</tr>
<tr>
<td></td>
<td>Infiltration from Surface Water Systems</td>
<td>13,819</td>
<td>17,375</td>
<td>14,237</td>
<td>16,101</td>
</tr>
<tr>
<td></td>
<td>Recharge from Spreading Basins</td>
<td>51,481</td>
<td>42,192</td>
<td>36,381</td>
<td>31,941</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL GW INFLOWS</strong></td>
<td><strong>145,504</strong></td>
<td><strong>152,603</strong></td>
<td><strong>142,163</strong></td>
<td><strong>138,452</strong></td>
</tr>
<tr>
<td><strong>Groundwater Outflows</strong></td>
<td>Pumpage from District Wells</td>
<td>54,239</td>
<td>54,258</td>
<td>54,258</td>
<td>54,258</td>
</tr>
<tr>
<td></td>
<td>Pumpage from Private Wells</td>
<td>87,323</td>
<td>94,145</td>
<td>117,046</td>
<td>138,076</td>
</tr>
<tr>
<td></td>
<td>M&amp;I Pumpage</td>
<td>2,695</td>
<td>2,743</td>
<td>2,743</td>
<td>2,743</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL GW OUTFLOWS</strong></td>
<td><strong>143,757</strong></td>
<td><strong>151,145</strong></td>
<td><strong>174,047</strong></td>
<td><strong>195,076</strong></td>
</tr>
<tr>
<td><strong>Change in Groundwater Storage</strong></td>
<td>Equivalent to &quot;Deficit&quot;</td>
<td>1,364</td>
<td>1,660</td>
<td>-31,586</td>
<td>-56,333</td>
</tr>
</tbody>
</table>

**Notes**

(a) All values reported in acre-feet per year (AFY).
(b) Projected GW Inflow terms based on Estimated Net Groundwater Inflows from Calibrated Historical Water Budget
(c) "Evapotranspiration" includes all estimated crop and vegetative evapotranspirative demands as well as evaporation of excess rainfall from open water bodies within the District.
(d) M&I Consumptive Use includes evapotranspiration on Urban Lands (no other consumptive uses specified within the District), which is in part met by precipitation.
(e) This value includes all groundwater extractions from AEWSD wells for its long-term groundwater banking and recovery program. On certain years, this value also includes minor groundwater inputs to the District delivery system from private wells that have elected to participate in the District's groundwater "pump-in" program.
(f) Apparent residual of water-budget calculated change in groundwater storage to [Total Inflows - Total Outflows] can be attributed to the deep percolation lag effect in the water budget spreadsheet model, which serves to delay infiltration from reaching the groundwater system. See "Appendix E - Methods & Data Used in the Water Budget Spreadsheet Model Approach" for further details on how monthly storage change is calculated within the water budget spreadsheet model.
## Summary of Projected Water Budget with Project & Management Implementation

**Arvin-Edison Water Storage District**

**Kern Subbasin Management Area**

### Total Water Budget Domain

<table>
<thead>
<tr>
<th>Water Budget Category</th>
<th>Water Budget Component</th>
<th>Historical Period (WY 1995-2014)</th>
<th>50-year Synthetic Hydrologic Period</th>
<th>2030 Climate (scaled from Baseline Period)</th>
<th>2070 Climate (scaled from Baseline Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Net) Subsurface Inflow (a)</td>
<td>18,484</td>
<td>18,519</td>
<td>18,519</td>
<td>18,519</td>
<td></td>
</tr>
<tr>
<td>Precipitation</td>
<td>72,445</td>
<td>72,060</td>
<td>72,653</td>
<td>70,549</td>
<td></td>
</tr>
<tr>
<td>Surface Water Imports</td>
<td>174,413</td>
<td>172,134</td>
<td>140,188</td>
<td>113,784</td>
<td></td>
</tr>
<tr>
<td>P&amp;M Augmented Supplies</td>
<td>-</td>
<td>0</td>
<td>22,400</td>
<td>40,775</td>
<td></td>
</tr>
<tr>
<td>Natural Surface Water Inflows</td>
<td>6,277</td>
<td>6,200</td>
<td>6,327</td>
<td>6,183</td>
<td></td>
</tr>
<tr>
<td>TOTAL INFLOWS</td>
<td>271,619</td>
<td>268,913</td>
<td>260,088</td>
<td>249,810</td>
<td></td>
</tr>
<tr>
<td><strong>Outflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P&amp;M Demand Reduction</td>
<td>6,715</td>
<td>6,951</td>
<td>7,153</td>
<td>7,429</td>
<td></td>
</tr>
<tr>
<td>M&amp;I Consumptive Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Water Exports &amp; Deliveries to White Wolf Subbasin</td>
<td>39,775</td>
<td>37,996</td>
<td>33,912</td>
<td>22,453</td>
<td></td>
</tr>
<tr>
<td>Natural Surface Water Outflows</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Subsurface Groundwater Outflow</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>TOTAL OUTFLOWS</td>
<td>269,830</td>
<td>267,480</td>
<td>259,997</td>
<td>249,966</td>
<td></td>
</tr>
<tr>
<td><strong>Change in Groundwater Storage</strong></td>
<td></td>
<td>1,364</td>
<td>1,660</td>
<td>343</td>
<td>28</td>
</tr>
</tbody>
</table>

### Groundwater Subdomain

<table>
<thead>
<tr>
<th>Water Budget Category</th>
<th>Water Budget Component</th>
<th>Historical Period (WY 1995-2014)</th>
<th>50-year Synthetic Hydrologic Period</th>
<th>2030 Climate (scaled from Baseline Period)</th>
<th>2070 Climate (scaled from Baseline Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groundwater Inflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Net) Subsurface Inflow (a)</td>
<td>18,484</td>
<td>18,519</td>
<td>18,519</td>
<td>18,519</td>
<td></td>
</tr>
<tr>
<td>Infiltration of Precipitation</td>
<td>3,783</td>
<td>3,857</td>
<td>3,879</td>
<td>3,752</td>
<td></td>
</tr>
<tr>
<td>Infiltration of Applied Water</td>
<td>57,937</td>
<td>70,660</td>
<td>72,727</td>
<td>74,610</td>
<td></td>
</tr>
<tr>
<td>Infiltration from Surface Water Systems</td>
<td>13,819</td>
<td>17,375</td>
<td>14,273</td>
<td>16,169</td>
<td></td>
</tr>
<tr>
<td>Recharge from Spreading Basins</td>
<td>51,481</td>
<td>42,192</td>
<td>36,881</td>
<td>31,931</td>
<td></td>
</tr>
<tr>
<td>TOTAL GW INFLOWS</td>
<td>145,504</td>
<td>152,603</td>
<td>145,780</td>
<td>144,981</td>
<td></td>
</tr>
<tr>
<td><strong>Groundwater Outflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumptage from District Wells (c)</td>
<td>53,239</td>
<td>54,258</td>
<td>54,258</td>
<td>54,258</td>
<td></td>
</tr>
<tr>
<td>Pumptage from Private Wells</td>
<td>87,823</td>
<td>94,145</td>
<td>88,663</td>
<td>88,105</td>
<td></td>
</tr>
<tr>
<td>M&amp;I Pumpage</td>
<td>2,695</td>
<td>2,743</td>
<td>2,743</td>
<td>2,743</td>
<td></td>
</tr>
<tr>
<td>TOTAL GW OUTFLOWS</td>
<td>143,757</td>
<td>151,145</td>
<td>145,663</td>
<td>145,105</td>
<td></td>
</tr>
<tr>
<td><strong>Change in Groundwater Storage</strong></td>
<td></td>
<td>1,364</td>
<td>1,660</td>
<td>343</td>
<td>28</td>
</tr>
</tbody>
</table>

### Notes

(a) All values reported in acre-feet per year (AFY).
(b) Projected GW Inflow terms based on Estimated Net Groundwater Inflows from Calibrated Historical Water Budget
(c) "Evapotranspiration" includes all estimated crop and vegetative evapotranspirative demands as well as evaporation of excess rainfall and from open water bodies within the District.
(d) M&I Consumptive Use includes evapotranspiration on Urban Lands (no other consumptive uses specified within the District), which is in part met by precipitation.
(e) This value includes all groundwater extractions from AEWSD wells for its long-term groundwater banking and recovery program. On certain years, this value also includes minor groundwater inputs to the District delivery system from private wells that have elected to participate in the District’s groundwater “pump-in” program.
(f) Apparent residual of water-budget calculated change in groundwater storage to [Total Inflows - Total Outflows] can be attributed to the deep percolation lag effect in the water budget spreadsheet model, which serves to delay infiltration from reaching the groundwater system. See “Appendix E - Methods & Data Used in the Water Budget Spreadsheet Model Approach” for further details on how monthly storage change is calculated within the water budget spreadsheet model.
Water Budget Domains and Subdomains

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Figure WB-1

EXTERNAL

Atmosphere
Watersheds
Out-of-District Water (artificial channels)
Adjacent Groundwater

WATER BUDGET DOMAIN

ARTIFICIAL CHANNELS

NATURAL CHANNELS

SPREADING GROUNDS

AGRICULTURAL LANDS

GROUNDSWATER SYSTEM

URBAN LANDS

INTERNAL SUBDOMAINS
Annual Surface Water Inflows by Source

Arvin Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Figure WB-3

Legend
- Surface Water Imports
- Direct Precipitation
- Streamflow into District

Abbreviations
- AFY = acre-feet per year
- DWR = California Department of Water Resources
Abbreviations
AF = acre-feet

Notes
1. Annual volumes reported by Arvin-Edison Water Year, which extends March – February of the following year.
Annual Surface Water Imports by Source

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-5

Abbreviations
AFY = acre-feet per year
WRMWSD = Wheeler Ridge-Maricopa Water Storage District
DWR = California Department of Water Resources

Notes
1. “Other” sources include wheeled surface water & groundwater from Kern Delta Water District.
### Abbreviations
- **AFY**: acre-feet per year
- **WRMWSD**: Wheeler Ridge-Maricopa Water Storage District
- **WY**: Water Year

### Notes
1. All values reported in acre-feet per year (AFY).

### Summary of Surface Water Import Sources, WY 1995 - 2014

#### Arvin-Edison Water Storage District
Kern County, California
December 2019

#### Total Average Annual Imports: 174,419 AFY

- **Friant-Kern Canal**: 102,387 AFY (59%)
- **Cross Valley Canal**: 42,162 AFY (24%)
- **Kern River**: 15,580 AFY (9%)
- **California Aqueduct (via Intertie Pipeline)**: 6,814 AFY (4%)
- **WRMWSD Deliveries to Overlap Areas**: 6,868 AFY (4%)
- **Other**: 608 AFY (0%)

Legend:
- Blue = Friant-Kern Canal
- Orange = Cross Valley Canal
- Green = California Aqueduct
- Yellow = Kern River
- Black = WRMWSD Deliveries to Overlap Areas
- Gray = Other
Legend

- Deliveries to White Wolf Subbasin Customers
- Exports to Metropolitan Water District

Abbreviations

- AFY = acre-feet per year
- DWR = California Department of Water Resources

Notes

1. Surface water outflows are blended in Arvin-Edison’s delivery network before leaving the Kern Subbasin and on certain years may include a proportion of groundwater inputs from recovery banking operations.
Legend

Groundwater Inflows

- Subsurface GW Inflow
- Infiltration of Applied Water
- Infiltration of Precipitation
- Infiltration from Surface Water Systems
- Recharge from Spreading Basins

Groundwater Outflows

- Groundwater Extraction

Change in Groundwater Storage

- Gain in GW Storage
- Reduction in GW Storage

Abbreviations

DWR = California Department of Water Resources
GW = groundwater

Notes

1. “Groundwater Extraction” includes all District, private, and municipal & industrial groundwater pumping.
Summary of Groundwater Inflows & Outflows, WY 1995 - 2014

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Figure WB-9

Legend

Groundwater Inflows
- Subsurface GW Inflow
- Infiltration of Applied Water
- Infiltration of Precipitation
- Infiltration from Surface Water Systems
- Recharge from Spreading Basins

Groundwater Outflows
- Groundwater Extraction

Abbreviations
AFY = acre-feet per year
GW = groundwater
WY = Water Year

Notes
1. All values reported in acre-feet per year (AFY).
2. “Groundwater Extraction” includes all District, private, and municipal & industrial groundwater pumping.
Abbreviations

AFY = acre-feet per year

Notes

1. “Seasonal high” condition is defined as March – February of the following year.
Abbreviations

AF = acre-feet

Notes

1. Values represent cumulative change in storage since the “seasonal high” condition of March 1994.
Annual Change in Storage vs. DWR Water Year Type

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Legend

DWR Water Year Type

- Wet
- Above Normal
- Below Normal
- Dry
- Critical

Abbreviations

AFY = acre-feet per year

Sources

1. DWR Water Year Type is from DWR’s Water Year Hydrologic Classification Indices for the San Joaquin Valley <http://cdec.water.ca.gov/reportapp/javareports?name=WSIHISt>.
Legend

DWR Water Year Type

- Wet
- Above Normal
- Below Normal
- Dry
- Critical

Abbreviations

AF = acre-feet

Sources

1. DWR Water Year Type is from DWR’s Water Year Hydrologic Classification Indices for the San Joaquin Valley
   <http://cdec.water.ca.gov/reportservlet/javareports?name=WSIHIST>.

Cumulative Change in Storage vs. DWR Water Year Type

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Figure WB-13
Comparison of Modeled & Water Level-Based Estimated Change in Storage

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-14

Legend
- Raster-Based Estimated Change In Storage (AF)
- Water Budget Spreadsheet Model-Calculated Change In Storage (AF)

Abbreviations
AF = acre-feet

Notes
1. Calibration of the water budget spreadsheet model was performed for the District’s entire service area, including the portion within the White Wolf Subbasin.
Summary of Total Inflows & Outflows, WY 2015

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-15

**Inflows**
- **Subsurface GW Inflow**: 22,676 AFY (3%)
- **Precipitation**: 65,315 AFY (46%)
- **Surface Water Imports**: 49,970 AFY (35%)
- **Natural Surface Water Inflows**: 4,269 AFY (3%)

Total Inflows: 142,229 AFY

**Outflows**
- **Surface Water Exports & Deliveries to WWB**: 84,344 AFY (27%)
- **Evapotranspiration**: 217,977 AFY (70%)
- **M&I Consumptive Use**: 9,082 AFY (3%)
- **Subsurface Groundwater Outflow**: 0 AFY (0%)
- **Natural Surface Water Outflows**: 0 AFY (0%)

Total Outflows: 311,403 AFY

**Abbreviations**
- AFY = acre-feet per year
- GW = groundwater
- M&I = municipal & industrial
- WWB = White Wolf Subbasin
- WY = Water Year

**Notes**
1. All values reported in acre-feet per year (AFY).
Summary of Groundwater Inflows & Outflows, WY 2015

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Figure WB-16

**Groundwater Inflows**
- Subsurface GW Inflow
- Infiltration of Applied Water
- Infiltration of Precipitation
- Infiltration from Surface Water Systems
- Recharge from Spreading Basins

**Groundwater Outflows**
- Groundwater Extraction

**Abbreviations**
- AF = acre-feet
- GW = groundwater
- WY = Water Year

**Notes**
1. All values reported in acre-feet (AF).
2. “Groundwater Extraction” includes all District, private, and municipal & industrial groundwater pumping.
Abbreviations

AFY = acre-feet per year
DWR = California Department of Water Resources

Notes
1. AEWSD’s Class 1 Contract is 40,000 AFY.
2. AEWSD’s Class 2 Contract is 311,675 AFY.
Legend

**Inflows**

- Subsurface GW Inflow
- Surface Water Imports
- Precipitation
- Natural Surface Water Inflows

**Outflows**

- Surface Water Exports & Deliveries to WWB
- M&I Consumptive Use
- Evapotranspiration

**Change in Groundwater Storage**

- Gain in GW Storage
- Reduction in GW Storage

**Abbreviations**

- DWR = California Department of Water Resources
- GW = groundwater
- M&I = municipal & industrial
- WWB = White Wolf Subbasin

**Annual Inflows & Outflows**

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Figure WB-18
Summary of Total Inflows & Outflows, WY 1995 - 2014
Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-19

Legend

Inflows
- Subsurface GW Inflow
- Surface Water Imports
- Precipitation
- Natural Surface Water Inflows

Outflows
- Surface Water Exports & Deliveries to WWB
- M&I Consumptive Use
- Evapotranspiration

Abbreviations
- AFY = acre-feet per year
- GW = groundwater
- M&I = municipal & industrial
- WWB = White Wolf Subbasin
- WY = Water Year

Notes
1. All values reported in acre-feet per year (AFY).
Water Supply Portfolio and Annual Precipitation, WY 1995 - 2015

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-20

Abbreviations
AFY = acre-feet per year

Legend
= Precipitation
= Surface Water Imports
= District Pumpage
= Private Pumpage
Observed vs. Modeled Change in Water Levels, WY 1995 - 2015

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-21
Projected Water Budget Supplies, Demands, and Shortfall Before Project & Management Action Implementation

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-22
10. MANAGEMENT AREAS

The information presented in the Basin Setting sections of this GSP (i.e., Section 7 Hydrogeologic Conceptual Model, Section 8 Current and Historical Groundwater Conditions and Section 9 Water Budget Information) is specific to and describes conditions within the Arvin-Edison Management Area. As discussed in Section 5.1.6 Lands Outside of District Covered by MA Plan, information regarding the undistricted lands (i.e., “White Lands”) covered by this MA Plan is presented in Appendix C.

10.1. Description and Justification

As discussed previously in Section 5 Description of the Plan Area, the Kern Subbasin is overlain by a large number of entities with water or land use management authority. A subset of these entities formed the Kern Groundwater Authority GSA. AEWSD is a member of the KGA GSA but is locally responsible for SGMA compliance within a specific portion of the KGA GSA -- the Arvin-Edison Management Area. This Management Area includes all of AEWSD’s service area within the Kern Subbasin except that portion which is overlain by the East Niles Community Services District (see Figure HCM-1).

The reason for creation of the Arvin-Edison Management Area is to ensure that AEWSD maintains maximum flexibility and control over sustainable groundwater management within the portion of its service area where land and water use is predominantly agricultural, and where there is a strong nexus between AEWSD management decisions and groundwater conditions.

The Arvin-Edison Management Area encompasses the entire boundaries of ACSD, an urban water supplier to a severely disadvantaged community ACSD has a right to control its groundwater wells and water system in compliance with all applicable Federal and State regulations. ACSD, as a component of the Arvin-Edison MA Plan, recognizes and acknowledges that the operation of its water wells and water system should be consistent with this MA Plan based on the needs of an urban water supplier. ACSD would provide input and feedback under the Arvin-Edison MA Plan to achieve the objectives contained herein. AEWSD and ACSD have entered into the MOU dated January 1, 2019 stating that ACSD will fully cooperate with AEWSD regarding the implementation of the KGA GSA, including taking steps as outlined in this MA Plan.

10.2. Minimum Thresholds and Measurable Objectives

The Sustainable Management Criteria developed for the Arvin-Edison Management Area, including the rationale for their selection, are described in detail in Section 14 Minimum Thresholds and Section 15 Measurable Objectives and Interim Milestones.
10.3. Monitoring

☐ 23 CCR § 354.20(b)(3)

Monitoring networks for each applicable Sustainability Indicator, including a discussion of the level of monitoring and an analysis appropriate for the Arvin-Edison Management Area, are described in detail in Section 16 Monitoring Network.
11. INTRODUCTION TO SUSTAINABLE MANAGEMENT CRITERIA

The Sustainable Groundwater Management Act (SGMA) legislation defines “Sustainability Goal” as “the existence and implementation of one or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield” (California Water Code [CWC] § 10721(u)). SGMA requires Groundwater Sustainability Plans (GSPs) to develop and implement plans to meet the Sustainability Goal (CWC § 10727(a)) and defines terms related to achievement of the Sustainability Goal, including:

- **Interim Milestone** - a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan (23 CCR § 351(q))
- **Measurable Objective** - specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin (23 CCR § 351(s))
- **Minimum Threshold** - a numeric value for each sustainability indicator used to define undesirable results (23 CCR § 351(t))

Collectively, the Sustainability Goal, Interim Milestones, Measurable Objectives, and Minimum Thresholds are referred to herein as Sustainable Management Criteria (SMCs).

The GSP Emergency Regulations specify how Groundwater Sustainability Agencies (GSAs) must establish SMCs for each applicable Sustainability Indicator. Sections 12, 13, 14, and 15 of this GSP describe the Sustainability Goal, Undesirable Results, Minimum Thresholds, and Measurable Objectives and Interim Milestones, respectively, developed as part of this MA Plan.
12. SUSTAINABILITY GOAL

The Sustainability Goal for the Arvin-Edison Management Area is to maintain an economically-viable groundwater resource that supports the current and future beneficial uses of groundwater (including municipal, agricultural, industrial, public supply, domestic, and environmental) by utilizing the area’s groundwater resources within the local sustainable yield. Long-term groundwater sustainability will be evaluated and maintained in compliance with locally-defined sustainability criteria. The Management Area will remain in compliance through the continued importation of surface water as well as implementation of projects and management actions to both increase water supplies and reduce demands within the Management Area. The District’s historical efforts to achieve a balanced and sustainable water supply for all lands, including to both the Surface Water Service Area and the Groundwater Service Area, and in an equitable manner, will continue under SGMA.

The local sustainability goal, above, is consistent with and in addition to the basin-wide sustainability goal being adopted by all GSAs in the Kern Subbasin, defined below:

“The sustainability goal of the Kern County Subbasin is to:

- Achieve sustainable groundwater management in the Kern County Subbasin through the implementation of projects and management actions at the member agency level of each GSA
- Maintain its groundwater use within the sustainable yield of the basin.
- Operate within the established sustainable management criteria, which are based on the collective technical information presented in the GSPs in the Subbasin.
- Implement projects and management actions that include a variety of water supply development and demand management actions.
- Collectively bring the Subbasin into sustainability and to maintain sustainability over the implementation and planning horizon.

Further, the Subbasin sustainability goal includes a commitment to monitor and report groundwater conditions, as required by SGMA, and to continue coordination among the KGA member agencies and all other GSA’s in the Subbasin to identify the potential for, or presence of, undesirable results and actions to prevent undesirable results. The coordination process established in the development of this GSP and memorialized in the Coordination Agreement will ensure that the Subbasin is managed as a shared groundwater resource and that the districts within the Subbasin work collaboratively towards achieving and maintaining sustainable groundwater use.”
13. UNDESIRABLE RESULTS

This section describes the Undesirable Results defined for the Arvin-Edison Management Area. Pursuant to the GSP Emergency Regulations, which state that Undesirable Results are to be defined consistently throughout the basin (23 CCR § 354.20), definitions of Undesirable Results have been developed through a coordinated effort of the Kern Subbasin GSAs and are described in the Umbrella GSP.

As discussed below for each Sustainability Indicator, the Undesirable Results definitions for the Basin refer to and rely on Minimum Thresholds established at the local management area level. Specifically, Undesirable Results for the Basin occur when Minimum Thresholds for a certain percentage (by acreage) of management areas are exceeded. Each management area determines what the local Minimum Thresholds values are and what combination of local exceedances constitutes a local Undesirable Result. If a local Undesirable Result manifests in a management area, that area begins to count towards the basin-wide Undesirable Results definition.

In the following sections, the Undesirable Results statements adopted by the KGA GSA and other Basin GSAs for each Sustainability Indicator are presented, along with a description of the local Arvin-Edison Management Area definition of Undesirable Results (i.e., what combination of Minimum Threshold exceedances, if any, constitutes a local Undesirable Result). AEWSD has coordinated with entities in the South of Kern River portion of the Kern Basin on these local definitions of Undesirable Results and the methodologies for developing associated Sustainability Criteria within their respective management areas.

13.1. Undesirable Results for Chronic Lowering of Groundwater Levels

The basin-wide definition of Undesirable Results for Chronic Lowering of Groundwater Levels is as follows:

“The point at which significant and unreasonable impacts over the planning and implementation horizon, as determined by depth/elevation of water, affect the reasonable and beneficial use of, and access to, groundwater by overlying users.

This is determined when the minimum threshold for groundwater levels are exceeded in at least three (3) adjacent management areas which represent at least 15% of the subbasin or greater than 30% of the subbasin (as measured by each Management Area). Minimum thresholds shall be set by each of the management areas through their respective Groundwater Sustainability Plans.”

The above basin-wide definition requires local definition within each management area of the Minimum Thresholds and combination of exceedances that constitute a significant and unreasonable impact to the reasonable and beneficial use of, and access to, groundwater by overlying users. As such, it is necessary to consider local conditions and beneficial uses and users within each management area.

13.1.1. Potential Causes of Undesirable Results

Potential causes of Undesirable Results due to Chronic Lowering of Groundwater Levels in the Arvin-Edison Management Area include increased pumping and/or reduced recharge. The primary use of
groundwater from the principal aquifer in the Arvin-Edison Management Area is for agricultural purposes, including pumping from private wells and pumping from AEWSD wells for recovery and delivery of previously banked groundwater. Groundwater is pumped for M&I use in the City of Arvin and for industrial use at several crop processing facilities within the Management Area. Groundwater is also pumped for domestic use by a small number of domestic wells. Increased pumping from the principal aquifer could occur if new land is put into agricultural production or if water use per acre on existing irrigated land increases. Pumping from the principal aquifer for potable domestic use is relatively small and unlikely to substantially increase. Reduced recharge could occur due to increased agricultural irrigation efficiency, reduced surface water imports and banking, reduced groundwater inflows from adjacent areas, or due to climate change that results in decreased precipitation and increased ET, as discussed in Section 9.4 Projected Water Budget.

13.1.2. Criteria Used to Define Undesirable Results

- **23 CCR § 354.26(b)(2)
- **23 CCR § 354.26(c)

Per Section 354.26(b)(2) of the GSP Emergency Regulations, the description of Undesirable Results must include a quantitative description of the number of Minimum Threshold exceedances that constitute an Undesirable Result. As discussed further below in Section 14 Minimum Thresholds and in Section 16 Monitoring Network, within the Arvin-Edison Management Area, Minimum Thresholds for groundwater levels are set at 16 Representative Monitoring Sites by considering groundwater levels and trends, well depths (i.e., beneficial users), and proximity to critical infrastructure. In a similar manner to how Undesirable Results are defined at the basin level, at the local Arvin-Edison Management Area level it is considered an Undesirable Result for Chronic Lowering of Groundwater Levels if Minimum Thresholds are exceeded in 40% or more of the Representative Monitoring Sites (i.e., 7 out of 16 sites) over four consecutive seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high groundwater level periods and two seasonal low groundwater level periods).

13.1.3. Potential Effects of Undesirable Results

- **23 CCR § 354.26(b)(3)

The primary potential effects of Undesirable Results caused by Chronic Lowering of Groundwater Levels on beneficial uses and users of groundwater in the Arvin-Edison Management Area include groundwater well dewatering, increased pumping lift, and potential land subsidence. Excessive well dewatering is detrimental to wells as it can lead to increased maintenance costs (i.e., well rehabilitation/redevelopment, pump lowering) and reduced well lifespan due to corrosion of well casing and screen, and in some cases the need to replace wells with deeper wells. Increased pumping lift results in more energy use per unit volume of groundwater pumped and greater pumping costs and can cause increased wear and tear on

---

77 AEWSD has proposed a Well Dewatering Mitigation Program to address these potential impacts to beneficial users (see Sections 14.1 and 18.1.6).
well pumps/motors. Land subsidence can affect critical infrastructure as discussed further below in
Section 13.5 Undesirable Results for Land Subsidence.

13.2. Undesirable Results for Reduction of Groundwater Storage

The basin-wide of Undesirable Results for Reduction of Groundwater Storage is as follows:

“The point at which significant and unreasonable impacts, as determined by the amount
of groundwater in the basin, affect the reasonable and beneficial use of, and access to,
groundwater by overlying users over an extended drought period.

This is determined when the volume of storage (above the groundwater level minimum
thresholds) is depleted to an elevation lower than the groundwater level minimum
threshold in at least three (3) adjacent management areas that represent at least 15% of
the subbasin or greater than 30% of the subbasin (as measured by the acreage of each
Management Area).

Minimum thresholds shall be set by each of the management areas through their
respective Groundwater Sustainability Plans.”

The above basin-wide definition ties the Undesirable Result for Reduction of Groundwater Storage directly
to the Minimum Thresholds for Chronic Lowering of Groundwater Levels which, as stated above, are
defined locally within each management area of the Kern Subbasin.

13.2.1. Potential Causes of Undesirable Results

☐ 23 CCR § 354.26(b)(1)

Reduction of Groundwater Storage is directly, if not linearly, correlated to Chronic Lowering of
Groundwater Levels. Therefore, the potential causes of Undesirable Results due to Reduction in
Groundwater Storage are generally the same as the potential causes listed above for Undesirable Results
due to Chronic Lowering of Groundwater Levels (i.e., increased groundwater pumping and reduced
recharge).

13.2.2. Criteria Used to Define Undesirable Results

☐ 23 CCR § 354.26(b)(2)
☐ 23 CCR § 354.26(c)

The criteria used to define Undesirable Results for Reduction of Groundwater Storage in the basin-wide
definition above are the Minimum Thresholds established at a local management area level for Chronic
Lowering of Groundwater Levels. Furthermore, Minimum Thresholds set related to Subsidence protect
against excessive loss of aquifer storage (and resulting reduction of Groundwater Storage). Extending this
definition to the local Arvin-Edison Management Area level, it would be considered significant and
unreasonable (i.e., an Undesirable Result) if groundwater storage were to be reduced by an amount that
would cause the groundwater levels in at least 40% of Representative Monitoring Sites (i.e., 7 of 16 sites)
to exceed their Minimum Thresholds for Chronic Lowering of Groundwater Levels over four consecutive
seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high
groundwater level periods and two seasonal low groundwater level periods). As discussed below in
Section 14.2 Minimum Threshold for Reduction of Groundwater Storage, due to the great depth of fresh
water and wells able to access it, there is significant usable groundwater storage within the Management Area even below the elevation of the Minimum Thresholds. As such, on a local level it is not necessary to define unique SMCs for Reduction of Groundwater Storage; the criteria set for Chronic Lowering of Groundwater Levels are “protective” and a reasonable proxy.

### 13.2.3. Potential Effects of Undesirable Results

**23 CCR § 354.26(b)(3)**

The primary potential effect of Undesirable Results caused by Reduction of Groundwater Storage on beneficial uses and users of groundwater in the Arvin-Edison Management Area is reduced groundwater supply reliability. The effect of reduced groundwater supply reliability would be most significant during periods of reduced surface water supply availability due to, for example, natural drought conditions, regulatory restrictions, natural disasters, or other causes. However, as discussed below, there is significant groundwater storage within the Management Area, and so these effects are unlikely to occur.

### 13.3. Undesirable Results for Seawater Intrusion

**23 CCR § 354.26(d)**

The GSP Emergency Regulations state that “An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators” (23 CCR § 354.26(d)). Because the Kern Subbasin is not located near any saline water bodies, seawater intrusion is not present and not likely to occur, the Seawater Intrusion Sustainability Indicator is not applicable to the Kern Subbasin, and therefore no Undesirable Results for this Sustainability Indicator are defined for the Subbasin.

### 13.4. Undesirable Results for Degraded Water Quality

The basin-wide definition of Undesirable Results for Degraded Water Quality is as follows:

“The point at which significant and unreasonable impacts over the planning and implementation horizon, as caused by water management actions, that affect the reasonable and beneficial use of, and access to, groundwater by overlying users.

This is determined when the minimum threshold for a groundwater quality constituent of concern is exceeded in at least three (3) adjacent management areas which represent at least 15% of the subbasin or greater than 30% of the designated monitoring points within the basin. Minimum thresholds shall be set by each of the management areas through their respective Groundwater Sustainability Plans.”

As with Chronic Lowering of Groundwater Levels, the above basin-wide definition allows for local definition of the Minimum Thresholds used to gauge Undesirable Results. Key to the basin-wide definition is the phrase “as caused by water management actions”. It is possible that water management actions affect water quality issues, whether those issues result from human action (e.g., nitrates) or are naturally occurring (e.g., arsenic). What remains unresolved is whether, and to what extent, groundwater levels affect the concentration of contaminants in groundwater, regardless of their source. It is proposed to
monitor the interaction of water management actions with groundwater levels, and in turn the interaction of groundwater levels with water quality, over the next five years to determine if a correlation exists.

13.4.1. **Potential Causes of Undesirable Results**

- Deep percolation of precipitation, seepage from various natural and man-made channels, and recharge from reservoirs and spreading basins;
- Irrigation system backflow into wells and flow through well gravel pack and screens from one formation to another\(^78\);
- Deep percolation of excess applied irrigation water\(^79\) and other water applied for cultural practices (e.g., for soil leaching). Potential COCs include salinity, nitrate, and agricultural chemicals;
- Lateral migration from adjacent areas with poorer quality groundwater. Potential COCs include both anthropogenic and natural constituents;
- Leaching from internal sources such as fine-grained, clay-rich interbeds. Potential COCs include arsenic and other constituents associated with fine-grained depositional environments (Smith et al., 2018); and
- Upwards vertical flow from deeper zones below the bottom of the basin. Potential COCs include salinity, petroleum hydrocarbons, and other naturally-occurring constituents.

In the case of deep percolation of precipitation and excess applied irrigation and leaching water, such activities are regulated separately under the CVRWQCB’s Irrigated Lands Regulatory Program (ILRP) and CV-SALTS. For the last three items listed above, the underlying cause has to do with hydraulic gradients and heads (groundwater levels), and thus the causes are the same as those associated with the Undesirable Effects of Chronic Lowering of Groundwater Levels, discussed above. As discussed in Section 8.5 *Groundwater Quality* and shown by the groundwater level and quality graphs included in Appendix H, there is no discernable relationship between groundwater levels and groundwater quality trends that is consistent across the Arvin-Edison Management Area. Thus, additional data collection and analysis will be needed to further evaluate this potential relationship.

13.4.2. **Criteria Used to Define Undesirable Results**

- **23 CCR § 354.26(b)(2)**

The basin-wide definition of Undesirable Results provides for local definition of the combination of

\(^78\) Kern County’s existing well destruction programs are designed to help minimize cross-connection between aquifer zones and prevent groundwater quality impairments that can result from cross-contamination of aquifer zones.

\(^79\) AEWSD is actively engaged in various local and Basin-level coordination efforts to help protect the quality of its imported surface water supplies (see Section 5.4 *Additional GSP Elements*).
Minimum Threshold exceedances that constitute and Undesirable Result in a management area. As described in Section 8.5 Groundwater Quality, agricultural use is the dominant beneficial use within the Arvin-Edison Management Area, and groundwater quality is generally suitable for agricultural uses. Water quality issues related to deep percolation of agricultural chemicals such as nitrate are regulated separately under the ILRP and CV-SALTS. Groundwater served by public water systems must meet water quality regulatory standards (i.e., MCLs) and these systems are regulated by the SWRCB and County.

As discussed previously in Section 8.5 Groundwater Quality, in recent years ACSD, which provides M&I supplies to the City of Arvin, has faced issues with arsenic in its groundwater wells. ACSD’s experience indicates that lowering groundwater levels reduces water quality, and it is suspected that there is a threshold below which certain contaminants will dominate the water quality. However, that level cannot be identified at this time, and it varies well-to-well and over time. ACSD is in the process of installing new production wells (see Section 17 Projects and Management Actions) following a process where in test wells are drilled to identify strata containing contaminants. One new well, Well #14, currently meets drinking water standards for arsenic, but also appears to be affected by lowering groundwater levels although the correlation has not been directly established. Until additional groundwater level and groundwater quality information is available to refine this definition, it is considered a local Undesirable Result for Degraded Water Quality within the Arvin-Edison Management Area if the Minimum Threshold in ACSD Well #14 is exceeded for four consecutive seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high groundwater level periods and two seasonal low groundwater level periods). If Undesirable Results do occur, ACSD will take appropriate action to ensure a continued safe water supply for customers (e.g. re-drilling, treatment, and/or investigating additional supply sources). It should be noted that regulatory oversight authority for drinking water quality rests with the SWRCB and the County, not with the GSA, and therefore measures to address drinking water quality served to the public are beyond the purview of this GSP. Those regulatory oversight and enforcement actions have and will occur on their own mandated timelines.

13.4.3. Potential Effects of Undesirable Results

Per § 354.26(b)(3) of the GSP Emergency Regulations, potential effects of Undesirable Results must be identified. As discussed above, water quality is generally suitable for the dominant beneficial use within the Arvin-Edison Management Area (i.e., agriculture). Nevertheless, more generally speaking, potential effects of Degraded Water Quality could include increased costs to blend relatively poor-quality groundwater with higher quality sources for agricultural use, and limitations on viable crop types or crop yield depending on crop sensitivity and tolerance to COCs in groundwater used for irrigation. That is why, among other things, AEWSD is actively working to protect and maintain the quality of its surface and groundwater supplies, with a focus on reducing salt loading to the aquifer system.

M&I use of groundwater has been and has the potential to continue to be affected by Degraded Water Quality. The potential effects of Undesirable Results caused by Degraded Water Quality on the M&I beneficial use may include increased costs to treat groundwater to drinking water standards and/or to procure and provide alternative water supplies to M&I customers.

13.5. Undesirable Results for Land Subsidence

The basin-wide definition of Undesirable Results for Land Subsidence is as follows:
“The point at which significant and unreasonable impacts, as determined by a subsidence rate and extent in the basin, that affects the surface land uses or critical infrastructure. This is determined when subsidence results in significant and unreasonable impacts to critical infrastructure as indicated by monitoring points established by a basin wide coordinated GSP subsidence monitoring plan.”

Critical infrastructure is defined in the adopted Undesirable Results definition document as:

“facilities which are utilized to provide public services such as water, utilities, and or transportation service for a region”

Unlike the Undesirable Results definitions for Chronic Lowering of Groundwater Levels, Reduction in Groundwater Storage, and Degraded Water Quality, the above basin-wide definition for Undesirable Results for Land Subsidence does not look towards a local definition of Minimum Thresholds on a management area level, but instead refers to a basin-wide coordinated GSP subsidence monitoring plan and affected water, utilities, and transportation service “for a region”. Thus, the definition is focused on regional impacts, rather than local impacts.

13.5.1. Potential Causes of Undesirable Results

☑️ 23 CCR § 354.26(b)(1)

Land Subsidence can be caused by several mechanisms, but the mechanism most relevant to sustainable groundwater management is the depressurization of aquifers and aquitards due to lowering of groundwater levels, which can lead to compaction of compressible strata and lowering of the ground surface. Therefore, the potential causes of Undesirable Results due to Land Subsidence are generally the same as the potential causes listed above for Undesirable Results due to Chronic Lowering of Groundwater Levels.

13.5.2. Criteria Used to Define Undesirable Results

☑️ 23 CCR § 354.26(b)(2)

The basin-wide definition of Undesirable Results refers to significant and unreasonable impacts to critical infrastructure which, as noted above, is defined with a regional emphasis. Within the Arvin-Edison Management Area, AEWSD’s surface water conveyance system is considered critical infrastructure because it serves as an integral component of the water supply delivery system for not only local in-District customers, but also for other out-of-District entities that participate in AEWS’s groundwater banking program (e.g., MWD).

Recent monitoring has shown some land subsidence impacts to a section of AEWSD’s North Canal in the vicinity of the Sycamore Spreading Works. Recognizing the importance of AEWSD’s canals to local and regional water supplies, it is considered an Undesirable Result for land subsidence to continue substantially degrading canal capacity, level management, or in-canal balancing volume. It is therefore unrealistic to define the Undesirable Result as “any further land subsidence”, as such an outcome would almost certainly be unavoidable, and therefore would prevent achievement of the Sustainability Goal. Therefore, the Undesirable Result for land subsidence is defined as the amount of subsidence that would occur if recent rates were to continue throughout the SGMA implementation period (i.e., if rates observed during the 2014 – 2018 time period were to continue through 2040).
Given the variability in subsidence throughout the Arvin-Edison Management Area, it is appropriate to incorporate a fraction of monitoring sites in the definition of Undesirable Results, similar to how the Undesirable Results definition for Chronic Lowering of Groundwater Levels states that it occurs when Minimum Thresholds for that indicator are exceeded in at least 40% of Representative Monitoring Sites. For Land Subsidence, it is considered an Undesirable Result if the Minimum Threshold is exceeded in at least 40% (i.e., 2 out of 5 of the local survey benchmark locations along the canal system within the Arvin-Edison Management Area).

13.5.3. Potential Effects of Undesirable Results

☑ 23 CCR § 354.26(b)(3)

Potential effects of Undesirable Results caused by Land Subsidence on beneficial uses and users of groundwater and overlying land uses within the Arvin-Edison Management Area could include damage to gravity-driven water conveyance infrastructure (i.e., AEWSD’s canal system) which could impair its ability to move water into, out of, and throughout AEWSD. Land subsidence could also affect non-critical infrastructure such as local water conveyance systems (e.g., AEWSD’s pressure pipeline distribution system) and groundwater well heads, discharges, and casings, but those land uses are not considered “critical infrastructure” per the basin-wide definition which emphasizes regional impacts. To Arvin-Edison and its growers, the undesirable results described are important local infrastructure that require subsidence monitoring and thresholds.

13.6. Undesirable Results for Depletions of Interconnected Surface Water

As of 19 December 2018, no basin-wide definition of Undesirable Results for Depletions of Interconnected Surface Water has been developed by the Kern Subbasin GSAs. Based on available data and information, depletion of interconnected surface water has not been observed within the Arvin-Edison Management Area.

13.6.1. Potential Causes of Undesirable Results

☑ 23 CCR § 354.26(b)(1)

Depletion of Interconnected Surface Water is generally correlated to Chronic Lowering of Groundwater Levels in an interconnected groundwater aquifer system. Therefore, the potential causes of Undesirable Results due to Depletion of Interconnected Surface Water are generally the same as the potential causes listed above for Undesirable Results due to Chronic Lowering of Groundwater Levels (i.e., increased groundwater pumping and reduced recharge). However, as discussed above, the degree of hydraulic connection between the principal aquifer and surface water within the Arvin-Edison Management Area is suspected to be negligible based on available water level information. Therefore, there does not appear to be any active potential causes for Undesirable Results due to Depletion of Interconnected Surface Water.

13.6.2. Criteria Used to Define Undesirable Results

☑ 23 CCR § 354.26(b)(2)

As described in Section 8.7 Interconnected Surface Water Systems, there are no major surface water systems that are believed to be interconnected to the underlying groundwater table within the Arvin-
Edison Management Area. Because there is little to no interconnected surface water, no Undesirable Result for Depletion of Interconnected Surface Water is defined within the Management Area.

### 13.6.3. Potential Effects of Undesirable Results

Potential effects of Undesirable Results of Depletion of Interconnected Surface Water may include reduced surface water flows to support downstream or in-stream uses. As discussed above, there is little to no interconnected surface water within the Arvin-Edison Management Area, and therefore no effects from Undesirable Results for this indicator have occurred or are expected to occur within the Management Area.

### 13.7. Undesirable Results Summary

Table SMC-1 below provides a summary of the local definitions of Undesirable Results for each Sustainability Indicator.

<table>
<thead>
<tr>
<th>Sustainability Indicator</th>
<th>Undesirable Results Definition within the Arvin-Edison Management Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Lowering of Groundwater Levels</td>
<td>Minimum Threshold exceedance in at least 40% (7 out of 16) Representative Monitoring Sites over four consecutive seasonal (bi-annual) measurements.</td>
</tr>
<tr>
<td>Reduction of Groundwater Storage</td>
<td>No local Undesirable Results definition; Chronic Lowering of Groundwater Levels used as a proxy.</td>
</tr>
<tr>
<td>Seawater Intrusion</td>
<td>No local Undesirable Results definition; Sustainability Indicator not applicable within the Kern Subbasin.</td>
</tr>
<tr>
<td>Degraded Water Quality</td>
<td>Minimum Threshold exceedance in ACSD Well #14 over four consecutive seasonal (bi-annual) measurements.</td>
</tr>
<tr>
<td>Land Subsidence</td>
<td>Continuation of historic (2014 – 2018) subsidence rates throughout the SGMA implementation period in at least 40% (2 out of 5) of subsidence monitoring locations.</td>
</tr>
<tr>
<td>Depletion of Interconnected Surface Water</td>
<td>No local Undesirable Results definition; Sustainability Indicator not applicable within the Arvin-Edison Management Area.</td>
</tr>
</tbody>
</table>

---

80 Sections of the North Canal impacted by localized land subsidence were raised in 2018 and designed for future raising, if necessary, in an effort to reduce cost. These sections could be raised again as part of land subsidence mitigation and thus the future subsidence along these reaches is not considered to be an “Undesirable Result” unless subsidence rates exceed those observed through the 2014-2018 period.
14. MINIMUM THRESHOLDS

Minimum Thresholds are the numeric criteria for each Sustainability Indicator that, if exceeded, may cause Undesirable Results. This section describes the Minimum Thresholds that have been developed to avoid Undesirable Results for each applicable Sustainability Indicator in the Arvin-Edison Management Area. These Minimum Thresholds have been developed in coordination with other KGA members and GSAs within the “south of Kern River” portion of the Kern Subbasin (e.g., WRMWSD and the Kern River GSA).

As shown in Table SMC-2, Minimum Thresholds within the Arvin-Edison Management Area are defined at different spatial scales and locations, or not at all, depending on the Sustainability Indicator. Where appropriate, the Minimum Thresholds for the Sustainability Indicators have been set using groundwater levels as a proxy, based on demonstration “that there is a significant correlation between groundwater levels and the other metrics” (DWR, 2017).

Table SMC-2. Spatial Scale of Minimum Threshold Definition

<table>
<thead>
<tr>
<th>Sustainability Indicator</th>
<th>Spatial Scale of Minimum Threshold Definition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Lowering of Groundwater Levels</td>
<td>Sustainability Criteria Zones</td>
<td>There are four Sustainability Criteria Zones defined; Groundwater levels will be measured at 16 Representative Monitoring Sites (i.e., wells).</td>
</tr>
<tr>
<td>Reduction of Groundwater Storage</td>
<td>No Minimum Threshold defined</td>
<td>Chronic Lowering of Groundwater Levels will be used as a proxy.</td>
</tr>
<tr>
<td>Seawater Intrusion</td>
<td>No Minimum Threshold defined</td>
<td>Sustainability Indicator not applicable within the Kern Subbasin.</td>
</tr>
<tr>
<td>Degraded Water Quality</td>
<td>Representative Monitoring Site</td>
<td>Groundwater quality for SGMA compliance will be monitored at one Representative Monitoring Site (i.e., ACSD Well #14). Seven additional Representative Monitoring Sites are defined for groundwater quality within the Management Area; these do not have associated Sustainability Criteria but will be used to collect supplemental data to further evaluate water quality trends under Plan implementation.</td>
</tr>
<tr>
<td>Land Subsidence</td>
<td>Representative Monitoring Sites (1)</td>
<td>Land surface elevation will be monitored at a network of five benchmarks scattered along AEWS&amp;D’s critical facilities.</td>
</tr>
</tbody>
</table>
Depletion of Interconnected Surface Water  |  No Minimum Thresholds defined  |  Sustainability Indicator not applicable within the Arvin-Edison Management Area

**Note:**
1. The local land subsidence Representative Monitoring Sites are supplemental to the basin-wide subsidence monitoring network being implemented, as discussed in the KGA Umbrella GSP and Appendices thereto.

### 14.1. Minimum Threshold for Chronic Lowering of Groundwater Levels

**☑ 23 CCR § 354.28(c)(1)**

Chronic Lowering of Groundwater Levels is arguably the most fundamental Sustainability Indicator, as it influences several other key Sustainability Indicators, including Reduction of Groundwater Storage, Land Subsidence, and in certain ways, Degraded Water Quality. Groundwater levels are also the most readily available and measurable metrics of groundwater conditions, which allows for a systematic, data-driven approach to development of Minimum Thresholds to be applied. There are no state, federal, or local standards that relate to this Sustainability Indicator.

#### 14.1.1. Minimum Threshold Development

**☑ 23 CCR § 354.28(c)(1)(A)**

Consistent with the GSP Emergency Regulations (23 CCR § 354.28(c)), the definition of Minimum Thresholds for Chronic Lowering of Groundwater Levels in the Arvin-Edison Management Area is based on consideration of trends in historical groundwater levels, water year types, projected water use in the management area, and the relationship to other Sustainability Indicators. Specifically, the information and criteria relied on to establish the Minimum Thresholds for Chronic Lowering of Groundwater Levels includes:

- Historical water level data from the selected Representative Monitoring Sites, each of which has a long-term historical record of water levels;
- The proximity to critical infrastructure (i.e., for consideration of potential land subsidence impacts); and
- Well construction information (i.e., for consideration of impacts to beneficial users).

This information was used to develop initial Minimum Threshold estimates using a quantitative algorithm that accounted for trends, historical lows, and water level variability (discussed below). Then, these initial estimates were mapped and generalized spatially to create four “Sustainability Criteria Zones” within the Arvin-Edison Management Area. This approach allowed for the most complete and representative development of Minimum Thresholds for Chronic Lowering of Groundwater Levels.

---

81 The representativeness of the wells with long-term hydrograph records is illustrated on Figure SMC-1, which shows the Fall 2015 groundwater level at each well compared to the average Fall 2015 groundwater elevation by PLSS section for all sections “associated with” (i.e., closest to) each long-term hydrograph location. The figure shows that the percent difference in water level in the local area around each well is small in most cases, indicating that the well is representative of that local area.
historical water level information to inform the Minimum Thresholds, while also allowing for the possibility that different wells (i.e., other than those with the best historical records) could be used as Representative Monitoring Sites.

**Minimum Threshold Algorithm**

- **Historical low water levels over a relevant time period are used as a starting point for Minimum Thresholds based on the fact that significant and unreasonable impacts to beneficial uses and users of groundwater due to groundwater levels are not known to have occurred since the time when water levels were at their historical low. The relevant time period for historical low determination is defined as WY 1966 – 2018 for the following reasons:**
  - The assumed upper-end usable lifespan of groundwater wells is approximately 50 years, and therefore most wells would likely not have experienced conditions prior to about 50 years ago;
  - The AEWSD began importing water in 1966, an action that represented a significant change to water management in this part of the Kern Subbasin (WRMWSD which overlaps a portion of the Arvin-Edison Management Area in the southwest, also began importing surface water in 1971); and
  - The relevant time period includes conditions observed up to “present” (Fall 2018).

- **Variability in groundwater levels is accounted for by calculating a Variability Correction Factor as the product of the observed water level range over a relevant time period and a “Range Fraction”. This Variability Correction Factor is applied to the historical low (as discussed below) and acknowledges the fact that different locations within the Arvin-Edison Management Area have experienced different amounts of water level variability.**
  - The time period for water level range determination is defined as WY 1995 – 2015 for the following reasons:
    - The 21-year length of this period is roughly the same as the 20-yr SGMA implementation period, and therefore the SGMA implementation period is expected to include a similar range of variability as the groundwater level range period;
    - The period includes a mix of wet and dry years and so variability in groundwater levels during this time should be reflective of variable climate;
    - The period is climatically close to the long-term average for precipitation and Kern River Flow (Todd Groundwater, 2016); and
    - This period is the same as the historical and current water budget period of interest defined by KGA and its member agencies, and therefore water budget and model results are available for this period.
The Range Fraction is set at 25% as a conservative allowance for water level fluctuation within a well.

- Recent trends in groundwater levels and projected water use are accounted for by extending the trend for a certain amount of time (the “Trend Extension Period”) to determine a Trend Continuation Factor. This factor is also applied to historical low water levels (as discussed below) in order to avoid rapid disruption to land uses and allow time for implementation of any Projects and/or Management Actions needed to eliminate declining trends.

- The time period for water level trend calculation is defined as WY 2009 – 2018 for the following reasons:
  - This period reflects the effects of changes to SWP/CVP deliveries resulting from Delta-related federal District Court rulings and initial implementation of the San Joaquin River Restoration Program; and
  - The period includes the recent significant drought, and therefore allows the Trend Continuation Factor to incorporate the possibility of another long-term drought in the future (e.g., potentially exacerbated by climate change), consistent with the basin-level Undesirable Results definition for Reduction in Groundwater Storage.

- The Trend Extension Period was set to ten years for the following reasons:
  - This length of time is considered reasonable and necessary to implement the various Projects & Management Actions that may be required to reverse declining groundwater level trends, in consideration of the potential regulatory, environmental, logistical, engineering, socioeconomic and other challenges that the various Projects & Management Actions may entail, as well as the time that such measures would likely take to manifest in observed groundwater level conditions; and
  - This length of time is half the duration of the SGMA implementation period, suggesting that by the halfway point, the Arvin-Edison Management Area should be on a trajectory towards achieving the Sustainability Goal.

- Using the above values (i.e., the Historical Low, the Variability Correction Factor, and the Trend Continuation Factor), the initial Minimum Threshold estimates for Chronic Lowering of Groundwater Levels at each long-term hydrograph location are calculations as the lower of: (a) the historic low groundwater level minus the Variability Correction Factor), and (b) the recent (Fall 2015) groundwater level minus the greater of either the Variability Correction Factor or the Trend Continuation Factor. In mathematical terms, the algorithm for defining the initial Minimum Threshold estimates for Chronic Lowering of Groundwater Levels at each long-term hydrograph location is as follows:

\[
MT = \min \left\{ \frac{HL - VCF}{Recent - \max \left\{ VCF \right\}} \right\}
\]

- \( VCF = \text{Range} \times 25\% \)
- \( TCF = \text{Trend} \times 10 \text{ yrs} \)
where:

- $MT$ is the initial Minimum Threshold estimate (ft msl);
- $HL$ is the historical low groundwater level over the WY 1965 – 2018 period (ft msl);
- $VCF$ is the Variability Correction Factor (ft);
- $TCF$ is the Trend Continuation Factor (ft);
- $Recent$ is the Fall 2015 groundwater level (ft msl);
- $Range$ is the water level range over the WY 1995 – 2015 period; and
- $Trend$ is the groundwater level trend over the 2009 – 2015 period (ft/yr).

**Adjustment in Areas Proximal to Critical Infrastructure**

In areas proximal to critical infrastructure that may be particularly sensitive to significant and unreasonable effects from land subsidence (discussed further below), an adjustment to the initial Minimum Threshold estimates was applied in the algorithm to keep the values at historical low groundwater levels. Specifically, for long-term hydrograph locations that were within one mile of critical infrastructure, the initial Minimum Threshold estimates were set to their historical low groundwater levels, as this theoretically prevents any further subsidence from occurring. Results from the initial Minimum Threshold estimation exercise described above are shown on Figure SMC-2. Also shown on this figure are the proposed Sustainability Criteria Zones defined within the Arvin-Edison Management Area which are discussed below.

**Consideration of Adjacent Basins**

Minimum Thresholds have been developed in consideration of and in coordination with neighboring water agencies within the Kern Subbasin (see Section 5.5.5 Interagency Coordination) and in neighboring basins (see Section 5.5.6 Interbasin Coordination). Through its membership in the White Wolf GSA (along with WRMWSD and TCWD), AEWSD has and will continue to consider the effects of Sustainability Criteria in the Arvin-Edison Management Area on the adjacent White Wolf Basin’s ability to achieve its sustainability goal.

**Spatial Generalization into Sustainability Criteria Zones**

Once the initial Minimum Threshold estimates for the long-term hydrograph locations were calculated using the algorithm described above, they were plotted on a map and examined for spatial patterns that could be used to generalize the values into zones. The purpose of this step was to allow flexibility in the selection of Representative Monitoring Sites for this Sustainability Indicator, recognizing the possibility that not all wells with long-term hydrograph data would be available for use in the monitoring network. It was determined that the Arvin-Edison Management Area could be divided into four zones, referred to as the North Canal, Edison, ACSD, and South Canal zones, as shown on Figure SMC-2. The Minimum Threshold Values for each Sustainability Criteria Zone is shown on Figure SMC-3.
As part of the delineation of Sustainability Criteria Zones within the Arvin-Edison Management Area, an analysis was performed regarding potential well impacts associated with various Minimum Threshold values. Using available well construction information for domestic, production (agricultural), and public supply wells, an assessment was made of the number of wells that could be dewatered at different generalized Minimum Threshold levels. Through this analysis, which was performed iteratively with different Minimum Threshold levels, it was determined that although the proposed Minimum Thresholds would potentially result in some wells being dewatered, the impacts would not be unreasonable and would be prevented and/or mitigated through a Well Dewatering Mitigation Program, to be developed as part of GSP Implementation (see Section 18.1 Plan Implementation Activities). Thus, the interests of beneficial uses and users were considered during Minimum Threshold definition. Results from this well impact analysis of Minimum Thresholds are shown on Figure SMC-4 and Figure SMC-5 for the Sustainability Criteria Zones and the PLSS sections, respectively.

The final Minimum Thresholds for Chronic Lowering of Groundwater Levels in each Sustainability Criteria Zone and at each Representative Monitoring Site are shown in Table SMC-3 and on Figure SMC-3.

14.2. Minimum Threshold for Reduction of Groundwater Storage

As discussed above, the Undesirable Results definition for Reduction of Groundwater Storage at the Basin level refers to a decrease in storage that would cause water levels to decline below Minimum Thresholds established in each management area for Chronic Lowering of Groundwater Levels. It is logical to tie these two Sustainability Indicators together, as the amount of groundwater in storage is directly, if not linearly, related to groundwater levels. Because of the close relationship between these two Sustainability Indicators, and because the Minimum Thresholds for Chronic Lowering of Groundwater Levels (discussed above) are protective of the beneficial uses and users of groundwater, it is not necessary to set a unique Minimum Threshold for Reduction of Groundwater Storage. Rather, Minimum Thresholds for Chronic Lowering of Groundwater Levels will be used as a proxy for the Reduction of Groundwater Storage Sustainability Indicator. There are no state, federal, or local standards that relate to this Sustainability Indicator.

14.2.1. Use of Groundwater Levels as Proxy

Pursuant to the GSP Emergency Regulations (23 CCR § 354.28(d)) and as further described in the DWR Sustainable Management Criteria BMP (DWR, 2017), Minimum Thresholds for Reduction of Groundwater Storage may be set by using groundwater levels as a proxy if it is demonstrated that a correlation exists between the two metrics. One approach to using groundwater levels as a proxy, described in the DWR Sustainable Management Criteria BMP (DWR, 2017), is to demonstrate that Minimum Thresholds for Chronic Lowering of Groundwater Levels are sufficiently protective to ensure prevention of significant and unreasonable occurrences of the Sustainability Indicator in question.

To demonstrate that the Minimum Thresholds for Chronic Lowering of Groundwater Levels are sufficiently protective, a calculation was performed to determine the volume of groundwater that would be removed from the primary aquifer if groundwater levels were to decline from current (Fall 2015) levels to their respective Minimum Thresholds for Chronic Lowering of Groundwater Level. This volume is then...
compared to the volume of usable storage, and it is shown that the usable storage is greater, and therefore the Minimum Thresholds for Chronic Lowering of Groundwater Levels are protective for the Reduction of Groundwater Storage Sustainability Indicator.

**Usable Storage**

To support the use of Minimum Thresholds for Chronic Lowering of Groundwater Levels as a proxy for Reduction of Groundwater Storage, it is informative to define an actual volume of “usable storage” above the median bottom depth of wells. This volume is calculated based on the following data and assumptions:

- Area of Arvin-Edison Management Area (105,630 acres)
- Storage coefficient (0.08)\(^{82}\)
- Average depth to groundwater in Fall 2015 (approximately 381 ft)
- Depth corresponding to the median bottom depth of wells (approximately 815 ft)

The volume of usable storage is approximately 3.7 million AF. This volume corresponds to the volume that would be pumped from private wells in roughly 42 years of pumping at the average historical rate pumped from WY 1995 – 2014 (i.e., 87,823 AFY).

**Storage Reduction at Minimum Threshold Levels**

The volume of groundwater that would be removed from storage if groundwater levels were to decline to Minimum Threshold levels is calculated for each PLSS section by subtracting the Minimum Threshold from the associated Sustainability Criteria Zone from the “current” (Fall 2015) gridded groundwater elevation data, multiplying the difference by the storage coefficient, and then summing the values for each PLSS section to arrive at a total volume for the entire Arvin-Edison Management Area. This calculation is shown in the equation below:

\[
MT_{Stor} = \sum_{k=1}^{n} (GW_{Li} - MT_{GW_{Li}}) * A_k * S_k
\]

where:

- \(MT_{Stor}\) is the Minimum Threshold for Reduction of Groundwater Storage (AF),
- \(GW_{L}\) is the current groundwater elevation (ft msl),
- \(MT_{GW_{L}}\) is the Minimum Threshold for Chronic Lowering of Groundwater Levels within the Sustainability Criteria Zone (subscript \(i\)) (ft msl),
- \(A\) is the area (acres), and
- \(S\) is the storage coefficient (dimensionless). The subscript \(k\) refers to each PLSS section (a total of \(n\) sections within the Arvin-Edison Management Area).

The resulting volume is approximately 1.08 million AF which is much less than the 3.7 million AF of “usable storage”. Therefore, the Minimum Thresholds for Chronic Lowering of Groundwater Levels are sufficiently protective to ensure prevention of significant and unreasonable occurrences of Reduction of Groundwater Storage.

---

\(^{82}\) There is uncertainty in the value for the storage coefficient used in the above calculations, as discussed in Section 7.1.4 *Principal Aquifers and Aquitards*. However, the value of 0.08 is considered conservative.
Storage. Therefore, no Minimum Threshold for Reduction of Groundwater Storage is set within the Arvin-Edison Management Area.

14.3. Minimum Threshold for Seawater Intrusion

- 23 CCR § 354.28(c)(3)
- 23 CCR § 354.28(e)

The GSP Emergency Regulations state that “An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in 23 CCR § 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators” (23 CCR § 354.28(e)). Because the Kern Subbasin is not located near any saline water bodies, seawater intrusion is not present and not likely to occur, the Seawater Intrusion Sustainability Indicator is not applicable to the Kern Subbasin, and therefore no SMC for this Sustainability Indicator are defined in the Arvin-Edison Management Area.

14.4. Minimum Threshold for Degraded Water Quality

- 23 CCR § 354.28(c)(4)

The GSP Emergency Regulations (23 CCR § 354.28(c)) states that the Minimum Threshold of Degraded Water Quality shall be the “degradation of water, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results”. The GSP Emergency Regulations further state that the Minimum Threshold “shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin”, and that “the Agency shall consider local, state, and federal water quality standards applicable to the basin.” This language indicates that Minimum Thresholds for Degraded Water Quality can reasonably be based on concentrations of water quality constituents of concern, as quantified by sampling measurements at Representative Monitoring Sites.

14.4.1. Minimum Threshold Development

Constituents of Concern

The powers granted to GSAs to effect sustainable groundwater management under SGMA generally revolve around managing the quantity, location, and timing of groundwater pumping. SGMA does not empower GSAs to develop or enforce water quality standards; that authority rests with the SWRCB Division of Drinking Water and Kern County. Because of the limited purview of GSAs with respect to water quality, and the rightful emphasis on those constituents that may be related to groundwater quantity management activities, the only constituent of concern applicable within the Arvin-Edison Management Area is arsenic in the vicinity of the City of Arvin and ACSD. As described in Section 8.5 Groundwater Quality, high arsenic concentrations are known to occur within the ACSD well network; however, there is no clear correlation that can be established between groundwater levels and arsenic concentrations at this time. As discussed further below in Section 17 Projects and Management Actions, ACSD is implementing projects to address drinking water quality issues within its service area.
Consideration of State, Federal and/or Local Standards

A Minimum Threshold for Degraded Water Quality is set for arsenic at one Representative Monitoring Site in the Arvin-Edison Management Area, namely ACSD’s Well #14. Based on available data, arsenic concentrations in this well have varied between 6 and 9.7 ug/L between October 2016 and October 2018 (Safe Drinking Water Information System). The California MCL for arsenic in water supplied to customers of public water systems is 10 ug/L.

14.4.2. Final Minimum Threshold

Given that measured concentrations have been below the California MCL it is appropriate to consider the California MCL as a Minimum Threshold. However, given the limited regulatory authority of GSAs with respect to water quality it is not appropriate to consider setting the Minimum Threshold lower than the California MCL. Therefore, the Minimum Threshold for Degraded Water Quality is set at 10 ug/L arsenic at ACSD Well #14. The final Minimum Thresholds for Degraded Water Quality is shown in Table SMC-4. Because this Minimum Threshold is based on criteria for drinking water quality, which is the most sensitive use, this definition considers the beneficial uses and users of groundwater.

14.5. Minimum Threshold for Land Subsidence

Minimum Thresholds for Land Subsidence are defined herein as levels of land subsidence that, if they occurred, would result in significant and unreasonable impacts to critical infrastructure and surface land uses. There are no state, federal, or local standards that relate to this Sustainability Indicator.

Within the Arvin-Edison Management Area, the critical infrastructure that has the potential to be significantly and unreasonably impacted by land subsidence includes AEWSD’s canal system. While certain other land uses exist within the Management Area that are potentially affected by land subsidence (see Section 13.5 Undesirable Results for Land Subsidence), those land uses are not of regional significance and are not considered to be critical infrastructure. The canal system is considered critical infrastructure because it supports the regional water supply system as well as the central mission of AEWSD which is the importation, banking, and delivery of surface water.

14.5.1. Minimum Threshold Development

Historical and recent rates of subsidence measured within the Arvin-Edison Management Area in proximity to the sensitive land uses listed above are discussed in Section 8.6 Land Subsidence. Minimum Thresholds for Land Subsidence are defined herein based on the maximum rate of subsidence observed through ground-based surveys between 2014 and 2018 at the “Sycamore Check”, a monitoring point near

---

83 https://sdwis.waterboards.ca.gov/PDWW/
the Sycamore Spreading Works, until the end of the SGMA implementation timeline, i.e., to 2040. Specifically, the Minimum Threshold for Land Subsidence is calculated as follows:

$$MT_{Sub} = Max\_rate\_Sycamore \times t\_impl$$

where:

- $MT_{Sub}$ is the Minimum Threshold for Land Subsidence as a cumulative amount (in),
- $Max\_rate\_Sycamore$ is the maximum rate of subsidence observed between 2014 and 2018 at the Sycamore Check, equal to 1.5 in/yr, and
- $t\_impl$ is the time from 2018 until the end of the SGMA GSP implementation timeframe (2040), equal to 22 years.

The rationale for this Minimum Threshold rate of subsidence is that such subsidence has been historically managed by AEWSD through maintenance and improvements to its facilities (e.g., adding additional freeboard to its canals, as necessary), and AEWSD could likely continue to manage/mitigate further subsidence if it were to occur at similar or lower rates.

### 14.5.2. Final Minimum Thresholds

| ✔️ 23 CCR § 354.28(b)(2) |
| ✔️ 23 CCR § 354.28(b)(6) |

Per the above calculation, the resulting Minimum Threshold rate of subsidence is 1.5 in/yr, and the Minimum Threshold cumulative amount of subsidence is 33 inches, relative to elevations measured in June 2018. The Minimum Threshold applies to all Representative Monitoring Sites along AEWSD’s canal system within the Arvin-Edison Management Area. The final Minimum Thresholds for Land Subsidence at each Representative Monitoring Site are shown in **Table SMC-5**. Additional information about the Representative Monitoring Sites for this Sustainability Indicator is provided in **Section 16 Monitoring Network**. It should be noted that the Minimum Thresholds for Chronic Lowering of Groundwater Levels include consideration of land subsidence by limiting the Minimum Thresholds to the historical low groundwater levels in those Representative Monitoring Sites that are within one mile of critical infrastructure (see **Section 14.1 Minimum Threshold for Chronic Lowering of Groundwater Levels**). While groundwater level measurements are not being used as a proxy for land subsidence measurements in these areas (i.e., the land subsidence monitoring network will consist of survey benchmark locations maintained and measured by AEWSD, these Minimum Thresholds for Chronic Lowering of Groundwater Levels are set conservatively to avoid further land subsidence.

### 14.6. Minimum Threshold for Depletions of Interconnected Surface Water

| ✔️ 23 CCR § 354.28(c)(6) |
| ✔️ 23 CCR § 354.28(e) |

The GSP Emergency Regulations state that “An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in 23 CCR § 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators” (23 CCR § 354.28(e)). As discussed above, based on available data and information, Depletion of Interconnected Surface Water has not been observed within the Arvin-Edison...
Management Area, and depths to groundwater are so deep as the preclude the possibility of occurrence of interconnected surface water. Therefore, there are no Undesirable Results and no Minimum Thresholds defined for this Sustainability Indicator.
15. **MEASURABLE OBJECTIVES AND INTERIM MILESTONES**

- **23 CCR § 354.30(a)**
- **23 CCR § 354.30(b)**

This section discusses the development of Measurable Objectives and Interim Milestones for all relevant Sustainability Indicators in the Arvin-Edison Management Area.

15.1. **Measurable Objective and Interim Milestones for Chronic Lowering of Groundwater Levels**

15.1.1. **Measurable Objectives for Chronic Lowering of Groundwater Levels**

- **23 CCR § 354.30(c)**

Initial estimates for Measurable Objectives for Chronic Lowering of Groundwater Levels were developed based on the groundwater levels that were observed in the 15 long-term hydrograph locations in or around Fall 2015. As with the Minimum Thresholds, the initial Measurable Objective estimates were then adjusted and generalized into values for each Sustainability Criteria Zone. The adjustments and generalizations generally entail decreasing the Measurable Objective for the zone relative to the Fall 2015 levels. The downward adjustments were made in recognition of the fact that in most cases groundwater levels in 2015 were not near their historical low, and therefore an ample Margin of Operational Flexibility could be achieved even with levels lower than they were in 2015. Also, considering the potential for reduced surface water imports in the future and potentially increased groundwater use, it was considered appropriate to set the Measurable Objectives to allow for some decrease from 2015 levels. Measurable Objectives for Chronic Lowering of Groundwater Levels for each Sustainability Criteria Zone are shown on Figure SMC-6 and Table SMC-3 presents the Measurable Objectives at each Representative Monitoring Site.

15.1.2. **Interim Milestones for Chronic Lowering of Groundwater Levels**

- **23 CCR § 354.30(e)**

Interim Milestones for Chronic Lowering of Groundwater Levels are defined herein based on a trajectory for groundwater levels informed by the current (Fall 2018) levels, the Minimum Thresholds, and the Measurable Objectives. This trajectory allows for and assumes a continuation of current groundwater level trends for the first 5-year period, a deviation from that trend over the second 5-year period, a recovery to the 5-year Interim Milestone in the third 5-year period, and recovery towards the Measurable
Objectives over the fourth (last) 5-year period. Specifically, the trajectory for groundwater levels prescribed in the Interim Milestones is as follows:

### Table SMC-6. Interim Milestone Trajectory for Chronic Lowering of Groundwater Levels

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Interim Milestone for Chronic Lowering of Groundwater Levels</th>
<th>Basis for Interim Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>2025</td>
<td>IM-5GWL</td>
<td>[\frac{1}{2} \times (GWLFall2018 + MT_GWL)]</td>
</tr>
<tr>
<td>2030</td>
<td>IM-10GWL</td>
<td>[\frac{1}{2} \times (IM-5GWL + MT_GWL)]</td>
</tr>
<tr>
<td>2035</td>
<td>IM-15GWL</td>
<td>[\frac{1}{2} \times (IM-10GWL + MO_GWL)]</td>
</tr>
<tr>
<td>2040</td>
<td>Not applicable (Measurable Objective)</td>
<td>Not applicable (Measurable Objective)</td>
</tr>
</tbody>
</table>

where:

IM-5GWL, IM-10GWL, and IM-15GWL are the Interim Milestones for Chronic Lowering of Groundwater Levels after 5 years, 10 years and 15 years, respectively;

GWLFall2018 is the measured groundwater elevations in Fall 2018;

MT_GWL is the Minimum Threshold for Chronic Lowering of Groundwater Levels (defined previously); and

MO_GWL is the Minimum Threshold for Chronic Lowering of Groundwater Levels (defined previously)

Interim Milestones and Measurable Objectives for Chronic Lowering of Groundwater Levels are presented in Table SMC-3, and are displayed relative to historical water levels at each Representative Monitoring Site on Figure SMC-7.

### 15.2. Measurable Objective for Reduction of Groundwater Storage

- 23 CCR § 354.30(c)
- 23 CCR § 354.30(d)

As discussed above, the Undesirable Results definition for Reduction of Groundwater Storage at the basin level refers to a decrease in storage that would cause water levels to decline below Minimum Thresholds established in each management area for Chronic Lowering of Groundwater Levels. It is logical to tie these two Sustainability Indicators together, as the amount of groundwater in storage is directly, if not linearly, related to groundwater levels. Because of the close relationship between these two Sustainability Indicators, the Measurable Objective for Chronic Lowering of Groundwater Levels serves as a proxy for Reduction of Groundwater Storage, and it is not necessary to set a unique Measurable Objective for
Reduction of Groundwater Storage. As stated above, the Measurable Objectives for Chronic Lowering of Groundwater Levels provide an adequate Margin of Operational Flexibility.

15.3. **Measurable Objective for Seawater Intrusion**

The GSP Emergency Regulations state that “An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in 23 CCR § 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators” (23 CCR § 354.28(e)). Because the Kern Subbasin is not located near any saline water bodies, seawater intrusion is not present and not likely to occur, the Seawater Intrusion Sustainability Indicator is not applicable to the Kern Subbasin, and therefore no SMCs for this Sustainability Indicator are defined in the Kern Subbasin.

15.4. **Measurable Objectives and Interim Milestones for Degraded Water Quality**

**23 CCR § 354.30(c)**

As with the Minimum Threshold, the Measurable Objective for Degraded Water Quality is defined for a single constituent of concern (arsenic) at one Representative Monitoring Site (i.e., ACSD Well #14). As discussed previously, arsenic concentrations within this well have varied between 6 and 9.7 μg/L over the available period of record (i.e., October 2016 and October 2018). The average arsenic concentration over 10 measurements was 7.55 μg/L. This average value is approximately 75 percent of the MCL for arsenic (10 μg/L) which is being used as the Minimum Threshold. As it is an appropriate goal to try to maintain concentrations of this constituent of concern at approximately current levels (which are below the drinking water standards), the Measurable Objective is therefore set at 7.5 μg/L arsenic. Similar to the Minimum Threshold, the Measurable Objective is defined based on measurements from four consecutive (bi-annual; seasonal high and seasonal low groundwater level) sampling events. This provides for a Margin of Operational Flexibility of 2.5 μg/L. Interim milestones for Degraded Water Quality are defined along a linear path starting with the maximum arsenic concentration observed between October 2016 and 2018 and ending with the Measurable Objective (7.5 μg/L arsenic) in 2040, as shown in **Table SMC-7** below.

**Table SMC-7. Interim Milestone Trajectory for Degraded Water Quality**

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Interim Milestone for Land Subsidence</th>
<th>Basis for Interim Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>2025</td>
<td>IM-5(_{WQ})</td>
<td>(WQ_{max2016-18} - \frac{1}{4} * (WQ_{max2016-18} - WQ_{MO}))</td>
</tr>
<tr>
<td>2030</td>
<td>IM-10(_{WQ})</td>
<td>(WQ_{max2016-18} - \frac{1}{2} * (WQ_{max2016-18} - WQ_{MO}))</td>
</tr>
<tr>
<td>2035</td>
<td>IM-15(_{WQ})</td>
<td>(WQ_{max2016-18} - \frac{3}{4} * (WQ_{max2016-18} - WQ_{MO}))</td>
</tr>
<tr>
<td>2040</td>
<td>Not applicable (Measurable Objective)</td>
<td>(WQ_{MO})</td>
</tr>
</tbody>
</table>

where:
IM-5\textsubscript{WQ}, IM-10\textsubscript{WQ}, and IM-15\textsubscript{WQ} are the Interim Milestones for Degraded Water Quality after 5 years, 10 years and 15 years, respectively;

\(WQ_{max2016-18}\) is the maximum arsenic concentration between October 2016 and 2018 (9.7 ug/L); and \(WQ\_MO\) is the Measurable Objective for Degraded Water Quality (7.5 ug/L arsenic concentration).

Interim Milestones and the Measurable Objective for Degraded Water Quality are presented in Table SMC-4.

### 15.5. Measurable Objectives and Interim Milestones for Land Subsidence

*23 CCR § 354.30(c)*
*23 CCR § 354.30(e)*

The Measurable Objective for Land Subsidence is defined as the amount of land subsidence that would be observed if the Minimum Threshold subsidence rates (1.5 in/yr) were to continue from 2018 through 2030 and then cease, which amounts to approximately half of the Minimum Threshold amount. While ideally there would be no further land subsidence along AEWSD’s canal system, as stated above, due to the inherent time lag of the aquitard depressurization process, there may still be some “built-in” subsidence potential that has yet to manifest. Therefore, it is not considered reasonable to expect an immediate and complete cessation to the historic subsidence rates. Rather, it is considered a reasonable and potentially achievable goal to reduce the observed historical rate by half over the SGMA implementation period (i.e., by 2040). Interim Milestones for land subsidence are specified as follows:

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Interim Milestone for Land Subsidence</th>
<th>Basis for Interim Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>2025</td>
<td>IM-5\textsubscript{Subs}</td>
<td>(GS_Elev_{2018} – 7 \times MT_Rate)</td>
</tr>
<tr>
<td>2030</td>
<td>IM-10\textsubscript{Subs}</td>
<td>(GS_Elev_{2018} – 12 \times MT_Rate)</td>
</tr>
<tr>
<td>2035</td>
<td>IM-15\textsubscript{Subs}</td>
<td>(GS_Elev_{2018} – 12 \times MT_Rate)</td>
</tr>
<tr>
<td>2040</td>
<td>Not applicable (Measurable Objective)</td>
<td>(GS_Elev_{2018} – 12 \times MT_Rate)</td>
</tr>
</tbody>
</table>

where:

IM-5\textsubscript{Subs}, IM-10\textsubscript{Subs}, and IM-15\textsubscript{Subs} are the Interim Milestones for Land Subsidence after 5 years, 10 years and 15 years, respectively;

\(GE\_Elev_{2018}\) is the measured ground surface elevations in June 2018; and

\(MT\_Rate\) is the Minimum Threshold rate for Land Subsidence (1.5 in/yr; defined previously).
Interim Milestones and Measurable Objectives for Land Subsidence are presented in Table SMC-5.

15.6. Measurable Objective for Depletions of Interconnected Surface Water

As discussed above, based on available data and information, Depletion of Interconnected Surface Water has not been observed within the Arvin-Edison Management Area. Therefore, there are no SMCs defined for this Sustainability Indicator.
TABLE SMC-3
Summary of Minimum Thresholds, Interim Milestones, and Measurable Objectives for Chronic Lowering of Groundwater Levels
Arvin-Edison Water Storage District
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>Representative Monitoring Site ID</th>
<th>Sustainability Criteria Zone</th>
<th>Minimum Threshold</th>
<th>Interim Milestones</th>
<th>Measurable Objective (ft)</th>
<th>Margin of Operational Flexibility (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29S29E33N001M</td>
<td>North Canal</td>
<td>50</td>
<td>2025</td>
<td>174</td>
<td>100</td>
</tr>
<tr>
<td>30S29E29A001M</td>
<td>North Canal</td>
<td>50</td>
<td>2030</td>
<td>112</td>
<td>106</td>
</tr>
<tr>
<td>31S29E05E001M</td>
<td>North Canal</td>
<td>50</td>
<td>2035</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>31S29E12M001M</td>
<td>North Canal</td>
<td>50</td>
<td></td>
<td>81</td>
<td>100</td>
</tr>
<tr>
<td>31S30E17K001M</td>
<td>North Canal</td>
<td>50</td>
<td></td>
<td>79</td>
<td>100</td>
</tr>
<tr>
<td>31S30E30J001M</td>
<td>North Canal</td>
<td>50</td>
<td></td>
<td>81</td>
<td>100</td>
</tr>
<tr>
<td>30S29E11N001M</td>
<td>Edison</td>
<td>250</td>
<td>2025</td>
<td>309</td>
<td>300</td>
</tr>
<tr>
<td>30S30E19E001M</td>
<td>Edison</td>
<td>250</td>
<td>2030</td>
<td>279</td>
<td>300</td>
</tr>
<tr>
<td>31S29E34A001M</td>
<td>ACSD</td>
<td>-70</td>
<td>2035</td>
<td>316</td>
<td>30</td>
</tr>
<tr>
<td>ACSD Well No. 14</td>
<td>ACSD</td>
<td>-70</td>
<td></td>
<td>-6</td>
<td>30</td>
</tr>
<tr>
<td>11N20W05J001S</td>
<td>South Canal</td>
<td>0</td>
<td>2025</td>
<td>53</td>
<td>50</td>
</tr>
<tr>
<td>12N20W36G001S</td>
<td>South Canal</td>
<td>0</td>
<td>2030</td>
<td>26</td>
<td>50</td>
</tr>
<tr>
<td>32S28E23H001M</td>
<td>South Canal</td>
<td>0</td>
<td>2035</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td>32S29E12P001M</td>
<td>South Canal</td>
<td>0</td>
<td></td>
<td>33</td>
<td>50</td>
</tr>
<tr>
<td>32S29E20H001M</td>
<td>South Canal</td>
<td>0</td>
<td></td>
<td>34</td>
<td>50</td>
</tr>
<tr>
<td>32S29E31N001M</td>
<td>South Canal</td>
<td>0</td>
<td></td>
<td>34</td>
<td>50</td>
</tr>
</tbody>
</table>

**Abbreviations:**

ft msl = feet above mean sea level

**Notes:**

All values are in ft msl.
TABLE SMC-4  
Summary of Minimum Thresholds, Interim Milestones, and Measurable Objectives for Degraded Water Quality  
Arvin-Edison Water Storage District  
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>Representative Monitoring Site ID</th>
<th>Recent Concentration (µg/L)</th>
<th>Minimum Threshold</th>
<th>Interim Milestones</th>
<th>Measurable Objective</th>
<th>Margin of Operational Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACSD Well #14</td>
<td>6 – 9.7(2)</td>
<td>10</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
</tr>
</tbody>
</table>

Notes:  
(1) All values shown are arsenic concentrations in micrograms per liter (µg/L).  
(2) Recent concentration values are based on samples collected between October 2016 and October 2018.
TABLE SMC-5
Summary of Minimum Thresholds, Interim Milestones, and Measurable Objectives for Land Subsidence
Arvin-Edison Water Storage District
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>Representative Monitoring Site ID</th>
<th>Minimum Threshold (ft amsl)</th>
<th>2018 Elevation (ft amsl)</th>
<th>Interim Milestones</th>
<th>Measurable Objective (ft amsl)</th>
<th>Margin of Operational Flexibility (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-CP-1</td>
<td>516.05</td>
<td>518.80</td>
<td>517.93</td>
<td>517.30</td>
<td>517.30</td>
</tr>
<tr>
<td>15-N CANAL PP CORNERS</td>
<td>508.62</td>
<td>511.37</td>
<td>510.50</td>
<td>509.87</td>
<td>509.87</td>
</tr>
<tr>
<td>30C-WELL 11</td>
<td>479.63</td>
<td>482.38</td>
<td>481.51</td>
<td>480.88</td>
<td>480.88</td>
</tr>
<tr>
<td>39-TEJON CREEK SIPHON</td>
<td>490.90</td>
<td>493.65</td>
<td>492.78</td>
<td>492.15</td>
<td>492.15</td>
</tr>
<tr>
<td>48-TOP 883 CS</td>
<td>484.13</td>
<td>486.88</td>
<td>486.01</td>
<td>485.38</td>
<td>485.38</td>
</tr>
</tbody>
</table>

**Abbreviations:**

*ft amsl* = feet above mean sea level
Abbreviations

GWE = Groundwater Elevation
DWR = California Department of Water Resources
ft msl = feet above mean sea level
PLSS = Public Land Survey System
RML = Representative Monitoring Location

Notes
1. All locations are approximate.
2. "Normalized Difference" is defined herein as the difference between the Fall 2015 GWE at the RML and the average Fall 2015 GWE within each section, divided by the total range of Fall 2015 GWE within the Arvin-Edison Kern Management Area.
3. Negative normalized differences (i.e., where the GWE at RML is less than the average Fall 2015 GWE within the section), are represented in green as those sections have an RML that is considered "overprotective" of local water level conditions.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 December 2019.
Groundwater Subbasin
Kern County (DWR 5-022.14)
White Wolf (DWR 5-022.18)

Sustainability Criteria Zones
- ACSD
- Edison
- North Canal
- South Canal
- Hydrograph
- Range Period (10/94 - 9/15)
- Trend Period (1/09 - 11/15)
- Initial Measurable Objective (MO) Estimate
- Initial Minimum Threshold (MT) Estimate
- Historical Low
- Fall 2015

Linear Regression (Trend Period)

Hydrograph Analysis
Kern County, California
December 2019

Notes
1. All locations are approximate.
2. Water levels that showed a rate of change between consecutive measurements greater than 50 ft in 60 days, or a significant change without a reasonable hydrological explanation, were removed from the hydrographs.
3. Representative monitoring location 12N20W05J001S does not have a complete historical water level data record, and is thus represented by nearby well 12N20W05J002S for the purposes of this analysis.

Sources
1. Basemap is ESRI’s ArcGIS Online world topographic map, obtained 12 December 2019.
2. Water level information obtained from AEWSD on 30 November 2017.

Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
ft = feet
ft msl = feet above mean sea level
MO = Measurable Objective
MT = Minimum Threshold
SGMA = Sustainable Groundwater Management Act

Water Level Sustainability Criteria - Hydrograph Analysis
Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure SMC-2
Arvin-Edison Water Storage District

**Abbreviations**
- ACSD = Arvin Community Services District
- ft msl = feet above mean sea level
- MT = Minimum Threshold

**Notes**
1. All locations are approximate.

**Sources**
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 December 2019.

---

**Legend**
- Arvin-Edison Water Storage District
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

**Proposed Water Level Minimum Thresholds**

**Groundwater Subbasin**
- North Canal Zone
  - MT = 50 ft msl
- South Canal Zone
  - MT = 0 ft msl
- ACSD Zone
  - MT = -70 ft msl
- Edison Zone
  - MT = 250 ft msl

**Sustainability Criteria Zones**
- ACSD
- Edison
- North Canal
- South Canal
Abbreviations
- DWR = California Department of Water Resources
- MT = Minimum Threshold
- N/A = Not Applicable
- PLSS = Public Land Survey System

Notes
1. All locations are approximate.
2. A "dewatered" well is considered to be a well whose total depth is less than the MT specified for the given sustainability criteria zone.
3. Wells that were already dewatered relative to Fall 2015 groundwater conditions are not included in the count of dewatered wells.

Sources
1. Well count and depth statistics from Well Completion Report Map Application, obtained on 19 October 2018, website: https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37
2. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.

Legend
- Arvin-Edison Water Storage District
- Sustainability Criteria Zones
- Groundwater Subbasin
  - Kern County (DWR 5-022.14)
  - White Wolf (DWR 5-022.16)

Count of Wells Dewatered at Minimum Threshold
- N/A
- 0
- 1
- 2
- 3
- 4 or more

Preliminary Well Impact Analysis by PLSS Section
Arvin-Edison Water Storage District
Kern County, California
December 2019
E60004.01
Figure SMC-5
2. Water levels that showed a rate of change between consecutive measurements greater than 50 ft in 60 days, or a significant change without a reasonable hydrological explanation, were removed from the hydrographs.

3. Representative monitoring location 12N20W05J001S does not have a complete historical water level data record, and is thus represented by nearby well 12N20W05J002S for the purposes of this analysis.

Notes
1. All locations are approximate.
2. Water level information obtained from AEWSD on 30 November 2017.
3. Water level information obtained from AEWSD on 12 December 2019.

Sources
1. Basemap is ESRIs ArcGIS Online world topographic map, obtained 12 December 2019.
2. Water level information obtained from AEWSD on 30 November 2017.

Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
ft = feet
IM = Interim Milestone
MO = Measurable Objective
MT = Minimum Threshold
SGMA = Sustainable Groundwater Management Act

Legend
- Arvin-Edison Water Storage District
- Representative Monitoring Location
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Sustainability Criteria Zones
- ACSD
- Edison
- North Canal
- South Canal
- Hydrograph
- Measurable Objective (MO)
- Minimum Threshold (MT)
- Interim Milestone (IM)
- Glide Path
- Fall 2018

Water Level Sustainability Criteria - Interim Milestones
Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064-01

Figure SMC-7
16. MONITORING NETWORK

This section describes the monitoring network designed for the Arvin-Edison Management Area, subsequently referred to as the “SGMA Monitoring Network”. Pursuant to the GSP Emergency Regulations, the SGMA Monitoring Network objective is to collect sufficient data for the correct assessment of the Sustainability Indicators relevant to the Arvin-Edison Management Area (see Section 13 Undesirable Results), and the impacts to the beneficial users of groundwater. Per 23 CCR § 354.32(e), the SGMA Monitoring Network incorporates the AEWSD CASGEM Monitoring Plan (included herein as Appendix K) and other elements from the existing monitoring programs occurring within the Management Area (see Section 5.2.1 Existing Monitoring and Management Programs) and includes additional components to comply with the GSP Emergency Regulations. All monitoring will be performed in accordance with the protocols agreed upon for the Basin, as described in the KGA Umbrella GSP.

16.1. Description of Monitoring Network

The objective of the Arvin-Edison Management Area SGMA Monitoring Network is to collect data with sufficient temporal frequency and spatial density necessary to evaluate Plan implementation as it relates to:

- Monitoring short-term, seasonal, and long-term trends in groundwater and related surface water conditions (see Section 8 Current and Historical Groundwater Conditions);
- Demonstrating progress toward achieving measurable objectives described in the Plan (see Section 15 Measurable Objectives and Interim Milestones);
- Monitoring impacts to the beneficial uses and users of groundwater (see Section 5.5.1 Beneficial Uses and Users of Groundwater);
- Monitoring changes in groundwater conditions relative to Measurable Objectives (see Section 15 Measurable Objectives and Interim Milestones) and Minimum Thresholds (see Section 14 Minimum Thresholds); and
- Quantifying annual changes in water budget components (see Section 9 Water Budget Information).

The Representative Monitoring Network consists of a series of Representative Monitoring Sites that: (1) were selected from the existing monitoring programs that are active within the Arvin-Edison Management Area (see Section 5.2.1 Existing Monitoring and Management Programs), (2) have been demonstrated...
to be representative of groundwater conditions within the Management Area (see Figure SMC-1, for example), and (3) where Sustainability Criteria (Minimum Thresholds, Measurable Objectives, and Interim Milestones) have been defined for at least one of the relevant Sustainability Indicators to the Basin (see Section 13 Undesirable Results):

- Chronic Lowering of Groundwater Levels;
- Reduction of Groundwater Storage;
- Degraded Water Quality; and
- Land Subsidence.

Per 23 CCR § 354.32(e), the selection of Representative Monitoring Sites was informed by the existing local monitoring programs and CASGEM network (see Section 5.2.1 Existing Monitoring and Management Programs) and leverages historical data wherever possible to help assess and quantify Basin response to Plan implementation relative to historical groundwater conditions (see Section 8 Current and Historical Groundwater Conditions). Pursuant to 23 CCR § 354.32(f), the spatial distribution, spatial density, and temporal frequency of measurements collected from Representative Monitoring Sites is determined for each Sustainability Indicator based on considerations of:

- Amount of current and projected groundwater use;
- Aquifer characteristics, including any vertical and/or lateral barriers to groundwater flow;
- Potential impacts to beneficial uses and users of groundwater, land uses and property interests affected by groundwater production, and other adjacent basins (and GSAs within the Basin); and
- Availability of historical data to evaluate long-term trends in groundwater conditions associated with the above factors.

Per 23 CCR § 354.32(g), other factors considered in the selection of Representative Monitoring Sites include:

- Availability of existing technical information about the Representative Monitoring Site (e.g., well location, construction information, condition, status, etc.);
- Quality and reliability of historical data at the Representative Monitoring Site;
- “Representativeness” to local groundwater conditions and nearby well populations (per 23 CCR § 354.36); and
- Projected availability of long-term access to the Representative Monitoring Site.

Table MN-1 summarizes the site type, site count, measured constituent(s), measurement frequency, and spatial density of the Monitoring Network for each of the relevant Sustainability Indicators mentioned above. Further details about the SGMA Monitoring Network for each Sustainability Indicator can be found in Sections 16.1.1 through 16.1.6.
Table MN-1. Summary of SGMA Monitoring Network

<table>
<thead>
<tr>
<th>Sustainability Indicator</th>
<th>Site Type</th>
<th>Site Count</th>
<th>Measured Constituent(s)</th>
<th>Measurement Frequency</th>
<th>Spatial Density (# sites / 100 mi²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Lowering of Groundwater Levels</td>
<td>Well</td>
<td>16</td>
<td>Water Level</td>
<td>Semiannually</td>
<td>9.7</td>
</tr>
<tr>
<td>Reduction of Groundwater Storage</td>
<td>Well</td>
<td>16</td>
<td>Water Level</td>
<td>Semiannually</td>
<td>9.7</td>
</tr>
<tr>
<td>Degraded Water Quality&lt;sup&gt;84&lt;/sup&gt;</td>
<td>Well</td>
<td>8</td>
<td>see list in Section 16.1.4</td>
<td>Annually</td>
<td>4.84</td>
</tr>
<tr>
<td>Land Subsidence&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>Stationary GPS</td>
<td>5</td>
<td>Ground Surface Elevation</td>
<td>Annually</td>
<td>3.03</td>
</tr>
</tbody>
</table>

Note:
(2) The local land subsidence monitoring network described herein is supplemental to the basin-wide subsidence monitoring network being implemented, as discussed in the KGA Umbrella GSP and Appendices thereto.

Pursuant to 23 CCR § 354.32(i), in all cases the SGMA Monitoring Network will adhere to the monitoring protocols specified for the Basin as described in Section 16.2 Monitoring Protocols for Data Collection and Monitoring and in the KGA Umbrella GSP and Appendices thereto.

16.1. Monitoring Network for Chronic Lowering of Groundwater Levels

☑ 23 CCR § 354.34(c)(1)

The SGMA Monitoring Network for Chronic Lowering of Groundwater Levels consists of 16 wells distributed across the Arvin-Edison Management Area (spatial density of 9.7 wells / 100 mi²) for which water level Sustainability Criteria have been defined within this MA Plan (see Section 14.1 Minimum Threshold for Chronic Lowering of Groundwater Levels and Section 15.1 Measurable Objective and Interim Milestones for Chronic Lowering of Groundwater Levels). Specific details regarding each of the Representative Monitoring Sites are listed in Table MN-2. The site locations and their spatial distribution are displayed on Figure MN-1. These Representative Monitoring Sites were selected based on the following considerations:

<sup>84</sup> The SGMA Monitoring Network for Degraded Water Quality includes additional Representative Monitoring Sites for which Sustainability Criteria have not been defined; these sites will be used to collect supplemental data to allow for continued evaluation of groundwater quality trends within the Arvin-Edison Management Area (see Section 16.1.4 Monitoring Network for Degraded Water Quality).
• **Current and projected groundwater use** – The Monitoring Network includes eight wells located within or immediately adjacent to AEWSD’s surface water service area and eight wells located in the “groundwater only” portion of the Management Area.

• **Aquifer characteristics** – All 16 wells included in the Monitoring Network screen the Kern River Formation, which is the only principal aquifer defined within this portion of the Basin. Additionally, the Monitoring Network includes a well near the White Wolf Fault (32S29E31N001M), a known lateral barrier to groundwater flow and the defined boundary between the Kern Subbasin (DWR 4-022.14) and the White Wolf Subbasin (DWR 5-022.18). As such, this network is sufficient to delineate groundwater occurrence, flow directions and hydraulic gradients.

• **Potential impacts to beneficial uses and users of groundwater, land uses or property interests, and adjacent Basins (or GSAs)** – The Monitoring Network includes six wells situated within one mile of AEWSD’s canal and/or spreading basin facilities (31S29E12M001M, 31S30E17K001M, 31S30E030J001M, 32S29E12P001M, 32S29E31N001M, and 12N20W36G001S), which are defined as “critical infrastructure” to the Management Area (see Section 13.5 Undesirable Results for Land Subsidence). The Monitoring Network also includes two wells within ACSD and the City of Arvin (ACSD Well #14 and 31S2934A001M), where a majority of municipal and industrial groundwater production occurs within the Management Area. The Monitoring Network also includes one well situated within half a mile of Caliente Creek (30S20E19E001M), which will be used to monitor hydraulic gradients between the creek and underlying principal aquifer. Finally, the Monitoring Network includes three wells proximate to the AEWSD-KDWD boundary (31S29E05E001M, ACSD Well #14, and 32S28E23H001M), which will be used to assess hydraulic gradients between the Arvin-Edison Management Area and the KDWD portion of the Kern River GSA.

• **Availability of historical data** – All 16 Representative Monitoring Sites have associated water level records spanning back through at least 1966, the year that AEWSD began importing surface water and coincident to the general period of historical low groundwater elevations within the Management Area (see Section 8 Current and Historical Groundwater Conditions).

• **Availability of site-specific technical information** – As shown in Table MN-2, each of the 16 Representative Monitoring Sites have known geographic coordinates, ground surface elevations, and reference point elevations. Seven of the 16 sites contain known well depths, and six of the 16 sites contain known well screen intervals. Seven of the 16 wells are presumed to still be active and in use for irrigation or municipal and industrial purposes, while the other nine are inactive wells which will be used for dedicated monitoring purposes only. All 16 wells are confirmed to be in suitable condition for recording water level measurements. For the sites where well construction information is incomplete or currently unavailable, AEWSD has developed a plan to fill these data gaps in accordance with 23 CCR § 354.38 (see Section 16.4 Assessment and Improvement of Monitoring Network).

• **Quality and reliability of historical data** – Each of the Representative Monitoring Sites contains at least 45 water level records, including at least one record in the last five years (i.e., since January 2014). Each site is included in AEWSD’s voluntary CASGEM network, and most sites have been

---

85 There are no interconnected surface water features presumed to occur within the Management Area as the water table is encountered well below the ground surface (i.e., depth to water greater than 150 ft. bgs) throughout AEWSD (see Section 8.7 Interconnected Surface Water Systems).
monitored biannually for at least the past ten years as part of AEWSD’s routine water level monitoring program.

- **“Representativeness” to local groundwater conditions** – The 16 wells’ “representativeness” to local groundwater conditions is illustrated on Figure SMC-1, which shows the Fall 2015 groundwater level at each well compared to the average groundwater elevation by PLSS section for all sections “associated with” (i.e., closest to) each long-term hydrograph location. The figure shows that the percent difference in water level in the local area around each well is small in most cases, indicating that the well is representative of that local area.

- **Long-term access** – For each of the 16 Representative Monitoring Sites, a fully executed long-term access agreement has been reached with associated landowners/well owners allowing AEWSD long-term access to the site to conduct monitoring for SGMA compliance purposes. A copy of the long-term access agreement template can be found in Appendix L.

All Representative Monitoring Sites will be monitored semiannually in accordance with the monitoring protocol described in Section 16.2 Monitoring Protocols for Data Collection and Monitoring. All data will be reported to DWR per the requirements specified under Section 16.5 Reporting Monitoring Data to the Department.

16.1.2. Monitoring Network for Reduction of Groundwater Storage

☑ 23 CCR § 354.34(c)(2)

As described in Section 13.2.2 Criteria Used to Define Undesirable Results and in Section 14.2.1 Use of Groundwater Levels as Proxy, the criteria used to define Undesirable Results for Reduction of Groundwater Storage are the Minimum Thresholds established at a local management area level for Chronic Lowering of Groundwater Levels. As such, the SGMA Monitoring Network for Reduction of Groundwater Storage will be comprised of the same Representative Monitoring Sites described in Section 16.1.1 Monitoring Network for Chronic Lowering of Groundwater Levels. The information collected from this SGMA Monitoring Network will be sufficient to estimate the change in annual groundwater in storage.

16.1.3. Monitoring Network for Seawater Intrusion

☑ 23 CCR § 354.34(c)(3)
☑ 23 CCR § 354.34(j)

As described in Section 13.3 Undesirable Results for Seawater Intrusion, seawater intrusion is not present and not likely to occur within the Kern Subbasin, the Seawater Intrusion Sustainability Indicator is not applicable to the Basin, and therefore no Undesirable Results for this Sustainability Indicator are defined for the Basin. As such, per the stipulations defined under 23 CCR § 354.32(j), a monitoring network has not been defined for the Seawater Intrusion Sustainability Indicator as it is demonstrated to not be applicable to the Basin.
16.1.4. Monitoring Network for Degraded Water Quality

The SGMA Monitoring Network for Degraded Water Quality consists of one well situated within ACSD for which water quality Sustainability Criteria have been defined within this MA Plan (see Section 14.4 Minimum Threshold for Degraded Water Quality and Section 15.4 Measurable Objectives and Interim Milestones for Degraded Water Quality). Specific details regarding ACSD Well #14 are listed in Table MN-2. The site location is displayed on Figure MN-2. As described by ACSD, Well #14 was selected as the Representative Monitoring Site based on the following considerations:

- **Current and projected groundwater use** – ACSD Well #14 is a municipal production well used to serve customers within the City of Arvin, which is entirely dependent on groundwater. Sampling data from this well is considered representative of local groundwater quality within ACSD and the greater City of Arvin.

- **Aquifer characteristics** – ACSD Well #14 is screened within the primary aquifer defined for the Basin (i.e., Kern River Formation).

- **Potential impacts to beneficial uses and users of groundwater, land uses or property interests, and adjacent Basins (or GSAs)** – ACSD Well #14 is used to provide drinking water supplies to domestic users within the City of Arvin as well as other industrial users within the Management Area. As such, compliance with Title 22 CCR drinking water regulations for Maximum Contaminant Levels (MCLs) is the governing regulatory criteria for this well due to the nature of its beneficial use.

- **Availability of historical data** – ACSD Well #14 was drilled in 2015 and thus does not have a long period of historical record; however, since the well was put into service in October 2016, it has been sampled for primary and secondary MCL constituents at monthly frequency in accordance with Title 22 CCR drinking water regulations.

- **Availability of site-specific technical information** – As shown in Table MN-2, ACSD Well #14 has known coordinates, well construction information (including total depth and perforated intervals), and a verified Well Completion Report (WCR No. e0295346).

- **Quality and reliability of historical data** – As described above, ACSD Well #14 has been sampled monthly for Title 22 constituents since it was put into service in October 2016.

- **“Representativeness” to local groundwater conditions** – As mentioned above, the water quality and water levels within ACSD Well #14 are considered representative of local conditions within the ACSD service area and the greater City of Arvin, whereby a large majority of human consumption of groundwater occurs within the Management Area.

- **Long-term access** – ACSD Well #14 is owned and operated by ACSD, and thus there are no anticipated access constraints to the Representative Monitoring Site.

The SGMA Monitoring Network for Degraded Water Quality also includes seven additional Representative Monitoring Sites selected from AEWSD’s existing water quality sampling program for which Sustainability Criteria have not been defined. These sites will be used to collect supplemental data to allow for continued evaluation of groundwater quality trends within the Arvin-Edison Management Area throughout Plan
implementation. Specific details regarding each of the Representative Monitoring Sites are listed in Table MN-2. The site locations are displayed on Figure MN-2. These Representative Monitoring Sites were selected based on the following considerations:

- **Current and projected groundwater use** – The Monitoring Network includes two wells located within AEWSD’s surface water service area and five wells located in the “groundwater only” portion of the Management Area.

- **Aquifer characteristics** – All seven wells included in the Monitoring Network screen the Kern River Formation, which is the only principal aquifer defined within this portion of the Basin.

- **Potential impacts to beneficial uses and users of groundwater, land uses or property interests, and adjacent Basins (or GSAs)** – The Monitoring Network is spread generally evenly across the Management Area and includes Representative Monitoring Sites in the areas of groundwater quality concern identified in Section 8.5 Groundwater Quality.

- **Availability of historical data** – Each of the seven Representative Monitoring Sites have been sampled for groundwater quality constituents (including the constituents of concern [COCs] identified in Section 8.5 Groundwater Quality) at least nine times, including at least four times since the year 2000. Four of the seven wells have sampling records extending back through 1966.

- **Availability of site-specific technical information** – As shown in Table MN-2, each of the seven Representative Monitoring Sites have known geographic coordinates, ground surface elevations, and reference point elevations. Only one of the seven sites contains known well depths and well screen intervals. Six of the seven wells are presumed to still be active and in use for irrigation purposes, while one is currently dedicated for monitoring purposes only. All seven wells are confirmed to be in suitable condition for collecting water quality samples. For the sites where well construction information is incomplete or currently unavailable, AEWSD has developed a plan to fill these data gaps in accordance with 23 CCR § 354.38 (see Section 16.4 Assessment and Improvement of Monitoring Network).

- **Quality and reliability of historical data** – Each of the seven Representative Monitoring Sites contains at least nine water quality sampling records, including at least four records since 2000 and at least two records in the last five years (i.e., since January 2014). Most sites have been monitored regularly for at least the past ten years as part of AEWSD’s routine water quality sampling program.

- **“Representativeness” to local groundwater conditions** – As described above, the seven sites are spread generally evenly across the basin, including some wells in the areas of groundwater quality concern identified in Section 8.5 Groundwater Quality.

- **Long-term access** – For each of the seven Representative Monitoring Sites, a preliminary agreement has been reached with associated landowners/well owners allowing AEWSD long-term access to the site to conduct monitoring for SGMA compliance purposes. A copy of the long-term access agreement template can be found in Appendix L.

All Representative Monitoring Sites will be sampled annually in accordance with the monitoring protocol described in Section 16.2 Monitoring Protocols for Data Collection and Monitoring. Representative Monitoring Sites will be sampled for the COCs identified in Section 8.5 Groundwater Quality, namely:
• Total Dissolved Solids
• Nitrate
• Arsenic
• Boron
• Iron
• Manganese

In addition, Representative Monitoring Sites will be monitored for other relevant groundwater quality constituents\textsuperscript{86} which may include constituents within some or all of the following categories:

• Descriptive parameters (temperature, pH, etc.)
• Major ions
• Heavy metals
• Organic substances
• Pesticides
• Microbes

All data will be reported to DWR per the requirements specified under Section 16.5 Reporting Monitoring Data to the Department.

16.1.5. Monitoring Network for Land Subsidence

\textbf{23 CCR § 354.34(c)(5)}

The SGMA Monitoring Network for Land Subsidence consists of five ground surface elevation survey locations distributed across the Arvin-Edison Management Area (spatial density of 3.03 sites / 100 mi\textsuperscript{2}. for which land subsidence Sustainability Criteria have been defined within this MA Plan (see Section 14.5 Minimum Threshold for Land Subsidence and Section 15.5 Measurable Objectives and Interim Milestones for Land Subsidence). Specific details regarding each of the Representative Monitoring Sites are listed in Table MN-2. The site locations and their spatial distribution are displayed on Figure MN-3. These Representative Monitoring Sites are located at AEWSD’s main critical infrastructure facilities (see Section 13.5 Undesirable Results for Land Subsidence), including:

• AEWSD North Canal Balancing Reservoir
• AEWSD North Canal Spreading Works
• AEWSD Sycamore Spreading Works
• AEWSD Tejon Spreading Works
• AEWSD Spillway Basin

\textsuperscript{86} As identified in Stanford University’s “A Guide to Water Quality Requirements under the Sustainable Groundwater Management Act” (Moran & Belin, 2019).
These sites were selected as the most representative locations for which to monitor ground surface elevations within AEWSD as they are each situated directly within or proximate to these critical infrastructure facilities. The Representative Monitoring Sites have been surveyed three times for ground surface elevations since 2012, including recent surveys completed in 2018 and 2019. AEWSD plans to complete surveys on an annual basis.

All Representative Monitoring Sites will be monitored annually in accordance with the monitoring protocol described in Section 16.2 Monitoring Protocols for Data Collection and Monitoring. All data will be reported to DWR per the requirements specified under Section 16.5 Reporting Monitoring Data to the Department.

16.1.6. Monitoring Network for Depletions of Interconnected Surface Water

- 23 CCR § 354.34(c)(6)
- 23 CCR § 354.34(j)

As described in Section 13.6 Undesirable Results for Depletions of Interconnected Surface Water, as of 19 December 2018 no basin-wide definition of Undesirable Results for Depletions of Interconnected Surface Water has been developed by the Kern Subbasin GSAs, and, based on available data and information, depletion of interconnected surface water has not been observed within the Arvin-Edison Management Area. As such, per the stipulations defined under 23 CCR § 354.32(j), a monitoring network has not been defined for the Depletion of Interconnected Surface Water Sustainability Indicator as it is demonstrated to not be applicable to the Basin.

16.2. Monitoring Protocols for Data Collection and Monitoring

- 23 CCR § 352.2

Pursuant to 23 CCR § 354.32(i), in all cases the Arvin Edison Management Area SGMA Monitoring Network will adhere to the monitoring protocols specified for the Basin as described in the KGA Umbrella GSP and Appendices thereto.

16.3. Representative Monitoring

- 23 CCR § 354.36

As described in Section 16.1 Description of Monitoring Network, AEWSD has defined a SGMA Monitoring Network for each relevant Sustainability Indicator to the Management Area that will be used for SGMA reporting purposes to evaluate Plan implementation with respect to meeting the Sustainability Goal defined for the Basin through compliance with the Minimum Thresholds and Measurable Objectives described in the Plan. The rationale for selecting Representative Monitoring Sites is described for each Sustainability Indicator in Sections 16.1.1 through 16.1.6 of this MA Plan.

As described in Section 16.1.2 Monitoring Network for Reduction of Groundwater Storage, the Monitoring Network for Chronic Lowering of Groundwater Levels will be used as a proxy to monitor Reduction in Groundwater Storage. As described in Section 14.2 Minimum Threshold for Reduction of Groundwater Storage, groundwater levels are considered sufficiently protective of Reduction in Groundwater Storage, and thus no Sustainability Criteria have been defined for this Sustainability Indicator.
Indicator. There are no other Sustainability Indicators for which groundwater levels will be used as a proxy for representative monitoring.

16.4. Assessment and Improvement of Monitoring Network

As described above and in the Basin-wide Monitoring Protocols (see KGA Umbrella GSP and Appendices thereto), the Arvin-Edison SGMA Monitoring Network will be reevaluated in each five-year GSP update, 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.

In all cases, the SGMA Monitoring Network developed for each Sustainability Indicator includes a sufficient density and spatial distribution of monitoring sites to meet the monitoring objectives outlined in Section 16.1 Description of Monitoring Network. In most cases, the existing Representative Monitoring Sites selected for each Sustainability Indicator conform to the best management practices for monitoring networks outlined in DWR’s Monitoring Networks and Identification of Data Gaps BMP (DWR, 2016d). As identified in Sections 16.1.1 through 16.1.6, there are a few notable exceptions:

Regarding the Monitoring Network for Chronic Lowering of Groundwater Levels

- Nine of the 16 sites are missing well depth information (wells 12N20W36G001S, 29S29E33N001M, 30S29E11N001M, 30S29E29A001M, 30S30E19E001M, 31S29E05E001M, 31S30E30J001M, 32S29E20H001M, and 32S29E31N001M);
- Ten of the 16 sites are missing perforation interval information (wells 12N20W36G001S, 29S29E33N001M, 30S29E11N001M, 30S29E29A001M, 30S30E19E001M, 31S29E05E001M, 31S30E30J001M, 32S29E20H001M, 32S29E31N001M, and 31S29E34A001M); and
- Seven of the 16 wells are presumed to still be active and in use for irrigation or municipal and industrial purposes (wells 30S29E29A001M, 31S29E12M001M, 31S29E34A001M, 31S30E17K001M, 31S30E30J001M, 32S29E31N001M, and ACSD Well #14).

Regarding the Monitoring Network for Degraded Water Quality

- Five of the seven sites are missing well depth information (wells 32S29E04R001M, 32S28E33R002M, 31S29E25J001M, and 31S29E10K001M);
- Six of the seven sites are missing perforation interval information (wells 32S29E04R001M, 32S28E33R002M, 31S29E25J001M, 31S29E10K001M, and 32S28E22R001M); and
- All seven wells are presumed to still be active and in use for irrigation or municipal and industrial purposes.

For the Representative Monitoring Sites currently missing well information and well screen information, AEWSD has proposed a plan to fill these data gaps by conducting video-logging on the identified wells (see Section 18.1 Plan Implementation Activities). In the event these data gaps cannot be readily filled, AEWSD will identify alternative sites or develop plans to construct new Representative Monitoring Sites for Chronic Lowering of Groundwater Levels as deemed necessary by AEWSD.
For the Representative Monitoring Sites still under active use, AEWSD will work to convert these sites to dedicated monitoring sites or will otherwise identify or develop alternative sites by the GSP implementation deadline (i.e., by January 2040).

16.5. Reporting Monitoring Data to the Department

Data collected from the SGMA Monitoring Network will be uploaded to a Data Management System to be established and maintained for the Kern Subbasin and reported to the DWR in accordance with the Monitoring Protocols developed for the Basin as described in the KGA Umbrella GSP and Appendices thereto. Additional data collected as part of AEWSD’s other regular monitoring programs (see Section 5.2.1 Existing Monitoring and Management Programs) may be used in conjunction with data collected from the SGMA Monitoring Network to meet compliance with GSP Emergency Regulations regarding Annual Reporting (23 CCR § 356.2) or as otherwise deemed necessary by AEWSD.

☑️ 23 CCR § 354.40
<table>
<thead>
<tr>
<th>Monitoring Site ID</th>
<th>Monitoring Site Type</th>
<th>Type of Measurement Taken</th>
<th>Frequency of Measurement</th>
<th>Groundwater Level &amp; Sustainability Indicator(s)</th>
<th>CASGEM Details</th>
<th>Monitoring Site Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>11623W15X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>12729W15X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>20216X01X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2016X01X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2113X01X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2132R12X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2121R12X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2112R12X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2102X01X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2012X01X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2002X01X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2011X01X0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>31S29E12M0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Annually x - - -</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>30S29E11N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>30S29E11N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>29S29E33N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>32S29E31N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>32S28E23H0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>31S30E17K0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>30S29E39A0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>30S30E18G0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>28S30E15J0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>27S30E14N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>26S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>25S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>24S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>23S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>22S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>21S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>20S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>19S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>18S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>17S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>16S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>15S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>14S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>13S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>12S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>11S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>10S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>9S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>8S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>7S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>6S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>5S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>4S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>3S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>2S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
<tr>
<td>1S30E15N0010</td>
<td>Well</td>
<td>Groundwater Level</td>
<td>Semiannually x x</td>
<td>35.2416</td>
<td>100-150 ft</td>
<td>CASGEM Well Type</td>
</tr>
</tbody>
</table>

December 2019 | Arvin-Edison Water Storage District | Kern Subbasin Management Area Plan
## Summary of Representative Monitoring Sites

This section provides a summary of representative monitoring sites within the Kern Subbasin Management Area. Each site includes critical information such as the type of pump, elevation details, and well completion specifics. The data is organized in a tabular format, including fields like monitoring site ID, reference point details, pump type, well status, and well construction details.

### Table MN-2

<table>
<thead>
<tr>
<th>Monitoring Site ID</th>
<th>Reference Point</th>
<th>Pump Type</th>
<th>Well Type</th>
<th>Well Status</th>
<th>Year Drilled</th>
<th>Total Completed Depth (ft bgs)</th>
<th>Elevation Reference Point (ft amsl)</th>
<th>Total Completed Depth (ft bgs)</th>
<th>Elevation Reference Point (ft amsl)</th>
<th>Top of Perforations Depth (ft bgs)</th>
<th>Bottom of Perforations Depth (ft bgs)</th>
<th>Casing Diameter (in)</th>
<th>Nameplate Horsepower</th>
<th>Well Capacity (gpm)</th>
<th>Well Discharge (gpm)</th>
<th>Well Construction Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>11G29N20W05J001S</td>
<td>394.24</td>
<td>Diesel</td>
<td>1009.14</td>
<td>INACTIVE</td>
<td>1962</td>
<td>395.24</td>
<td>UNKNOWN</td>
<td>395.24</td>
<td>8</td>
<td>380</td>
<td>367</td>
<td>Principal Aquifer (KRF)</td>
<td>No. 242701_redacted</td>
<td>1000</td>
<td></td>
<td>Top of Soundings tube No. 242701_redacted</td>
</tr>
<tr>
<td>12N20W36G001S</td>
<td>477.40</td>
<td>Diesel</td>
<td>N/A</td>
<td>INACTIVE</td>
<td>1962</td>
<td>477.40</td>
<td>UNKNOWN</td>
<td>477.40</td>
<td>10</td>
<td>N/A</td>
<td>250</td>
<td>Principal Aquifer (KRF)</td>
<td>No. 242661_redacted</td>
<td>1000</td>
<td></td>
<td>Top of Soundings tube No. 242661_redacted</td>
</tr>
<tr>
<td>29S29E33N001M</td>
<td>264.63</td>
<td>Electric</td>
<td>Single</td>
<td>INACTIVE</td>
<td>1962</td>
<td>264.63</td>
<td>UNKNOWN</td>
<td>264.63</td>
<td>10</td>
<td>N/A</td>
<td>250</td>
<td>Principal Aquifer (KRF)</td>
<td>No. 242651_redacted</td>
<td>1000</td>
<td></td>
<td>Top of Soundings tube No. 242651_redacted</td>
</tr>
<tr>
<td>30S29E11N001M</td>
<td>626.63</td>
<td>Electric</td>
<td>Single</td>
<td>INACTIVE</td>
<td>1962</td>
<td>626.63</td>
<td>UNKNOWN</td>
<td>626.63</td>
<td>10</td>
<td>N/A</td>
<td>250</td>
<td>Principal Aquifer (KRF)</td>
<td>No. 242651_redacted</td>
<td>1000</td>
<td></td>
<td>Top of Soundings tube No. 242651_redacted</td>
</tr>
</tbody>
</table>

### Abbreviations

- **ACSD** = Arvin Community Services Agreement
- **AEWSD** = Arvin Edison Water Storage District
- **ACSM** = Arvin Edison Water Storage Management
- **AG** = Agricultural
- **DWR** = California Department of Water Resources
- **KRF** = Kern River Formation
- **CASGEM** = California Statewide Groundwater Elevation Monitoring
- **pp** = parts per million
- **gpm** = gallons per minute
- **in** = inches
- **ft** = feet
- **NAD** = North American Datum
- **amsl** = above mean sea level
- **bgs** = below ground surface
- **gpm** = gallons per minute
- **N/A** = not applicable
- **yr** = year
- **CT** = California Geologic Survey
- **DWD** = Department of Water Resources
- **SGMA** = Sustainable Groundwater Management Act
- **SS** = Surface Storage
- **SW** = Subsurface Water
- **N** = North
- **E** = East
- **S** = South
- **W** = West
- **STN** = Station
- **SMH** = Statewide Monitoring Hub
- **DRY** = Dry Hole
- **MONITOR** = Converted Monitor
- **INACTIVE** = Inactive
- **ACTIVE** = Active
- **CONVERTED** = Converted
- **NO DRIVER** = No Driver
- **SUBMERISBLE** = Submersible
- **ELECTRIC** = Electric
- **DIESEL** = Diesel
- **M&I** = Municipal / Industrial
- **IRRIGATION** = Irrigation

### Notes

1. Water level and discharge are measured at the Arvin-Edison Management Area and are not considered to be sustainability indicators of concern to the Arvin-Edison Management Area.
2. The reference of the well log is given in cases where such a log is available but does not contain a DWR Well Completion Report number.
3. Only one Principal Aquifer is defined for the Arvin-Edison Management Area - the "Kern River Formation Principal Aquifer".

December 2019
Arvin-Edison Water Storage District
© 2019 eki environment & water

Abbreviations
ACSD = Arvin Community Services District
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
SGMA = Sustainable Groundwater Management Act

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 December 2019.
2. Well information received from AEWSD on 20 May 2019.

SGMA Water Level Monitoring Network
Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure MN-1
Abbreviations
ACSD = Arvin Community Services District
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
SGMA = Sustainable Groundwater Management Act

Notes
1. All locations are approximate.
2. "Other Representative Monitoring Sites" include all monitoring sites for which WQ Sustainability Criteria have not been defined within the Management Area.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Well information received from AEWSD on 20 May 2019.
SGMA Land Subsidence Monitoring Network
Arvin-Edison Water Storage District
Kern County, California
December 2019
B60064.01
Figure MN-3

Legend
- Representative Monitoring Site
- Arvin-Edison Water Storage District
- AEWSD Spreading Basin
- AEWSD Canal

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Abbreviations
- ACSD = Arvin Community Services District
- AEWSD = Arvin-Edison Water Storage District
- DWR = California Department of Water Resources
- SGMA = Sustainable Groundwater Management Act

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 November 2019.
2. Land subsidence survey point information received from AEWSD on 20 May 2019.
17. PROJECTS AND MANAGEMENT ACTIONS

Pursuant to the GSP Emergency Regulations, this section presents the Projects and Management Actions (P/MAs) proposed to support achievement of the sustainability goal within the Arvin-Edison Management Area. The P/MAs were developed using a portfolio approach whereby individual P/MAs were identified and grouped into categories based on their expected benefits. Implementation of P/MAs within those benefit categories is estimated to occur along a “glide path” that will result in closing of the currently identified “deficit” under the 2030 Climate Change Scenario by the January 2040 GSP implementation deadline (see Section 9.4.5 Projected Water Budget Results), as well as in response to observed groundwater conditions relative to the associated Sustainability Indicators. The proposed P/MAs thus represent a path to achieve the sustainability goal for the Management Area, as further demonstrated by results from the basin-wide numerical groundwater flow model that show groundwater levels exceeding Measurable Objectives when P/MAs are implemented. This approach allows for flexible implementation of P/MAs as needed to address future conditions throughout the 50-year GSP planning and implementation horizon (i.e., out to 2070). The P/MAs presented herein were developed with consideration of costs and benefits and preliminary feasibility analysis; however, each P/MA will require significant further evaluation (i.e., engineering, economic, environmental, legal, etc.) prior to implementation. In addition to the P/MAs presented herein, AEWSD and ACSD will continue to conduct data gap filling activities as part of Plan Implementation that may include, but are limited to, validating the status of existing wells, refining the water budget parameters based on additional data and modeling, collecting additional data related to aquifer conditions and properties, and conducting additional data compilation and analysis of groundwater conditions information (see Section 18.1 Plan Implementation Activities).

This section first presents the goals and objectives of the P/MAs, including the relevant Sustainability Indicators, the spatial “focus areas” within the Arvin-Edison Management Area, and the categories of expected benefits and the implementation glide path. Next, a list of specific P/MAs grouped by benefit category and type is presented, information which is also provided in Table PMA-1 (detailed P/MA Information Forms are included in Appendix M). Following this list is a discussion of how the P/MAs address overdraft conditions or other Undesirable Results (i.e., water quality); a description of the various potentially applicable permitting and regulatory requirements; a discussion of the P/MA status and implementation timeline; a discussion of how the expected benefits will be evaluated; a description of sources of outside water that are relied upon; a discussion of the legal authority required to implement the P/MAs; a summary of estimated costs and how the AEWSD plans to meet those costs; and a discussion of how recharge and extraction will be managed to avoid depletion of groundwater levels and storage.
17.1. Goals and Objectives of Projects and Management Actions

17.1.1. Relevant Sustainability Indicators

Per the GSP Emergency Regulations, GSPs must include P/MAs to address any existing or potential future Undesirable Results for the identified relevant Sustainability Indicators. As discussed in Section 13 Undesirable Results, the relevant Sustainability Indicators in the Arvin-Edison Management Area include: (1) Chronic Lowering of Groundwater Levels, (2) Reduction of Groundwater Storage, (3) Degraded Water Quality, and (4) Land Subsidence. Because groundwater levels and storage area directly correlated, P/MAs that address groundwater levels also address groundwater storage, and the two Sustainability Indicators are considered together in this discussion of P/MAs. Each of these relevant Sustainability Indicators is further associated with specific areas within the Arvin-Edison Management Area. Therefore, the goal of the P/MAs discussed herein is to address significant and unreasonable effects related to the relevant Sustainability Indicators in the relevant areas.

17.1.2. Focus Areas

Groundwater levels are generally lowest and tend to show decreasing trends in the west/central portions of the Arvin-Edison Management Area that rely exclusively on groundwater (i.e., outside of the SWSA) (see Figure GWC-1, Figure GWC-2, and Figure GWC-5). For that reason, the proposed P/MAs that address groundwater levels and storage are focused on those areas. Land Subsidence is also closely tied to groundwater levels but is only relevant where there is critical infrastructure (defined with an emphasis on regional infrastructure, as discussed in Section 13.5 Undesirable Results for Land Subsidence above). Therefore, the area relevant to the Land Subsidence Sustainability Indicator is along the AEWSD surface canals. Groundwater quality is generally suitable for agricultural uses in the Arvin-Edison Management Area, and therefore water quality concerns are most relevant in the ACSD area where groundwater is used as a drinking water supply. As discussed in Section 13.4 Undesirable Results for Degraded Water Quality, there may be a link between groundwater levels and arsenic concentrations in ACSD wells, and therefore P/MAs to address groundwater levels in this area are expected to have positive impacts on groundwater quality in ACSD wells. In addition, ACSD has identified and is implementing projects to address drinking water quality issues.

17.1.3. Benefit Categories

23 CCR § 354.42(b)(5)

The primary water management “tools” (i.e., authorities) by which GSAs can address conditions that may lead to Undesirable Results associated with water quantity (i.e., Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage) pertain to management of inflows (supplies) and outflows (demands). Therefore, the primary categories of expected benefits for these water quantity-related P/MAs are:

- Water supply augmentation, including
  - Wet year supplies
  - Other (i.e. all year) new supplies; and
- Water demand reduction.
All of the P/MAs that have water quantity-related benefits belong to at least one of those two primary categories. In addition, some of these quantity-related P/MAs also have secondary benefits, including:

- Water quality improvement;
- Flood control;
- Water management flexibility/efficiency; and
- Improved data to better understand the Basin Setting components.

Two projects being led by ACSD address drinking water quality as their primary benefit.

17.1.4. Implementation Glide Path

23 CCR § 354.42(d)

As stated above, the goals and objectives of the P/MAs presented herein are to address any existing or potential Undesirable Results by the GSP implementation deadline for the Kern Subbasin (i.e., by January 2040). As such, P/MAs could be implemented incrementally on an as-needed basis to achieve this goal and after significant data gaps across the basin and a multitude of questions about any GSP-mandated reductions in light of current and future uncertainties (i.e., climate change, hydrologic time periods used for evaluation purposes, lack of basin-wide modeling calibration/validation, etc.) are addressed. While the exact schedule and timetable for implementation of individual P/MAs is not known at this time, a general implementation schedule, also known as a “glide path”, has been developed and is summarized in Table PMA-2 below. This preliminary “glide path” aims to address a certain percentage of the projected deficit during each five-year period through 2040, which in turn will affect conditions of the relevant Sustainability Indicators based on the assumption that those conditions are directly related to the balance of supplies and demands within the Arvin-Edison Management Area. The “glide path” also includes a preliminary estimate of the supply augmentation and/or demand reduction measures necessary to address the projected deficit specified under the 2070 Climate Change Scenario by the end of the 50-year GSP planning and implementation horizon (i.e., January 2070).
Table PMA-2. General Project and Management Actions Implementation Schedule (“Glide Path”)

<table>
<thead>
<tr>
<th>Projected Deficit (AFY)</th>
<th>P/MA Implementation Schedule (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>By 2025</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>31,600</td>
<td>56,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target Deficit Reduction (%)</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>100%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Deficit Reduction (AFY)</td>
<td>8,000</td>
<td>16,000</td>
<td>24,000</td>
<td>32,000</td>
<td>56,500</td>
</tr>
</tbody>
</table>

P/MA Benefits, by Type (AFY)

<table>
<thead>
<tr>
<th>Type</th>
<th>By 2025</th>
<th>By 2030</th>
<th>By 2035</th>
<th>By 2040</th>
<th>By 2070</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Year Supplies (4)</td>
<td>6,400</td>
<td>12,000</td>
<td>16,800</td>
<td>20,800</td>
<td>33,050</td>
</tr>
<tr>
<td>Other New Supplies</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,600</td>
<td>7,725</td>
</tr>
<tr>
<td>Demand Reduction</td>
<td>1,600</td>
<td>4,000</td>
<td>7,200</td>
<td>9,600</td>
<td>15,725</td>
</tr>
<tr>
<td>Total P/MA Benefits</td>
<td>8,000</td>
<td>16,000</td>
<td>24,000</td>
<td>32,000</td>
<td>56,500</td>
</tr>
</tbody>
</table>

Abbreviations:
AFY = acre-feet per year
P/MA = Projects and Management Actions

Notes:
(1) Projected Deficit to be addressed by implementation of P/MAs up to 2040 is the net water supply shortfall based on the 2030 Climate Change Scenario. Projected Deficit to be addressed by future P/MA implementation beyond 2040 (i.e., up to 2070) is the net water supply shortfall based on the 2070 Climate Change Scenario.
(2) In the 2025 through 2040 periods, 70% of the target deficit reduction is met by Water Supply Augmentation P/MAs and the remaining 30% may be met by Demand Reduction P/MAs as necessary. In the period from 2040 through 2070, at least 75% of the additional target deficit reduction is met with Water Supply Augmentation P/MAs and the remaining 25% may be met with Demand Reduction P/MAs as necessary.
(3) AEWSD will presumably need to meet an additional 153,000 AF banked water return obligation to MWD by the 2034 termination date of its existing water management program agreement.
(4) Specific “wet-year supply augmentation” projects that are currently underway within AEWSD include the Sunset Spreading Works Project (P/MA #1), DiGiorgio Unit In-Lieu Project (P/MA #16), and On-Farm Recharge Project (P/MA #6).

17.2. List of Projects and Management Actions

23 CCR § 354.44(b)(1)

This section provides a list of the P/MAs identified by AEWSD, divided into the two primary benefit categories discussed above, both of which address the Chronic Lowering of Groundwater and Reduction of Groundwater Storage Sustainability Indicators. Within these two categories, the P/MAs are further classified into seven types based on the mechanism by which the primary benefit is achieved. In addition, the list includes two projects that address drinking water quality in the ACSD service area. Details of the
P/MAs are provided in Table PMA-1 and in the P/MA forms included in Appendix M. Figure PMA-1 shows the approximate locations of these P/MAs.

### 17.2.1. Water Supply Augmentation Projects

The Projects listed below have supply augmentation as their primary expected benefit, and include Projects to Enhance Recharge, Projects to Manage and/or Capture Floodwater\(^{87}\), Projects to Increase Surface Storage Capacity / Delivery Flexibility, In-Lieu Projects, and Projects to Develop New Supplies.

**Projects to Enhance Recharge**

1. AEWSD Sunset Spreading Works
2. Private and Caltrans Basin Connections

**Projects to Manage and/or Capture Floodwater**

3. Sycamore Creek Detention and Sedimentation Basin
4. AEWSD South Canal Flood Study / Improvements
5. Stormwater Management and Flood Control Improvements
6. On-Farm Recharge
7. Caliente Creek Habitat Mitigation and Groundwater Recharge

**Projects to Increase Surface Storage Capacity / Delivery Flexibility**

8. AEWSD Intake Canal / KDWD Buena Vista Canal Intertie
9. AEWSD Intake Canal / KDWD Farmer’s Canal Intertie
10. AEWSD Wasteway Basin Improvements
11. Forrest Frick Pipeline / KDWD Eastside Canal Intertie
12. AEWSD North Canal Balancing Reservoir Expansion and Discharge Pipelines
13. AEWSD Lateral Capacity Improvement Projects
14. Conversion of Granite Quarry to Sycamore Reservoir
15. AEWSD South Canal Balancing Reservoir

**In-Lieu Projects**

16. Frick Unit In-Lieu Project
17. DiGiorgio Unit In-Lieu Project
18. General In-Lieu Banking Program

---

\(^{87}\) From a water supply augmentation perspective, projects to manage and/or capture floodwaters may have limited new benefit, as typically those floodwaters already contribute to the recharge and supplies within the Arvin-Edison Management Area. However, this group of projects aims to better manage and secure such floodwaters, both physically and in terms of associated water rights issues.
Projects to Develop New Supplies

- 19. Reclamation of Oilfield Produced Water
- 20. Wastewater Reclamation with Cities of Arvin and Bakersfield

17.2.2. **Water Demand Reduction Management Actions**

The Management Actions listed below have water demand reduction as their primary expected benefit and include Management Actions / Policies to Reduce Overall Water Demand and Management Actions / Policies to Reduce Groundwater Pumping.

**Management Actions / Policies to Reduce Overall Water Demand**

- 21. Subsidies for Land Conversion
- 22. On-Farm Water Conservation

**Management Actions / Policies to Reduce Groundwater Pumping**

- 23. Groundwater Fee Increase
- 24. Groundwater Extraction Quantification Method
- 25. Groundwater Allocation Per Acre
- 26. Groundwater Marketing and Trading
- 27. Education of Groundwater Use per Acre

17.2.3. **Projects to Improve Drinking Water Quality in ACSD Service Area**

The two projects listed below are being implemented by ACSD to improve the quality of drinking water served by ACSD.

- 28. ACSD Emergency 1,2,3-TCP Treatment at Well No. 13
- 29. ACSD Arsenic Mitigation Project – Phase II

17.3. **Circumstances for Implementation**

- ☑ 23 CCR § 354.44(b)(1)(A)

Using the portfolio/menu approach, P/MAAs will be selected for implementation based on further consideration of the magnitude of expected benefit, the relative cost and ease of implementation, and other factors. Some P/MAAs will be implemented immediately upon adoption of the GSP. Others will be implemented when grant funds are obtained or upon completion of feasibility studies, economic evaluations, and/or other necessary planning studies.

As discussed above, an overall P/MA implementation schedule, or preliminary “glide path” has been developed that serves as a framework to guide the level of benefits that are planned to be achieved over the GSP implementation period (i.e., until 2040), and further through the SGMA planning and implementation horizon (i.e., through 2070). Accelerated implementation of P/MAAs (i.e., at expected benefit accrual rates faster than those shown in Table PMA-2 above) could be triggered if Minimum Thresholds for Chronic Lowering of Groundwater Levels are exceeded in more than 20% of (i.e., 4 out of 16) of Representative Monitoring Sites.
17.4. Public Notice Process

Public notice requirements vary for the different P/MAAs listed above. Some projects that involve infrastructure improvements only may not require specific public noticing (other than that related to construction), whereas certain other management actions that involve, for example, imposition of fees by AEWSD and/or ACSD, may require public noticing pursuant to Proposition 218 or Proposition 26. In general, P/MAAs being considered for implementation will be discussed during regular AEWSD Board Meetings and/or ACSD Board Meetings which are open to the public. Additional stakeholder outreach efforts will be conducted prior to and during P/MAA implementation, as required by law.

17.5. Addressing Overdraft Conditions

As discussed in Section 9.2.4 Overdraft Conditions, the Arvin-Edison Management Area as a whole does not have a net water budget deficit over the historical period based on the Management Area-specific spreadsheet water budget model. However, groundwater levels in some areas (i.e., outside of the SWSA) have shown persistent decreasing trends, suggesting a local imbalance of supplies versus groundwater pumping. Furthermore, the projected water budget indicates that under the 2030 Climate Change Scenario, imported water supplies to the Arvin-Edison Management Area may be reduced, resulting in a net deficit of approximately 31,600 AFY. The P/MAAs presented herein are expected to result in benefits (discussed below) that will address the projected deficit so as to avoid Undesirable Results and maintain sustainability.

17.6. Permitting and Regulatory Process

Permitting and regulatory requirements vary for the different P/MAAs depending on whether they are infrastructure projects, recharge projects, demand reduction management actions, and so forth. The various types of permitting and regulatory requirements (not all applicable to every P/MAA) include the following, if applicable:

- **Federal**
  - National Environmental Policy Act (NEPA) documentation, if federal grant funds are used;
  - National Pollution Discharge Elimination System (NPDES) stormwater program permit (administered by the California State Water Resources Control Board);

- **State**
  - California Environmental Quality Act (CEQA) documentation, including one or more of the following: Initial Study (IS), Categorical Exemption (CE), Negative Declaration (ND), Mitigated Negative Declaration (MND), Environmental Impact Report (EIR);

---

88 Prior to the start of water importation into the AEWSD area in 1966, groundwater levels were in a state of chronic decline.
Projects and Management Actions
Management Area Plan
Arvin-Edison Management Area, Kern Subbasin

- California State Water Resources Control Board permits and regulations regarding recycled water use, waste discharge, and stormwater capture for recharge;
- California Surface Mining and Reclamation Act (SMARA) regulations;
- California Division of Safety of Dams regulations;

- **Regional**
  - San Joaquin Valley Air Pollution Control District (SJVAPCD) permit and regulations;
  - Power and Water Resources Pooling Authority (PWRPA);

- **County/Local**
  - Encroachment permits – Kern County, KDWD, CalTrans, and others;
  - Kern County grading permit;
  - Kern County well construction permit.

Specific currently-identified permitting and regulatory requirements for each P/MA are listed in **Table PMA-1**. Upon implementation of any P/MA, the regulatory and permitting requirements of the P/MA will be re-examined.

17.7. **Status and Implementation Timetable**

☑️ **23 CCR § 354.44(b)(4)**

With a few exceptions, the current status of P/MAIs listed in **Table PMA-1** is “not yet initiated”\(^{89}\). As discussed above in **Section 17.3 Circumstances for Implementation**, P/MAIs related to water quantity will be initiated in a manner and sequence that achieves the “glide path” level of expected benefits shown in **Table PMA-2**, with accelerated implementation if Minimum Thresholds for Chronic Lowering of Groundwater Levels are exceeded in more than 20% of (i.e., 4 out of 16) Representative Monitoring Sites. **Table PMA-1** presents preliminary estimates of the time required to complete/implement each P/MA and a timetable for accrual of expected benefits. These estimates will be refined, as necessary, upon further evaluation of the P/MAIs.

17.8. **Expected Benefits**

☑️ **23 CCR § 354.44(b)(5)**

The different categories of expected benefits are presented above in **Section 17.1.3 Benefit Categories**, and the specific expected benefits of each P/MA are presented in **Table PMA-1**. Below is a discussion of how the expected benefits will be evaluated.

\(^{89}\) AEWSD has completed purchase of lands that will be developed into the AEWSD Sunset Spreading Works, has completed Phase I of the DiGiorgio Unit In-Lieu Project (formally known as the “North In-Lieu Project”), and has begun implementing the On-Farm Recharge Project. ACSD has begun implementation of the two drinking-water-quality-related projects.
17.8.1. Evaluation of Benefits

Each of the AEWSD-led P/MAs has expected benefits related to water quantity, and the two ACSD-led projects have expected benefits related to drinking water quality. Once a P/MA is implemented, it is important for there to be a way to evaluate, ideally to quantify, the benefits resulting from that P/MA. The way in which P/MA benefits are evaluated/quantified depends on the P/MA type. For those P/MAs that involve direct supply augmentation, the benefit is quantified directly through measurement of those flows. For P/MAs that involve indirect supply augmentation through, for example, increased surface water storage capacity and delivery flexibility, quantification of the benefit will require a comparison of the observed water supply condition (e.g., total imported water) against a hypothetical condition where the P/MA was not in place. For P/MAs that involve water demand reduction the benefit will be evaluated by comparison of the observed water demand condition (e.g., irrigated acreage) against a hypothetical condition where the P/MA was not in place. Because it is not possible to determine with certainty what the condition without the P/MA would be like, quantification of the benefits is inherently uncertain. For the two ACSD-led projects associated with water quality, evaluation of benefits will be done through regular water quality monitoring of ACSD wells, pursuant to its public water system permit.

As discussed above, although the P/MAs described herein are laid out along a general timetable defined by incremental elimination of water budget deficits (i.e., the “glide path”), the goals and objectives of P/MA implementation are not necessarily to achieve a certain water budget outcome, but rather to ensure that Undesirable Results for relevant Sustainability Indicators are avoided by the end of the SGMA implementation period (i.e., by 2040). For this reason, ultimately the success of the collective implementation of P/MAs will be determined by whether the Sustainability Goal is achieved.

17.8.2. Evaluation Relative to Water Level Sustainability Criteria

As mentioned in Section 9 Water Budget Information, as part of its involvement in the KGA GSA, AEWSD is participating in the development of a numerical groundwater water flow model for the Kern Subbasin based on DWR’s California Central Valley Groundwater-Surface Water Simulation beta fine-grid model (C2VSim-FG). As part of this process, all Basin GSAs were asked to input their proposed P/MAs into the Baseline and 2030 Climate Change C2VSim-FG projected model scenarios to assess water level responses to GSP implementation relative to proposed Water Level Sustainability Criteria defined for each GSA/Management Area (see Sections 14.1 and 15.1). As demonstrated in Figure PMA-2, for each of the sixteen water level Representative Monitoring Sites within the Arvin-Edison Management Area, groundwater elevations are expected to meet their Minimum Thresholds under P/MA implementation in both the Baseline and 2030 Climate Change Scenarios. Water levels are also maintained at or above the Measurable Objectives upon full P/MA implementation. The results of this Basin-wide projected modeling exercise thus further support the notion that the proposed P/MA implementation strategy is expected to result in sustainable management of groundwater levels within the Arvin-Edison Management Area.

17.9. Source and Reliability of Water from Outside AEWSD

Several of the P/MAs discussed below and shown in Table PMA-1 rely on additional water supplies from outside of the AEWSD area. Specifically, certain P/MAs rely on the availability of water during wet years to fill surface storage, conduct managed recharge, and offset groundwater pumping. As discussed in
Section 9.4 Projected Water Budget, the volume of CVP supplies is anticipated to decrease under the 2030 Climate Change Scenario relative to the Baseline Scenario, and that decrease is the main cause of the projected deficit. However, the FWA projections of Friant-Kern deliveries to AEWSD (FWA, 2018) assume a certain level of demand for Paragraph 16(b) wet year supplies, as described in the following excerpts:

“This analysis simulates 16(b) delivery via the Friant Kern and Madera canals with an anticipated level of future groundwater infiltration facilities throughout the Friant Division. These facilities were contemplated as a result of SJRRS implementation, and are described by analysis in the SJRRS PEIS/R.

The future management of 16(b) supplies cannot be fully anticipated at this time. Policy for the allocation of supplies has been in a constant state of evolution. For the purposes of this TM, a suggested allocation of 16(b) supplies among Friant Contractors is presented, based on the relative expected reduction in delivery of SJRRS on Class 1 and 2 contract supplies, by contractor.”

The FWA (2018) further states:

“The second SJRRS water category, Paragraph 16(b) supplies, are quantified in the CalSim II model by assuming a demand for this potential supply and meeting this demand, limited by availability of flood water and channel capacity for delivery.”

The level of demand within the Arvin-Edison Management Area that is assumed in the CalSim II modeling for the FWA analysis is almost certainly less than the level of demand under the proposed P/MAs discussed herein. Therefore, with additional demand for wet year (Paragraph 16(b)) supplies created by implementation of various P/MAs within the Arvin-Edison Management Area, this analysis assumes that additional Paragraph 16(b) water will be available.

In addition to the apparent underestimation of Friant Kern supplies available to AEWSD described above, AEWSD will continue its efforts to refine modeling results but also continue to secure additional water supplies for importation into the Arvin-Edison Management Area through transfers, exchanges, and purchases, as necessary and possible given pricing and timing constraints.

17.10. Legal Authority Required

☑️ 23 CCR § 354.44(b)(7)

AEWSD and ACSD are Participating Members of the KGA GSA, which is organized as a joint powers authority. AEWSD, as a water storage district, possesses the legal authority to implement the supply augmentation P/MAs discussed herein. ACSD, as a public water system, has the legal authority to implement the drinking water quality projects discussed herein. As a GSA, per CWC § 10725 through 10726.8, the KGA GSA possesses the legal authority necessary to implement the demand management P/MAs described herein, and will either act upon AEWSD’s behalf to enforce these P/MAs as necessary or will delegate authority to AEWSD itself to enforce the GSP within the Arvin-Edison Management Area.
17.11. Estimated Costs and Plans to Meet Them

☑️ 23 CCR § 354.44(b)(8)

Estimated costs for each P/MA are presented in Table PMA-1. Given the uncertainty in the scope and timing of these P/MA, the costs are presented as ranges. These costs include “one-time” costs and ongoing costs. The one-time costs may include capital costs associated with construction, feasibility studies, permitting, environmental (CEQA) compliance, or any other costs required to initiate a given P/MA. The ongoing costs are associated with operations and maintenance (O&M) and/or costs to otherwise continue implementing a given P/MA. It should be noted that depending on the source and nature of funding for the P/MA, the one-time costs may or may not be incurred entirely at the beginning of the P/MA; in some instances, loans or other financing options may allow for spreading out of “one-time” costs over time.

Potential sources of funding for the various P/MA are also presented in Table PMA-1, and include the following:

- AEWS fund, generally supported by fees charged to landowners within AEWS, including potentially the following:
  - General fund
  - SGMA compliance subaccount (to be created)
- Partnering agencies for certain P/MA (e.g., KDWD, TCWD, Cities of Bakersfield and Arvin, oil field producers)
- Grant funding from sources including DWR, USBR, and the Federal Emergency Management Agency (FEMA)
- ACSD fund, generally supported by local rate payers
- Other

Upon implementation of any given P/MA, the available funding sources for that P/MA will be re-examined.

17.12. Management of Recharge and Groundwater Extractions

☑️ 23 CCR § 354.44(b)(9)

As stated previously in Section 9 Water Budget Information, under historical conditions (WY 1995 – 2014), and under the Baseline Scenario of the projected water budget, the Arvin-Edison Management Area is in a state of approximate water supply/demand balance (i.e., a small net surplus). It is only under the projected 2030 (and 2070) Climate Change Scenarios that a net water supply deficit is projected to occur. That projected deficit is due, in large part, to a projected reduction in imported water supplies. However, as discussed above, the assumptions used in the FWA modeling analysis (FWA, 2018) regarding demand for Paragraph 16(b) water likely underestimate the demand for such wet year water within AEWS, and therefore also underestimate Friant-Kern deliveries to AEWS under the 2030 and 2070 conditions. Many of the projects discussed herein and shown on Table PMA-1 take advantage of additional wet year supplies that are assumed to be available once demands increase. These P/MA includes various direct recharge projects and projects that increase storage capacity and delivery flexibility.
In addition to these supply augmentation projects, the portfolio also includes policy-based management actions aimed at demand reduction. Some of these management actions aim to reduce overall water demand, and others are more specifically focused on reducing groundwater pumping. These management actions will rely initially on financial incentives (e.g., tiered pricing and/or fees) to drive voluntary demand reduction, but also include setting of mandatory groundwater pumping allocations, if necessary. A groundwater allocation program would likely include mechanisms to allow for trading or exchange of pumping allocations within designated areas, subject to constraints dictated by groundwater conditions observed within the Monitoring Network. Through this combination of increased recharge during wet years and as-needed demand reduction, AEWSD’s P/MA efforts will ensure that chronic lowering of groundwater levels and storage during drought will be offset by increases in groundwater levels and storage during other periods.
<table>
<thead>
<tr>
<th>P/MA Number</th>
<th>P/MA Name</th>
<th>Summary Description</th>
<th>Relevant Sustainability Indicators Affected</th>
<th>Circumstances for Implementation</th>
<th>Public Noticing Process</th>
<th>Permitting and Regulatory Process Requirements</th>
<th>Status</th>
<th>Timetable / Circumstances for Initiation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundwater Level &amp; Storage</td>
<td>Land Subsidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundwater Quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>AEWSD Sunset Spreading Works</td>
<td>The Sunset Spreading Works, approximately 150 acres, is located on the boundary between AEWSD and KDWD, adjacent to KDWD's Eastside Canal. The Project will take surface water (Federal CVP, State Water Project, or local supplies) diverted through KDWD's Eastside Canal and recharge the surface supplies as part of AEWSD's and KDWD's joint water management programs. The Project will include the construction of exterior and interior dikes for a direct recharge facility, a new turnout and pump station from the KDWD Eastside Canal, and interbasin structures.</td>
<td>x</td>
<td>x</td>
<td>To be implemented upon adoption of AEWSD GSP Chapter</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>KDWD encroachment permit; CEQA; NEPA if federal funds are used</td>
<td>Completed land acquisition</td>
</tr>
<tr>
<td>2</td>
<td>Private &amp; Caltrans Basin Connections</td>
<td>This project involves the construction of pipelines to connect several on-farm private basins and Caltrans sumps near AEWSD to utilize for groundwater recharge.</td>
<td>x</td>
<td></td>
<td>Grant funding</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>Caltrans permitting; CEGA if longer pipeline connections are required</td>
<td>Not yet initiated</td>
</tr>
<tr>
<td>3</td>
<td>Sycamore Creek Detention &amp; Sedimentation Basin</td>
<td>The proposed basin would serve to intercept sediment from Sycamore creek flows to prevent constriction where sediment deposits downstream, reduce the peak outflow, and prevent the likelihood of a canal and spreading baring breach. Detained water could be recharged for irrigation demands or recharged for groundwater supply augmentation.</td>
<td>x</td>
<td>x</td>
<td>Grant funding</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>County grading permit; NEPA if federal grant funds used; SMAA (potentially)</td>
<td>Not yet initiated</td>
</tr>
<tr>
<td>4</td>
<td>AEWSD South Canal Flood Study / Improvements</td>
<td>The South Canal Flood Study would review and possibly revise the FEMA floodplain in this area in order to increase the height of the canal bank to provide additional operational freeboard and accordingly reduce the potential for canal spills and subsequent flooding. The additional canal storage could allow for the capture and use of additional floodwater in lieu of groundwater pumping.</td>
<td>x</td>
<td></td>
<td>Grant funding</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>Not applicable for study</td>
<td>Not yet initiated</td>
</tr>
<tr>
<td>5</td>
<td>Stormwater Management and Flood Control Improvements</td>
<td>Potential construction of new sedimentation/detention basins, flood ditch erosion protection, Spillway Basin expansion, lengthening the South Canal's siphon under David Road or extension of the South Canal liner through designated floodplain reaches.</td>
<td>x</td>
<td>x</td>
<td>Grant funding/Completion of feasibility study</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>Permits: TBD; NEPA requirements if funds are granted</td>
<td>Not yet initiated</td>
</tr>
<tr>
<td>6</td>
<td>On-Farm Recharge</td>
<td>The program will encourage individual growers to perform on-farm recharge for individual and aggregated benefits. Water may be recharged on-farm in private basins and/or distributed through irrigation systems across irrigated acreage in excess of current crop ET.</td>
<td>x</td>
<td></td>
<td>Underway</td>
<td>No public notice required for implementation; outreach and education will expand program.</td>
<td>Not applicable</td>
<td>Underway</td>
</tr>
<tr>
<td>7</td>
<td>Caliente Creek Habitat Mitigation and Groundwater Recharge</td>
<td>Restoration of agricultural lands to native vegetation to provide flood mitigation. Two alternatives are being considered, of which Alternative 1 is partial agricultural and 2 is non-agricultural.</td>
<td>x</td>
<td></td>
<td>Grant funding</td>
<td></td>
<td>CEGA; NEPA (if federal funds used); SWIRCB Waste Discharge Requirements; CDFW Agreement; Determination of consistency with VFHP</td>
<td>Not yet initiated</td>
</tr>
</tbody>
</table>

December 2019

Arvin-Edison Water Storage District
Kern Subbasin Management Area Plan
<table>
<thead>
<tr>
<th>P/MA Number</th>
<th>P/MA Name</th>
<th>Timetable for Completion</th>
<th>Timetable for Accrual of Expected Benefits</th>
<th>Water Supply Augmentation</th>
<th>Water Demand Reduction</th>
<th>Water Quality Improvement</th>
<th>Flood Control</th>
<th>Water Management Flexibility / Efficiency</th>
<th>Data Gap Filling/ Monitoring</th>
<th>Source(s) of Water, if applicable</th>
<th>Legal Authority Required</th>
<th>Estimated Costs</th>
<th>Potential Funding Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AEWSD Sunset Spreading Works</td>
<td>Construction duration: approx. 2 years</td>
<td>1 year after construction</td>
<td>2,000 - 3,000 AFY recharge</td>
<td>410 AFY x x</td>
<td>Additional wet-year imported water supplies</td>
<td>Existing Authority as a Water Storage District</td>
<td>$7,310,000 (excluding property purchase; scalable)</td>
<td>TBD</td>
<td>AEWSD (50%), KDWD (50%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Private &amp; Caltrans Basin Connections</td>
<td>Construction duration: within 5 years</td>
<td>1-3 years after construction</td>
<td>50 - 500 AFY recharge</td>
<td>None</td>
<td>Additional wet-year imported water supplies; local stormwater</td>
<td>None</td>
<td>$100K - $500K</td>
<td>Not applicable</td>
<td>AEWSD, Grants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sycamore Creek Detention &amp; Sedimentation Basin</td>
<td>Construction duration: approx. 2 years</td>
<td>1-3 years after construction</td>
<td>200 - 300 AFY stormwater capture</td>
<td>x</td>
<td>Local stormwater</td>
<td>None</td>
<td>$2M - $10M</td>
<td>$10K - $50K</td>
<td>AEWSD, Grants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AEWSD South Canal Flood Study / Improvements</td>
<td>Study approx. 1 year; construction approx. 1 year</td>
<td>1-3 years after construction</td>
<td>100 - 200 AF increased storage capacity / stormwater capture</td>
<td>x x</td>
<td>Local stormwater</td>
<td>None</td>
<td>$100K - $300K for study plus construction costs estimated at $2M</td>
<td>Not applicable</td>
<td>AEWSD, FEMA Grants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stormwater Management and Flood Control Improvements</td>
<td>Construction duration: approx. 1 year</td>
<td>1-3 years after construction</td>
<td>TBD</td>
<td>x x</td>
<td>Local stormwater</td>
<td>None</td>
<td>$1M - $10M</td>
<td>TBD</td>
<td>AEWSD and partnering agencies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>On-Farm Recharge</td>
<td>Ongoing</td>
<td>Immediately</td>
<td>TBD</td>
<td></td>
<td>Local stormwater</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Private, if required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Caliente Creek Habitat Mitigation and Groundwater Recharge</td>
<td>Construction duration TBD</td>
<td>Flood control benefits immediately</td>
<td>TBD</td>
<td>x</td>
<td>Local stormwater</td>
<td>None</td>
<td>$1.6 M for Alternative 1; $3.8 M for Alternative 2</td>
<td>TBD</td>
<td>AEWSD, Grants</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Projects to Enhance Recharge**

**Projects to Manage and/or Capture Floodwater**
<table>
<thead>
<tr>
<th>No.</th>
<th>FMA Number</th>
<th>FMA Name</th>
<th>Summary Description</th>
<th>Relevant Sustainability Indicators Affected</th>
<th>Circumstances for Implementation</th>
<th>Public Noticing Process</th>
<th>Permitting and Regulatory Process Requirements</th>
<th>Status</th>
<th>Timetable / Circumstances for Initiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>AEWSD Intake Canal / KDWD Buena Vista Canal Intertie</td>
<td>Improvement of existing and/or construction of new interties between AEWSD Intake Canal and KDWD's Buena Vista Canal to facilitate water exchanges between the two districts and Kern County partners.</td>
<td>x</td>
<td>Completion of feasibility study</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>None (CEQA exempt under 15301 and 15303)</td>
<td>Not yet initiated</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>AEWSD Intake Canal / KDWD Farmer's Canal Intertie</td>
<td>Improvement of existing and/or construction of new interties between AEWSD Intake Canal and KDWD's Farmer's Canal to facilitate water exchanges between the two districts and Kern County partners.</td>
<td>x</td>
<td>Project to be implemented upon FEMA grant approval</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>None (CEQA exempt under 15301 and 15303)</td>
<td>Not yet initiated</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>AEWSD Wasteway Basin Improvements</td>
<td>The primary use of the existing AEWSD Wasteway Basin is to provide emergency water storage in the event of power failure. Additionally, it works as a detention facility for the City of Bakersfield stormwater. This project would include construction of a HDPE liner along the levees, installation of recirculation pumps, and basin grading. These improvements would allow the basin to serve as a location to divert and clarify sediment.</td>
<td>x</td>
<td>To be implemented upon adoption of AEWSD GIS Chapter / Grant funding</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>SCEA; NEPA requirements if grant funds are used; possible County encroachment permits</td>
<td>Not yet initiated</td>
<td>initiation upon FEMA grant approval</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Forrest Frick Pipeline / KDWD Eastside Canal Intertie</td>
<td>This project would connect the Forrest Frick Pipeline to the KDWD Eastside Canal to send AEWSD SW supplies through KDWD to serve portions of the AEWSD GWSA with temporary water contracts, utilizing existing infrastructure (turnouts, pipelines that are both District and landowner owned). With the District's new 9(d) contract, certain provisions of Reclamation law are no longer applicable and all lands within the service area can now be served with federal water supplies.</td>
<td>x</td>
<td>Completion of feasibility study</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>None</td>
<td>Not yet initiated</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>AEWSD North Canal Balancing Reservoir Expansion &amp; Discharge Pipelines</td>
<td>The proposed project will consist of the installation of a pipeline system that will convey flows from the four (4) wells within the AEWSD Balancing Reservoir directly to the basin discharge structure and no longer through the basin low flow channels. Infiltration and evaporation losses on well discharge flows will be eliminated and power efficiency for the wells (kwh/af) will be significantly enhanced since all water pumped will be discharged into the North Canal.</td>
<td>x</td>
<td>Grant funding/Completion of feasibility study</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>Permits; TBD; NEPA requirements if funds are granted</td>
<td>Not yet initiated</td>
<td>upon grant funding</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>AEWSD Lateral Capacity Improvement Projects</td>
<td>Increase delivery capacity of the AEWSD N-55 lateral system. Some examples of the actions considered for this project are: replacement of lateral system and landowner pipelines, renovation of storage tanks, construction of pump stations, etc.</td>
<td>x</td>
<td>To be implemented upon adoption of AEWSD GIS Chapter / Grant funding</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>CEQA; DMR SMARA permit issuance; NEPA requirements if grant funds are used</td>
<td>Not yet initiated</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Conversion of Granite Quarry to Sycamore Reservoir</td>
<td>The Granite Co. quarry, located upstream of the Sycamore Spreading Basins, is approaching the end of its operational life and could be converted into a balancing / detention / spreading reservoir. Excess flows in the North Canal could be pumped into the quarry reservoir, so the detained water could be recirculated for irrigation demands in lieu of groundwater pumping and/or recharged.</td>
<td>x</td>
<td>Grant funding, South County flooding response</td>
<td>Infrastructure improvement; no public noticing necessary</td>
<td>Not available</td>
<td>Not yet initiated</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>AEWSD South Canal Balancing Reservoir</td>
<td>Creation of a reservoir to allow water storage for flow mismatches in the AEWSD canal system during operation or emergencies. Depending on the location, this reservoir would increase storage capacity by ~500 AF.</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Projects to Increase Surface Storage Capacity / Delivery Flexibility

<table>
<thead>
<tr>
<th>P/MA Number</th>
<th>P/MA Name</th>
<th>Timetable for Completion</th>
<th>Timetable for Accrual of Expected Benefits</th>
<th>Expected Benefits</th>
<th>Estimated Costs</th>
<th>Source(s) of Water, if applicable</th>
<th>Legal Authority Required</th>
<th>One-time Costs</th>
<th>Ongoing Costs (per year)</th>
<th>Potential Funding Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>AEWSD Intake Canal / KDWD Buena Vista Canal Intertie</td>
<td>Construction duration: approx. 1 year</td>
<td>1 year after construction</td>
<td>8,000 AFY increased transfer/ exchange potential</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
<td>None</td>
<td>$2M - $5M</td>
<td>~$20,000</td>
<td>AEWSD, KDWD</td>
</tr>
<tr>
<td>9</td>
<td>AEWSD Intake Canal / KDWD Farmer’s Canal Intertie</td>
<td>Construction duration: approx. 1 year</td>
<td>1 year after construction</td>
<td>4,000 AFY increased transfer/ exchange potential</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
<td>None</td>
<td>$1M - $2.5M</td>
<td>~$20,000</td>
<td>AEWSD, KDWD</td>
</tr>
<tr>
<td>10</td>
<td>AEWSD Wasteway Basin Improvements</td>
<td>Construction duration: 3 years</td>
<td>Upon completion of construction</td>
<td>1,550 AFY stormwater capture</td>
<td>x</td>
<td>Stormwater from Bakersfield storm sewer system</td>
<td>None</td>
<td>$2.5M</td>
<td>~$32,000</td>
<td>FEMA 75% - AEWSD 25%</td>
</tr>
<tr>
<td>11</td>
<td>Forrest Frick Pipeline / KDWD Eastside Canal Intertie</td>
<td>Construction duration TBD</td>
<td>1-3 years after construction</td>
<td>10 AFY recharge; 3 AFY/ac of land served</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
<td>None</td>
<td>$0.5M - $1.5M</td>
<td>TBD</td>
<td>AEWSD</td>
</tr>
<tr>
<td>12</td>
<td>AEWSD North Canal Balancing Reservoir Expansion &amp; Discharge Pipelines</td>
<td>Construction duration TBD</td>
<td>1-3 years after construction</td>
<td>16 AF increased storage capacity; 100 AFY recharge</td>
<td>50 AFY reduced evaporative losses</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
<td>None</td>
<td>$300K</td>
<td>TBD</td>
</tr>
<tr>
<td>13</td>
<td>AEWSD Lateral Capacity Improvement Projects</td>
<td>Construction duration TBD</td>
<td>TBD</td>
<td>1,000 AFY increased delivery capacity</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
<td>None</td>
<td>$10M - $20M</td>
<td>TBD</td>
<td>AEWSD</td>
</tr>
<tr>
<td>14</td>
<td>Conversion of Granite Quarry to Sycamore Reservoir</td>
<td>Construction duration TBD</td>
<td>1-3 years after construction</td>
<td>3,000 – 6,000 AFY recharge; 2,500 AF increased storage capacity</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
<td>W/L require property acquisition or land use agreement with quarry owner</td>
<td>$10M - $20M</td>
<td>TBD</td>
<td>AEWSD, TCWD, Grants</td>
</tr>
<tr>
<td>15</td>
<td>AEWSD South Canal Balancing Reservoir</td>
<td>Construction duration TBD</td>
<td>TBD</td>
<td>500 AF increased storage capacity</td>
<td>190 AFY</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
<td>None</td>
<td>$1M - $10M</td>
<td>~$5,000</td>
</tr>
<tr>
<td>P/MA Number</td>
<td>P/MA Name</td>
<td>Summary Description</td>
<td>Relevant Sustainability Indicators Affected</td>
<td>Circumstances for Implementation</td>
<td>Public Noticing Process</td>
<td>Permitting and Regulatory Process Requirements</td>
<td>Status</td>
<td>Timetable / Circumstances for Initiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----------</td>
<td>---------------------</td>
<td>--------------------------------------------</td>
<td>----------------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------</td>
<td>--------</td>
<td>---------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>In-Lieu Projects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Frick Unit In-Lieu Project</td>
<td>This project would increase the ability of the District to provide surface water supplies to the Groundwater Service Area (GWSA) to help meet crop irrigation requirements. With the Project, the District will supply surface water when available through new facilities to the GWSA to meet crop irrigation requirements with the intent of reducing District wide groundwater use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not yet initiated</td>
<td>upon grant funding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>DiGiorgio Unit In-Lieu Project</td>
<td>The District will supply SW when available through new facilities to the GWSA to meet its water requirements with the intent of reducing District-wide GW use. However, when SW is in short supply and under agreement, the landowners could recover and return GW from their own wells to the District canal system through new pipelines once they have satisfied their own water needs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Completed Phase I</td>
<td>Future Phases initiated upon grant funding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>General In-Lieu Banking Program</td>
<td>The In Lieu Banking Program consists of supplying surface water to landowners that previously relied only on groundwater (GWSA). New infrastructure would have to be built to facilitate the implementation of this program.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not yet initiated</td>
<td>upon grant funding</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Projects to Develop New Supplies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Reclamation of Oilfield Produced Water</td>
<td>Reclaiming water from oil production facilities for irrigation purposes is currently an untapped water source in AEWSD. After treatment and cooling, produced water could be pumped into AEWSD facilities to serve irrigation demands in lieu of groundwater pumping.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not yet initiated</td>
<td>upon agreement with oil field producers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Wastewater Reclamation with City of Arvin &amp; Bakersfield</td>
<td>Reclaiming water from Cities of Arvin and Bakersfield wastewater treatment facilities for irrigation purposes is currently an untapped water source in AEWSD. After wastewater treatment, the effluent could be pumped into AEWSD facilities to serve irrigation demands in lieu of groundwater pumping.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not yet initiated</td>
<td>upon agreement with cities</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Management Actions / Policies to Reduce Overall Water Demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Incentives for Land Conversion</td>
<td>The District would provide subsidies to incentivize groundwater users to convert land to alternative land uses (e.g., solar farms) and reduce groundwater extractions. The District may consider a subsidy structure to determine which subsidies would result in the greatest expected annual benefit in acre-feet per year.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not yet initiated</td>
<td>upon adoption of GSP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>On-farm Water Conservation</td>
<td>The NRCS is offering landowner incentive programs to assist in implementing various conservation activities, including but not limited to: irrigation system improvements, water/nutrient/pest management, and pump engine replacement. Interested landowners can call (661) 336-0967 or visit the website (<a href="http://www.ca.nrcs.usda.gov">www.ca.nrcs.usda.gov</a>) for more information.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not yet initiated</td>
<td>upon stakeholder interest</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table PMA-1
Details of Projects and Management Actions
Arvin-Edison Water Storage District
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>P/MA Number</th>
<th>P/MA Name</th>
<th>Timetable for Completion</th>
<th>Timetable for Accrual of Expected Benefits</th>
<th>Expected Benefits</th>
<th>Estimated Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Primary</td>
<td>Secondary</td>
</tr>
<tr>
<td><strong>In-Lieu Projects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Frick Unit In-Lieu Project</td>
<td>TBD</td>
<td>1-3 years after completion</td>
<td>3,500 AFY increased surface water deliveries</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
</tr>
<tr>
<td>17 DiGiorgio Unit In-Lieu Project</td>
<td>TBD</td>
<td>1-3 years after completion</td>
<td>4,250 AFY increased surface water deliveries</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
</tr>
<tr>
<td>18 General In-Lieu Banking Program</td>
<td>TBD</td>
<td>1-3 years after completion</td>
<td>2.75 AFY/ac increased surface water deliveries every 2.5 years</td>
<td>x</td>
<td>Additional wet-year imported water supplies</td>
</tr>
<tr>
<td><strong>Projects to Develop New Supplies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 Reclamation of Oilfield Produced Water</td>
<td>TBD</td>
<td>1 year after agreement</td>
<td>1,000 AF/yr</td>
<td></td>
<td>oil field produced water</td>
</tr>
<tr>
<td>20 Wastewater Reclamation with City of Arvin &amp; Bakersfield</td>
<td>TBD</td>
<td>1 year after agreement</td>
<td>10,000 AFY</td>
<td></td>
<td>wastewater from Cities of Arvin and Bakersfield</td>
</tr>
<tr>
<td><strong>Management Actions / Policies to Reduce Overall Water Demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 Incentives for Land Conversion</td>
<td>TBD</td>
<td>3-5 years after implementation</td>
<td>2.75 AFY/ac of land converted</td>
<td></td>
<td>reduced irrigated area resulting in decreased ET</td>
</tr>
<tr>
<td>22 On-farm Water Conservation</td>
<td>TBD</td>
<td>3-3 years after initiation</td>
<td>50 - 500 AFY</td>
<td></td>
<td>conservation practices resulting in decreased applied water and crop consumptive use</td>
</tr>
<tr>
<td>P/MA Number</td>
<td>P/MA Name</td>
<td>Summary Description</td>
<td>Relevance to Sustainability Indicators Affected</td>
<td>Circumstances for Implementation</td>
<td>Public Noticing Process</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------</td>
<td>---------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>23</td>
<td>Groundwater Fee Increase</td>
<td>Increase GWMA costs to incentivize groundwater users to reduce groundwater extractions and take surface water when available. The District may consider modifying its fee structure study to determine the best strategy for curbing groundwater overdraft without causing inequitable economic impact.</td>
<td>Groundwater Flow &amp; Storage</td>
<td>x</td>
<td>Contingent on P/MA 15, 16, and 17.</td>
</tr>
<tr>
<td>24</td>
<td>Groundwater Extraction Quantification Method</td>
<td>Application of a new policy to specify an approved method to quantify the individual and aggregated groundwater extractions for the required SGMA annual reporting. Some methods to consider (or a combination of them) are the following: (1) Irrigated Acreage determined by aerial imagery; (2) Irrigated area hybrid determined by annual crop survey alongside aerial imagery; (3) Calibrated energy records; (4) Volumetric flow measurement; (5) Remote sensing of evapotranspiration; (6) Other.</td>
<td>Groundwater Quality</td>
<td>x</td>
<td>To be implemented upon adoption of AEWSD GSP Chapter</td>
</tr>
<tr>
<td>25</td>
<td>Groundwater Allocation per Acre</td>
<td>This program would provide a finite groundwater allocation on a per acre basis. The policy would identify and forecast the demands associated with existing water rights, domestic and environmental uses. The sustainable yield and ultimate groundwater allocation would take into consideration the applicable beneficial uses and users of groundwater. Once an individual groundwater allocation is determined, the District may adopt a policy which provides a gradual &quot;ramp-down&quot; wherein an allocation would decrease over time to arrive at the actual groundwater allocation to allow growers time to adjust to the concept of an allocation and, for some growers, a reduction in groundwater use. The policy would detail the number of years and amount of reduction each year.</td>
<td>Land Subsidence</td>
<td>x</td>
<td>To be implemented upon adoption of AEWSD GSP Chapter</td>
</tr>
<tr>
<td>26</td>
<td>Groundwater Marketing &amp; Trading</td>
<td>Contingent on the GW extraction quantification and allocation programs, the District would pursue a groundwater market and trading program to provide uses and beneficial users more flexibility in utilizing a groundwater allocation. This District may adopt a policy to define a groundwater trading program, acknowledging that many complexities and considerations required to successfully initiate and manage a trading program may arise. Therefore the District should discuss any other water bank/credit systems in existence. The District may adopt a groundwater trading structure and consider a variety of structures including: (1) Bilateral contracts or &quot;coffee shop&quot; markets; (2) Brokerage; (3) Bulletin boards; (4) Auctions and reverse auctions; (5) Electronic clearing-houses or &quot;smart markets&quot;; (6) Other trade structures.</td>
<td>Groundwater Flow &amp; Storage</td>
<td>x</td>
<td>Contingent on Management Actions 23 and 24</td>
</tr>
<tr>
<td>27</td>
<td>Education of Groundwater Users per Acre</td>
<td>This program would provide groundwater users an expected groundwater volume, as an education tool, prior to enforcement actions on groundwater allocations, with the goal of providing awareness of overdraft conditions. This information would be provided in an annual letter, along with average crop demand, GWA average extraction, GW overdraft, and reminders of GSA powers and authorities.</td>
<td>Groundwater Flow &amp; Storage</td>
<td>x</td>
<td>To be implemented upon adoption of AEWSD GSP Chapter</td>
</tr>
<tr>
<td>P/MA Number</td>
<td>P/MA Name</td>
<td>Timetable for Completion</td>
<td>Timetable for Accrual of Expected Benefits</td>
<td>Expected Benefits</td>
<td>Source(s) of Water, if applicable</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------</td>
<td>--------------------------</td>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>Groundwater Fee Increase</td>
<td>TBD</td>
<td>1-3 years after implementation</td>
<td>quantity TBD</td>
<td>reduced irrigated area resulting in decreased ET</td>
</tr>
<tr>
<td>24</td>
<td>Groundwater Extraction Quantification Method</td>
<td>Dependent on methodology; approx. 2-3 years</td>
<td>1 year after implementation</td>
<td>x x</td>
<td>NA</td>
</tr>
<tr>
<td>25</td>
<td>Groundwater Allocation per Acre</td>
<td>TBD</td>
<td>1-3 years after implementation</td>
<td>quantity TBD</td>
<td>mandatory reduction in District-wide groundwater pumping</td>
</tr>
<tr>
<td>26</td>
<td>Groundwater Marketing &amp; Trading</td>
<td>1-2 years after initiation by GSA Board</td>
<td>1-3 years after implementation</td>
<td>x</td>
<td>NA</td>
</tr>
<tr>
<td>27</td>
<td>Education of Groundwater Use per Acre</td>
<td>TBD</td>
<td>1 year after initiation</td>
<td>100 AFY</td>
<td>conservation practices resulting in decreased applied water and crop consumptive use</td>
</tr>
<tr>
<td>P/MA Number</td>
<td>P/MA Name</td>
<td>Summary Description</td>
<td>Relevance Sustainability Indicators Affected</td>
<td>Circumstances for Implementation</td>
<td>Public Noticing Process</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------</td>
<td>---------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>28</td>
<td>ACSD Emergency 1,2,3-TCP Treatment at Well No. 13</td>
<td>The project involves the installation of emergency 1,2,3-TCP treatment at the well head. The work will include installation of a skid mounted treatment system with two granular activated carbon media vessels for removal of 1,2,3-TCP, connection to the existing well discharge piping, installation of below ground and above ground influent and effluent piping and appurtenances, electrical and controls, and modifications to the existing well site PLC programming.</td>
<td>x</td>
<td>Implementation underway</td>
<td>Public meetings, direct mail</td>
</tr>
<tr>
<td>29</td>
<td>ACSD Arsenic Mitigation Project - Phase II</td>
<td>The purpose of the project is to bring the ACSD water system into compliance for Arsenic. All five of the ACSD active wells exceed the maximum contaminant level (MCL) of 10 ppb for Arsenic. The project was separated into two phases. Phase II involves drilling three new wells, constructing a 1.0 MG storage tank and booster pumping plant, and connecting the facilities to the existing distribution system. The original five (5) water wells will then be abandoned and destroyed in accordance with Kern County Standards.</td>
<td>x</td>
<td>Implementation underway</td>
<td>Public meetings, direct mail</td>
</tr>
</tbody>
</table>
### Table PMA-1
Details of Projects and Management Actions
Arvin-Edison Water Storage District
Kern Subbasin Management Area

<table>
<thead>
<tr>
<th>P/MA Number</th>
<th>P/MA Name</th>
<th>Timetable for Completion</th>
<th>Timetable for Accrual of Expected Benefits</th>
<th>Expected Benefits</th>
<th>Estimated Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Water Supply Augmentation</td>
<td>Water Demand Reduction</td>
<td>Water Quality Improvement</td>
</tr>
<tr>
<td>28</td>
<td>Emergency 1,2,3- TCP Treatment at Well No. 13</td>
<td>In progress</td>
<td>Upon completion</td>
<td>x</td>
<td>NA</td>
</tr>
<tr>
<td>29</td>
<td>Arsenic Mitigation Project - Phase II</td>
<td>In progress</td>
<td>Upon completion</td>
<td>x</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Projects to Improve Drinking Water Quality in ACSD Service Area**

**Abbreviations:**
- **AEWSD** = Arvin-Edison Water Storage District
- **AFY** = acre-feet per year
- **CDFW** = California Department of Fish and Game
- **CEQA** = California Environmental Quality Act
- **DMR** = California Division of Mine Reclamation
- **FEMA** = Federal Emergency Management Agency
- **GSA** = Groundwater Sustainability Agency
- **GWSA** = Groundwater Only Service Area
- **KDWD** = Kern Delta Water District
- **NEPA** = National Environmental Protection Act
- **NMRC** = Natural Resources Conservation Service
- **P/MA** = Project/Management Action
- **SMARA** = Surface Mining and Reclamation Act
- **SWRCB** = State Water Resources Control Board

**Notes:**
- (a) Summary table developed based off information provided by AEWSD and its engineering consultant, Provost & Pritchard, on 10 February 2019, 18 March 2019 and 25 April 2019.
Locations of Proposed Projects & Management Actions

Arvin-Edison Water Storage District
Kern County, California
December 2019
860064.01
Figure PMA-1

Notes
1. All locations are approximate.
2. Additional P/MA not displayed on the map include:
   2 - Private / Caltrans Basin Connections
   5 - Stormwater Mgmt. / Flood Control
   6 - On-Farm Recharge

Projects 21-27 are water demand reduction management actions.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 27 November 2019.
18. AEWSD PLAN IMPLEMENTATION

Per the GSP Emergency Regulations, “plan implementation” refers to “an [Groundwater Sustainability] Agency’s exercise of the powers and authorities described in the Act, which commences after an Agency adopts and submits a Plan or Alternative to the Department and begins exercising such powers and authorities” (23 CCR § 351(y)). This section describes the activities that will be performed by Arvin-Edison Water Storage District (AEWSD) as part of GSP implementation within the Arvin-Edison Management Area, with a focus on the first five years. Section 19 ACSD Plan Implementation presents plan implementation information for Arvin Community Services District (ACSD). This section does not address any actions by other entities with potential management authority in the Management Area – i.e., the Kern Groundwater Authority (KGA) Groundwater Sustainability Agency (GSA).

Key GSP implementation activities to be undertaken by AEWSD over the next five years include:

- Monitoring and data collection;
- Data gap filling efforts;
- Projects & Management Action (P/MA) implementation, including policy development to support GSP implementation;
- Technical and non-technical coordination with other water management entities within the Kern County Subbasin (Kern Subbasin);
- Continued outreach and engagement with stakeholders;
- Annual reporting;
- Enforcement and response actions, as necessary; and
- Evaluation and updates, as necessary, of the MA Plan as part of the required periodic evaluations (i.e., “five-year updates”).

Each of these activities is discussed in more detail below.

18.1. Plan Implementation Activities

18.1.1. Monitoring and Data Collection

As discussed in Section 16 Monitoring Network, successful sustainable groundwater management relies on a foundation of data to support decision making. As such, collection of data within the Arvin-Edison Management Area will be a key part of GSP implementation. These data collection efforts include data on applicable sustainability indicators to be collected from the networks of Representative Monitoring Sites (RMS), as well as other data and information required for management and reporting under the Sustainable Groundwater Management Act (SGMA), as described below.
Monitoring of Applicable Sustainability Indicators

Section 16 Monitoring Network discusses the monitoring networks (i.e., Representative Monitoring Sites; RMS) and protocols that will be used for the applicable sustainability indicators within the Arvin-Edison Management Area, including Chronic Lowering of Groundwater Levels, Reduction of Groundwater Storage (using groundwater levels as a proxy), and Land Subsidence. Those protocols will be followed in the defined networks as part of GSP implementation. Data collected will be incorporated into AEWSD’s own Data Management System (DMS) for subsequent inclusion in the basin-wide DMS. These data will be used to support coordination efforts within the KGA GSA and the Kern Subbasin (e.g., as part of Annual Reports; see Section 18.1.5 Annual Reporting).

Monitoring results will be evaluated against applicable Sustainable Management Criteria (SMCs; i.e., Undesirable Results, Minimum Thresholds, and Measurable Objectives) to support local management efforts. In addition to the single RMS for water quality in the ACSD area, AEWSD has established a network of water quality monitoring sites and sampling protocols within the other parts of the Arvin-Edison Management Area. Those data collection activities will also be conducted to support improved local understanding and groundwater management decisions. If it is determined in the future that SMCs are warranted outside of ACSD for this Sustainability Indicator, the MA Plan will be amended as such.

AEWSD anticipates that within the first five years of GSP implementation (i.e., in the 2020 – 2025 timeframe), the following efforts related to monitoring will be performed:

- Refinement of the local DMS to comply with the basin-wide DMS;
- Refinement of the Monitoring Network, including potentially adding, replacing or drilling new wells and/or video-logging to collect missing screen/depth info of Representative Monitoring Sites with data existing data gaps (see Section 16.4 Assessment and Improvement of Monitoring Network);
- Semi-annual monitoring for water levels at the RMS, with the potential for more frequent (i.e., monthly) monitoring and/or monitoring of additional well sites;
- Semi-annual monitoring for water quality at the RMS, with the potential for monitoring of additional well sites; and
- Compilation and review of publicly available subsidence data.

Collection of Other Required Information

Besides the data on Sustainability Indicators described above, collection and reporting of other types of information is required under SGMA (see further discussion below in Section 18.1.5 Annual Reporting). These other types of information include:

- Groundwater extraction information; and
- Surface water supply data

Groundwater extraction information will be quantified for inclusion in the Annual Reports through methods described in the Coordination Agreement and Appendices thereto.

Surface water supply data will be based on metered imports through the AEWSD canal system (i.e., at the head of the North Canal at the Forrest Frick Pumping Plant and at the California Aqueduct Intertie). All surface water delivered into the Arvin-Edison Management Area will have a source/type (e.g., Central
Valley Project [CVP], State Water Project [SWP], Kern River, or other) assigned to it to facilitate basin-wide accounting of these supply sources.

Data Gap Filling

The District will prioritize and begin to fill the key data gaps identified in this MA Plan related to the hydrogeologic conceptual model, groundwater conditions, and water budgets, among other things. Such efforts will include, but not be limited to, validating the status of existing wells, refining the water budget parameters based on additional data and modeling, collecting additional data related to aquifer conditions and properties, and conducting additional data compilation and analysis of groundwater conditions information using sources identified in Appendix I and other public datasets as they become available (e.g., California Department of Fish and Wildlife’s new “Critical Species Lookbook” dataset).

18.1.2. Project and Management Action Implementation

A main part of GSP implementation will be the implementation of P/MAs to address and prevent potential Undesirable Results. As described in Section 17 Projects and Management Actions, a portfolio of P/MAs has been developed with the goal of addressing the relevant Sustainability Indicators in the specific areas of concern within the Arvin-Edison Management Area, and each P/MA in the portfolio has certain expected benefits. Table PMA-1 provides the required details about each P/MA, including the circumstances under which they will be implemented.

For many of the P/MAs shown in Table PMA-1, initial steps in implementation will include performing various studies or analyses to refine the concepts into actionable projects and/or policies. Studies and work efforts may include, but are not limited to, the following:

- White papers exploring policy options;
- California Environmental Quality Act (CEQA) studies and documentation;
- Engineering feasibility studies and preliminary design reports;
- Financial and/or economic analysis such as Proposition 218 studies; and
- Legal analyses.

Once the necessary initial studies are completed, P/MAs will undergo, as necessary, final engineering design (in the case of infrastructure projects) and final drafting (in the case of policy-based actions). At that point, construction of projects and/or adoption of policies will occur, followed by ongoing operations and maintenance (O&M), as necessary. It is anticipated that each implemented P/MA will have its own set of monitoring or data collection components to allow for P/MA assessment and, if necessary, modification.

AEWSD anticipates that within the first five years of GSP implementation (i.e., in the 2020 – 2025 timeframe), the following efforts related to P/MA implementation will be performed:

- Refine existing General Project/General Administration Service Charges internal policy

---

90 https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/
91 Studies conducted in support of P/MA implementation will be based on the best available data and science.
- Initiate engineering design, permitting (i.e., CEQA and others), and construction of the AEWSD Sunset Spreading Works (P/MA #1);
- Initiate the South Canal Flood Study, including identification of potential grant funding sources (P/MA #4);
- Continue implementation of on-farm recharge (P/MA #6);
- Initiate feasibility study, engineering design, and permitting (i.e., CEQA and others) of the Forrest Frick Pipeline / Kern Delta Water District (KDWD) Eastside Canal Intertie (P/MA #11);
- Initiate engineering design and permitting (i.e. CEQA and others) of the Frick Unit In-Lieu Project (P/MA #16);
- Initiate feasibility study of the Conversion of Granite Quarry to Sycamore Reservoir project (P/MA #14);
- Initiate feasibility study of Reclamation of Oilfield Produced Water project (P/MA #19);
- Initiate study of Wastewater Reclamation with City of Arvin and Bakersfield project (P/MA #20);
- Initiate policy study for Incentives for Land Conversion (P/MA #21);
- Initiate policy study on Groundwater Extraction Quantification Method (P/MA #24);
- Initiate policy study on Groundwater Allocation per Acre (P/MA #25); and
- Initiate outreach for Education of Groundwater Use per Acre (P/MA #27).

In addition to the above specific P/MA activities, AEWSD will continue to actively participate in the local, regional and state-wide water market(s) to secure additional short- and long-term surface water supplies through exchanges, trades, and sales. AEWSD will also actively explore and pursue grant funding source to support other P/MAs listed in Table PMA-1.

AEWSD also anticipates that part of P/MA implementation will involve review and potential modification of AEWSD’s landowner contracts to provide, among other things, greater flexibility in terms of water purchase and delivery and revenue to support other P/MAs. AEWSD will also work with owners of irrigated parcels within the undistricted areas that are covered by this GSP (see Appendix C) to develop approaches to address the imbalance in projected water budgets for those lands.

18.1.3. Intrabasin Coordination

Just as this MA Plan has been developed as part of a coordinated GSP process in the Kern Subbasin, coordination amongst all water management entities involved in SGMA in the Kern Subbasin will continue during GSP implementation. This coordination will include both technical and non-technical matters, as discussed below.

Technical Coordination

Continued technical coordination will be critical to ensure that all entities in the Kern Subbasin as a whole approach local groundwater management using a robust shared framework of data, information, and technical assumptions. AEWSD and ACSD will coordinate with other water management entities on technical matters including, but not limited to, the following:

- DMS development and maintenance;
• Groundwater model refinement and updates;
• Water budget refinement and collection of supporting data; and
• Basin-wide monitoring and reporting efforts.

Non-Technical Coordination

Non-technical coordination will involve matters related to policy, advocacy, governance, and the like. AEWSD will continue to actively participate in coordination meetings with and amongst fellow KGA members and the other Kern Subbasin GSAs. The AEWSD Board has also adopted a resolution to become an exclusive GSA for the Arvin-Edison Management Area and plans to finalize this in early 2020. This GSA formation effort will be conducted in coordination with all other GSAs in the Kern Subbasin to ensure continued GSA coverage of the Subbasin. Other non-technical coordination activities will be pursued, as necessary.

18.1.4. Stakeholder Engagement

AEWSD’s Stakeholder Communication and Engagement Plan (SCEP; see Appendix E) is a key part of the MA Plan, and will continue to be refined, updated and executed during GSP implementation. Anticipated stakeholder engagement activities include, but are not limited to:

• Regular SGMA updates during AEWSD Board meetings;
• Hosting stakeholder workshops, as needed;
• Posting of relevant announcements and information on the AEWSD website; and
• Conducting informational discussions and meetings, as necessary, with interested stakeholders.

Any GSP implementation actions that relate to establishment of allocations of groundwater pumping or “native yield” on a landowner level will be conducted through a robust stakeholder engagement process.

18.1.5. Annual Reporting

Per the GSP Emergency Regulations, an annual report on basin conditions and GSP implementation status is required to be submitted to the Department of Water Resources (DWR) by April 1 of each year following GSP adoption. These annual reports will be prepared on the basin-level but will require input from each local entity, including from AEWSD and ACSD. Activities required at the District level and the Basin level are described below.

District-Level Activities

In support of the annual reporting requirements, AEWSD will provide to the basin-level entity preparing the reports all monitoring data from the RMS in its designated monitoring networks, as well as the other required information discussed above. AEWSD will also provide review and comment on the draft reports to ensure that local information is properly incorporated into the basin-level reports.

Basin-Level Activities

An entity will be designated at the basin level to compile and consolidate all of the local information into annual reports that meet the requirements of the GSP Emergency Regulations (23 CCR § 356.2).
18.1.6. **Enforcement and Response Actions**

Part of successful management involves the ability to adapt and respond to unforeseen or uncertain circumstances. To the extent possible, methods to address foreseeable problems should be developed before those problems arise. It is anticipated that there may need to be actions taken to enforce compliance with the GSP and any policies adopted thereunder. Such actions, if necessary, will be taken in accordance with applicable laws and authorities.

**Impacted Well Mitigation Program**

In other cases, a response action may be needed that is driven not by a non-compliance concern (e.g., an Undesirable Result), but rather by a physical, social or economic condition that falls outside of the six Sustainability Indicators defined under SGMA. One such condition that may arise is that of wells being impacted by low groundwater levels. Impacts could include dewatering of pumps or dewatering of well screens to the point of significant reduction in production. To address this potential occurrence, an Impacted Well Mitigation Program will be developed whereby a potential remedy will be provided to owners of wells that are demonstrably unreasonably impacted by groundwater conditions, as defined within the policy. Funding for such a program may be sourced from the AEWSD general fund or from a dedicated fund supported by a fee on owners of commercial (i.e., agricultural or industrial) supply wells. The program may be modeled after similar programs developed elsewhere in the basin or around the state (e.g., the Kern Water Bank’s program [Kern Water Bank, 2017]), and may include, but not limited to, remedies such as lowering of pumps, deepening of wells, drilling new wells, and support for access to alternative water sources. The program will be developed in coordination with and in consideration of the interests of local stakeholders within the MA Plan area.

18.1.7. **Periodic Evaluations of GSP**

*23 CCR § 356.4*

Per the GSP Emergency Regulations (23 CCR § 356.4), AEWSD will conduct a periodic evaluation of its MA Plan, at least every five years, and will modify the MA Plan as necessary to ensure that the Sustainability Goal defined for the Kern Subbasin (see **Section 12 Sustainability Goal**) is achieved within the Arvin-Edison Management Area. The GSP elements that will be covered in the periodic evaluation are described below. It is anticipated that the 2025 plan will require substantial revision, especially on matters related to the water budget, P/MAs and sustainability criteria.

**Sustainability Evaluation**

This section will evaluate the current groundwater conditions for each applicable sustainability indicator within the Arvin-Edison Management Area, including progress toward achieving Interim Milestones and Measurable Objectives.

**Plan Implementation Progress**

This section will evaluate the current implementation status of P/MAs, along with an updated project implementation schedules and any new projects that are not included in this MA Plan.
Reconsideration of GSP Elements

Per 23 CCR § 356.4(c), elements of the MA Plan, including the Basin Setting, Management Areas, Undesirable Results, Minimum Thresholds, and Measurable Objective, will be reviewed and revised if necessary.

Monitoring Network Description

This section will provide a description of the Monitoring Network, including identification of data gaps, assessment of monitoring network function with an analysis of data collected to date, identification of actions that are necessary to improve the monitoring network, and development of plans or programs to fill data gaps.

New Information

This section will provide a description of significant new information that has been made available since the adoption or amendment of the MA Plan, or the last five-year assessment, including data obtained to fill identified data gaps. As discussed above under Reconsideration of GSP Elements, if evaluation of the Basin Setting, Measurable Objective, Minimum Threshold, or Undesirable Results definition warrant changes to any aspect of the MA Plan, this new information would also be included.

Regulations or Ordinances

AEWSD possesses the legal authority to implement regulations or ordinances related to the MA Plan. This section will provide a description of relevant actions taken by AEWSD, including a summary of related regulations or ordinances.

Legal or Enforcement Actions

This section will summarize legal or enforcement actions taken by AEWSD and/or the KGA GSA in relation to the MA Plan, along with how such actions support sustainability in the Arvin-Edison Management Area.

Plan Amendments

This section will provide a description of proposed or complete amendments to the MA Plan.

Coordination

This section will describe coordination activities relevant to the Arvin-Edison Management Area.

18.2. Plan Implementation Costs

23 CCR § 354.6(e)

Per the GSP Emergency Regulations (23 CCR § 354.6(e) and 354.44(b)(8)), this section provides estimates of the costs to AEWSD to implement this MA Plan and potential sources of funding to meet those costs.

18.2.1. Estimated Costs

Costs to AEWSD to implement this MA Plan can be divided into several groups, as follows:

- Costs of local groundwater management activities;
- AEWSD’s proportional share of costs for basin-wide groundwater management activities; and
• Costs to implement P/MAs, including capital/one-time costs and ongoing costs.

**Table PI-1** provides an estimate of the costs for each of the above groups. Costs to implement P/MAs are shown in **Table PI-1** for each main P/MA category; estimated costs for individual P/MAs are provided in **Table PMA-1**.

**18.2.2. Sources of Funding to Meet Costs**

As shown in **Table PI-1**, costs for GSP implementation are estimated to be significant – i.e., approximately $2.93 million per year on average over the next 20 years. To meet these costs, AEWSD will need to establish new funding sources or increase existing funding sources. SGMA grants GSAs certain financial authorities (California Water Code [CWC] § 10725.4 and 10730 through 10731), including to raise revenue through use of fees, assessments, pump taxes, and other methods to pay for the costs incurred by the GSA for SGMA compliance. AEWSD will likely meet the estimated costs through a combination of the following:

- AEWSD revenue from assessments/fees;
- Special assessments/fees for specific projects;
- Grant funding or other financing options; and/or
- Penalties levied on prohibited activities.

**18.3. Plan Implementation Schedule**

This section discusses a general estimated schedule for GSP implementation. The GSP Emergency Regulations do not specifically require that a schedule for GSP implementation over the 20-year implementation period (i.e., 2020 through 2040) be provided, and any such schedule would be subject to considerable uncertainty. However, the following factors and constraints inherent to the GSP process guide the schedule for GSP implementation:

- The GSP Emergency Regulations require achievement of the Sustainability Goal (i.e., avoidance of Undesirable Results) within 20 years of GSP adoption, which in the case of the Kern Subbasin means by 2040.
- The P/MA implementation glide path discussed in **Section 17.1.4 Implementation Glide Path** above spells out the general schedule for when expected benefits from P/MAs will accrue between 2020 and 2040.
- Annual reports are due on April 1 of the following year.
- Periodic evaluations are required at least every five years, meaning this MA Plan will be updated no later than 31 January 2025.
### Part 1. Costs of Local Groundwater Management Activities

<table>
<thead>
<tr>
<th>Local Groundwater Management Activity</th>
<th>2020 - 2025</th>
<th>2025 - 2030</th>
<th>2030 - 2035</th>
<th>2035 - 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring and Data Collection</td>
<td>[no incremental cost]</td>
<td>[no incremental cost]</td>
<td>[no incremental cost]</td>
<td>[no incremental cost]</td>
</tr>
<tr>
<td>Monitoring of Applicable Sustainability Indicators</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Voluntary Monitoring of Groundwater Quality at Selected Sites</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Collection of Other Required Information</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Enforcement and Response Actions</td>
<td>$70,300</td>
<td>$70,300</td>
<td>$70,300</td>
<td>$70,300</td>
</tr>
<tr>
<td>Enforcement Actions</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Impacted Well Mitigation Program</td>
<td>$60,300</td>
<td>$60,300</td>
<td>$60,300</td>
<td>$60,300</td>
</tr>
<tr>
<td>Data Gap Filling</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Local Stakeholder Engagement</td>
<td>$40,000</td>
<td>$40,000</td>
<td>$40,000</td>
<td>$40,000</td>
</tr>
<tr>
<td>Annual Reporting - District-Level Activities</td>
<td>$12,500</td>
<td>$12,500</td>
<td>$12,500</td>
<td>$12,500</td>
</tr>
<tr>
<td>Periodic Evaluation of GSP - District-Level Activities</td>
<td>$100,000</td>
<td>$100,000</td>
<td>$100,000</td>
<td>$100,000</td>
</tr>
<tr>
<td><strong>TOTAL Annual Costs of Local Groundwater Management Activities</strong></td>
<td><strong>$272,800</strong></td>
<td><strong>$272,800</strong></td>
<td><strong>$272,800</strong></td>
<td><strong>$272,800</strong></td>
</tr>
</tbody>
</table>

### Part 2. Costs for Basin-Wide Groundwater Management Activities

<table>
<thead>
<tr>
<th>Local Groundwater Management Activity</th>
<th>2020 - 2025</th>
<th>2025 - 2030</th>
<th>2030 - 2035</th>
<th>2035 - 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrabasin Coordination</td>
<td>$105,000</td>
<td>$105,000</td>
<td>$105,000</td>
<td>$105,000</td>
</tr>
<tr>
<td>Technical Coordination</td>
<td>$49,000</td>
<td>$49,000</td>
<td>$49,000</td>
<td>$49,000</td>
</tr>
<tr>
<td>DMS Maintenance</td>
<td>$4,000</td>
<td>$4,000</td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Groundwater Model Updates</td>
<td>$16,000</td>
<td>$16,000</td>
<td>$16,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>Water Budget Refinement</td>
<td>$16,000</td>
<td>$16,000</td>
<td>$16,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>Collection of Supporting Data (e.g., METRIC ET)</td>
<td>$13,000</td>
<td>$13,000</td>
<td>$13,000</td>
<td>$13,000</td>
</tr>
<tr>
<td>Non-Technical Coordination</td>
<td>$56,000</td>
<td>$56,000</td>
<td>$56,000</td>
<td>$56,000</td>
</tr>
<tr>
<td>Annual Reporting - Basin-Level Activities</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Periodic Evaluation of GSP - Basin-Level Activities</td>
<td>$12,000</td>
<td>$12,000</td>
<td>$12,000</td>
<td>$12,000</td>
</tr>
<tr>
<td><strong>TOTAL Costs for Basin-Wide Groundwater Management Activities</strong></td>
<td><strong>$120,000</strong></td>
<td><strong>$120,000</strong></td>
<td><strong>$120,000</strong></td>
<td><strong>$120,000</strong></td>
</tr>
</tbody>
</table>
### TABLE PI.1
**Estimated Costs for Plan Implementation**
Arvin-Edison Water Storage District
Kern Subbasin Management Area

#### Part 3. Costs to Implement Projects and Management Actions

<table>
<thead>
<tr>
<th>Projects and Management Actions Category</th>
<th>2020 - 2025</th>
<th>2025 - 2030</th>
<th>2030 - 2035</th>
<th>2035 - 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capital Costs</td>
<td>Annual O&amp;M Costs</td>
<td>Total Average Annual Costs</td>
<td>Capital Costs</td>
</tr>
<tr>
<td>Projects to Enhance Recharge</td>
<td>$7,505,000</td>
<td>$50,000</td>
<td>$1,151,000</td>
<td>$0</td>
</tr>
<tr>
<td>Projects to Manage and/or Capture Floodwater</td>
<td>$2,800,000</td>
<td>$50,000</td>
<td>$610,000</td>
<td>$3,260,000</td>
</tr>
<tr>
<td>In-Lieu Projects</td>
<td>$6,111,515</td>
<td>$200,000</td>
<td>$1,422,303</td>
<td>$3,055,757</td>
</tr>
<tr>
<td>Projects to Increase Surface Storage Capacity / Delivery Flexibility</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Management Actions / Policies to Reduce Overall Water Demand</td>
<td>$55,870</td>
<td>$505,000</td>
<td>$516,174</td>
<td>$1,305</td>
</tr>
<tr>
<td>Management Actions / Policies to Reduce Groundwater Pumping</td>
<td>$590,000</td>
<td>$30,000</td>
<td>$148,000</td>
<td>$0</td>
</tr>
</tbody>
</table>

**TOTAL Costs to Implement P/MAs**

<table>
<thead>
<tr>
<th>2020 - 2025</th>
<th>2025 - 2030</th>
<th>2030 - 2035</th>
<th>2035 - 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>$17,312,385</td>
<td>$835,000</td>
<td>$4,207,477</td>
<td>$6,307,062</td>
</tr>
</tbody>
</table>

#### Grant Total Costs of GSP Implementation

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>2020 - 2025</th>
<th>2025 - 2030</th>
<th>2030 - 2035</th>
<th>2035 - 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1. Costs of Local Groundwater Management Activities</td>
<td>$272,800</td>
<td>$272,800</td>
<td>$272,800</td>
<td>$272,800</td>
</tr>
<tr>
<td>Part 2. Costs for Basin-Wide Groundwater Management Activities</td>
<td>$120,000</td>
<td>$120,000</td>
<td>$120,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>Part 3. Costs to Implement Projects and Management Actions</td>
<td>$4,297,477</td>
<td>$2,116,412</td>
<td>$2,249,812</td>
<td>$1,499,261</td>
</tr>
</tbody>
</table>

**TOTAL Annual Costs of GSP Implementation**

<table>
<thead>
<tr>
<th>2020 - 2025</th>
<th>2025 - 2030</th>
<th>2030 - 2035</th>
<th>2035 - 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4,690,277</td>
<td>$2,509,212</td>
<td>$2,642,612</td>
<td>$1,892,061</td>
</tr>
</tbody>
</table>
19. ACSD PLAN IMPLEMENTATION

Section 18 AEWSD Plan Implementation describes the plan implementation activities that will be performed by AEWSD. ACSD will coordinate its activities with AEWS in to supplement the information and activities of AEWSD with information and activities specific to ACSD. These activities will focus on the first five years of the GSP implementation period and will concentrate on gathering information specific to ACSD’s function as a public water supplier.

Implementation activities mirror those of AEWS and include:

- Monitoring and data collection – with a focus on potable water quality;
- Projects & Management Action (P/MA) implementation – which includes the development of new arsenic-compliant wells, increased storage capacity, improved and expanded water distribution facilities, and evaluation of reuse of treated wastewater;
- Technical and non-technical coordination with AEWS, the City of Arvin, and other water management entities within the Kern Subbasin;
- Continued outreach and engagement with ACSD’s water users;
- Annual reporting to AEWS along with its existing state-mandated reporting programs;
- Enforcement actions as necessary, and as described in its Urban Water Management Plan; and
- Evaluation and updates, as necessary, of ACSD’s portion of AEWS’s MA Plan as a part of the required periodic evaluations.

19.1. Plan Implementation Activities

19.1.1. Monitoring and Data Collection

ACSD’s data collection program will include information on applicable sustainability indicators gathered from its Representative Monitoring Site (RMS) together with information from its network of the remaining active public water supply wells.

Section 16 Monitoring Network discusses AEWS’s monitoring network, which includes ACSD’s Well #14. ACSD will collect information on groundwater levels and groundwater quality to be incorporated into AEWS’s Monitoring Program. Additionally, ACSD maintains a data management system on all of its water sources, and this information will be made available to AEWS on an annual basis. ACSD, as a public water system, is required to monitor and report water production and water quality to State Waterboards, Division of Drinking Water on an annual basis, and to report any water quality violations immediately to State Waterboards.

ACSD’s information will be utilized by both ACSD and AEWS to evaluate applicable Sustainable Management Criteria (SMC). AEWS anticipates evaluating its Sustainable Management Criteria over the next five years to determine if additional water quality monitoring sites are needed in order to develop a better understanding of the effects of the proposed AEWS management programs on groundwater quality. ACSD anticipates working closely with AEWS in this effort.

Monitoring efforts for the next five years include:
• Refinement of AEWSD’s Data Management System (DMS) to comply with the basin-wide DMS.
• Refinement of the Monitoring Network as necessary
• Semi-annual monitoring of groundwater levels at the Representative Monitoring Sites (RMS)
• Monitoring water quality at ACSD’S RMS, together with all of the other ACSD well sites
• Assistance, as required, in AEWSD’s effort to monitor subsidence data

Additionally, ACSD will provide AEWSD with groundwater extraction data for all of its groundwater sources. ACSD currently does not have a surface water supply.

19.1.2. Project and Management Action Implementation

Projects and Management Actions (P/MAs) will be undertaken to prevent Undesirable Results. ACSD’S P/MAs are described in the following paragraphs:

• Phase II of ACSD’s Arsenic Mitigation Project
  o Phase II is currently underway. It involves construction of three new water wells to replace three older wells that are currently contaminated with arsenic and 1,2,3-TCP. This effort is underway and will be completed in 2020.

• USEPA Replacement Well for Well No. 1
  o Well No. 1 was in the path of a contamination plume from the Brown and Bryant Superfund Site and therefore the USEPA has provided funding for the destruction of Well #1. The plume did not reach the well prior to its destruction. USEPA is also partially funding the construction of a replacement well, and this well will be completed and on-line by mid-2020.

• Well No. 11 Storage Tank and Blending Facility
  o A new 1 million-gallon storage tank will be constructed at the Well #11 site. This tank will provide much-needed above ground storage and will also provide the opportunity to blend water from Wells #10 and #11 so as to reduce the levels of arsenic in these two wells, which are just above the state arsenic MCL.

• ACSD has state-mandated water shortage supply programs that are described in ACSD’s 2015 Urban Water Management Plan. These programs address water shortages caused by drought and events that create a loss of water supplies, such as well failures, and system-wide power outages.

• ACSD is mandated to reduce water consumption on a per-capita basis by 20% relative to its “baseline” by the end of Year 2020. SB X7-7 required urban water suppliers to reduce per-capita water consumption by 10% by the end of Year 2015, a goal that ACSD achieved. It is on pace to meet the 20% standard by the end of 2020, as well.

• AB 1668: This bill would require the State Water Resources Control Board, in coordination with the Department of Water Resources, to adopt long-term standards for the efficient use of water, as
provided, and performance measures for commercial, industrial, and institutional water use on or before June 30, 2022.

- The bill would require the department, in coordination with the board, to conduct necessary studies and investigations and make recommendations, no later than October 1, 2021, for purposes of these standards and performance measures. The bill would authorize the department and the board to jointly recommend to the Legislature a standard for indoor residential water use.

- The bill, until January 1, 2025, would establish 55 gallons per capita daily as the standard for indoor residential water use, beginning January 1, 2025, would establish the greater of 52.5 gallons per capita daily or a standard recommended by the department and the board as the standard for indoor residential water use, and beginning January 1, 2030, would establish the greater of 50 gallons per capita daily or a standard recommended by the department and the board as the standard for indoor residential water use. The bill would impose civil liability for a violation of an order or regulation issued pursuant to these provisions, as specified.

This listing of P/MAs will set ACSD on the path of sustainability. ACSD will continue to monitor water levels, water consumption, and water quality, and will issue annual reports to state Waterboards and AEWSD for use in the pursuit of sustainability.

In addition to the above specific P/MA activities, ACSD will participate on the local water market to secure additional short-term and long-term surface water supplies through cooperative programs with AEWSD, ACSD will also pursue grant funding sources to support the P/MAs and future management actions and joint programs with AEWSD, that will result in a sustainable water supply for ACSD.

19.1.3. Intrabasin Coordination

Technical Matters

As outlined in Section 18.1.3 Intrabasin Coordination, ACSD will continue to participate with AEWSD and the Kern Groundwater Authority members involved in the SGMA process. This process will include both technical and non-technical matters. Technical matters include:

- DMS development and maintenance
- Groundwater model refinement and updates
- Water budget refinement and collection of supporting data
- Basin-wide monitoring and reporting efforts

Non-Technical Matters

In matters related to policy, advocacy, governance, etc., ACSD will continue to actively participate in coordination meetings with fellow KGA members and the other Kern County GSAs.
19.1.4. **Stakeholder Engagement**

AEWSD’s Stakeholder Communication and Engagement Plan, which was developed in coordination with ACSD, is a key part of the GSP. The Plan will continue to be refined and updated during the GSP Implementation. Anticipated activities include:

- Regular SGMA updates during ACSD Board meetings
- Stakeholder workshops
- Use of ACSD’s website to communicate with water users
- Informal discussions and meetings with interested stakeholders, as needed

19.1.5. **Annual Reporting**

ACSD will conduct annual monitoring and reporting and transmit this information to AEWSD for incorporation in its annual reports as outlined in Section 18.1.5 Annual Reporting.

19.1.6. **Enforcement and Response Actions**

Enforcement actions are incorporated in ACSD’s Water Shortage Contingency and Water Shortage Plans. These plans outline the actions that ACSD can take in the event of a mandated reduction in water consumption. ACSD will cooperate with AEWSD on enforcement actions that are in the common interest and will comply to the extent possible with actions taken by AEWSD to correct unsustainable activities.

ACSD has policies in place to deal with excess water consumption and waste of water. Water is an essential commodity to sustain life and therefore ACSD must exhibit care in application of certain management actions.

19.1.7. **Periodic Evaluations of GSP**

In cooperation with AEWSD, ACSD will participate in the periodic evaluation of AEWSD’s Management Area Plan of the KGA GSP.

ACSD will conduct a periodic evaluation of the GSP every five years and will cooperate with AEWSD to modify the plan to assure compliance with Sustainability Goals. It is anticipated that certain changes to the plan will be necessary as more information is developed over the first five years of the implementation period and that water budgets, projects and management actions, and sustainability criteria will be modified as a result of new information.

It is anticipated that elements of the MA Plan including Basin Setting, Management Areas, Undesirable Results, Minimum Thresholds, and Measurable Objectives will be revised if necessary, and that the Monitoring Network will be evaluated to identify data gaps and determine if modifications in the Network are needed to more accurately describe the groundwater conditions.

ACSD possesses the legal authority to implement regulations or ordinances related to the MA Plan. ACSD will provide a description of relevant actions taken by ACSD, including a summary of related regulations or ordinances.

ACSD will summarize legal or enforcement actions taken by ACSD and/or AEWSD or KGA in relation to the MA Plan, along with a description of how such actions support sustainability in the AEWSD Management Area.
Proposed or implemented plan amendments by ACSD will be described.

The Evaluation will be conducted in coordination with AEWSD (see Section 18.1.7 Periodic Evaluations of GSP).

19.2. Plan Implementation Costs

23 CCR § 354.6(e)

Estimates of the cost to ACSD to implement its portion of the MA Plan will be developed.

19.2.1. Estimated Costs

ACSD costs will be divided into the following categories:

- Costs of the local groundwater management activities
- ACSD’s share of the cost of basin-wide groundwater management activities
- Costs to implement P/MAs, including one-time capital costs and ongoing operations and maintenance costs

19.2.2. Sources of Funding to Meet Costs

ACSD is a Severely Disadvantaged Community with an annual household income of less than $40,000 per year. The cost shared by ACSD for the implementation of the Plan has not yet been determined, however, ACSD has budgeted $50,000 annually for SGMA-related expenses.

The sole source of ACSD operating revenue is from water tolls. The cost of implementation will be borne by the water users. A Proposition 218 election must be held and approved by ACSD residents prior to implementation of a rate increase. The last Prop 218 rate increase was approved in 2016 and implemented in 2017. The rate increase was 16% for the first year and 15.5% per year for the next four years. 2022 will be the last year of the raises approved in 2016.

Grant/loan funding may be available for projects. The Arsenic Mitigation Project is being financed by a Proposition 1 Grant/Loan. The USEPA Replacement Well is being partially financed by a grant from the USEPA.

Funding Sources Available to ACSD include:

- ACSD revenue from fees and assessments
- Special assessments
- Grant / Loan funding
- Penalties levied on prohibited activities

19.3. Plan Implementation Schedule

The Sustainability Goal is to be achieved within 20 years of Plan adoption, which is 2040.
Projects and Management Actions are currently being implemented by ACSD. The interim goal of SB X7-7 (10% water consumption reduction by 2015 on a per-capita basis) has been met by ACSD and ACSD is on target to meet the 2020 goal of a 20% per-capita water consumption reduction by the end of 2020.

The requirements of SB 1668 are being implemented by ACSD.
REFERENCES AND TECHNICAL STUDIES

☑ 23 CCR § 354.4(b)

Arvin Community Services District (ACSD) and Dee Jasper & Associates, Inc., 2016, *Arvin Community Services District 2015 Urban Water Management Plan*


Central Valley Regional Water Quality Control Board (CVRWQCB), 2000, Order No. R5-00-093, Waste Discharge Requirements for City of Arvin and United States Filter Corporation Arvin Wastewater Treatment Facility, Kern County.

Central Valley Regional Water Quality Control Board (CVRWQCB), 2009, Order No. R5-2009-0122, Waste Discharge Requirements for City of Bakersfield Wastewater Treatment Plant No. 2, Kern County.

Central Valley Regional Water Quality Control Board (CVRWQCB), 2013, Order No. R5-2013-0120, Waste Discharge Requirements General Order for Growers within the Tulare Lake Basin Area that are Members of a Third-Party Group, Kern County.


Diepenbrock, A., 1933, Mount Poso oil field: California Division of Oil and Gas Summary of Operations – California Oil Fields, v. 19, no. 2.


Hagan, K., 2001, The effects of the White Wolf fault on groundwater hydrology in the southern San Joaquin Valley, California, M.S. thesis in partial fulfillment of the degree of Master of Science in Geology at California State University – Bakersfield, CA.


APPENDICES

Appendix A  GSP Submittal Checklist
Appendix B  Power & Water Resources Pooling Authority Description
Appendix C  White Lands Addendum
Appendix D  ACSD 2018 Water Use Summary
Appendix E  Summary of Stakeholder Communications and Engagement
Appendix F  Detailed Responses to Selected Comments Received Regarding the MA Plan
Appendix G  SWRCB Concurrence Letters Re: Edison Oil Field
Appendix H  Analysis of Temporal Characteristics of Available Groundwater Quality Data
Appendix I  Potential Additional Water Quality Data Sources
Appendix J  Methods and Data Used in the Water Budget Spreadsheet Model Approach
Appendix K  AEWSD CASGEM Monitoring Plan
Appendix L  AEWSD Long-term Access Agreement
Appendix M  Project and Management Action Information Forms
Appendix N  Board Resolution
Appendix A

GSP Submittal Checklist
**Article 5. Plan Contents for Sample Basin**

<table>
<thead>
<tr>
<th>§354. Introduction to Plan Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>This Article describes the required contents of Plans submitted to the Department for evaluation, including administrative information, a description of the basin setting, sustainable management criteria, description of the monitoring network, and projects and management actions.</td>
</tr>
<tr>
<td>Note: Authority cited: Section 10733.2, Water Code.</td>
</tr>
</tbody>
</table>

**SubArticle 1. Administrative Information**

<table>
<thead>
<tr>
<th>§354.2. Introduction to Administrative Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>This Subarticle describes information in the Plan relating to administrative and other general information about the Agency that has adopted the Plan and the area covered by the Plan.</td>
</tr>
<tr>
<td>Note: Authority cited: Section 10733.2, Water Code.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>§354.4. General Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each Plan shall include the following general information:</td>
</tr>
<tr>
<td>(a) An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.</td>
</tr>
<tr>
<td>15:28 15ES</td>
</tr>
<tr>
<td>(b) A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.</td>
</tr>
<tr>
<td>297:299 References</td>
</tr>
<tr>
<td>Note: Authority cited: Section 10733.2, Water Code.</td>
</tr>
<tr>
<td>Reference: Sections 10733.2 and 10733.4, Water Code.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>§354.6. Agency Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:</td>
</tr>
<tr>
<td>(a) The name and mailing address of the Agency.</td>
</tr>
<tr>
<td>31 3.1</td>
</tr>
<tr>
<td>(b) The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.</td>
</tr>
<tr>
<td>31:32 3.2</td>
</tr>
<tr>
<td>(c) The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.</td>
</tr>
<tr>
<td>32 3.3</td>
</tr>
<tr>
<td>(d) The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.</td>
</tr>
<tr>
<td>32 3.4</td>
</tr>
<tr>
<td>(e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.</td>
</tr>
<tr>
<td>32, 287:288 3.5, 18.2</td>
</tr>
<tr>
<td>Note: Authority cited: Section 10733.2, Water Code.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>§354.8. Description of Plan Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each Plan shall include a description of the geographic areas covered, including the following information:</td>
</tr>
<tr>
<td>(a) One or more maps of the basin that depict the following, as applicable:</td>
</tr>
<tr>
<td>(1) The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.</td>
</tr>
<tr>
<td>69 PA-1</td>
</tr>
<tr>
<td>(2) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.</td>
</tr>
<tr>
<td>69:71 PA-1:PA-3</td>
</tr>
</tbody>
</table>

GSP Document References
### Article 5. Plan Contents for Sample Basin

<table>
<thead>
<tr>
<th>Plan Contents for Sample Basin</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.</td>
<td>70: PA-2</td>
</tr>
<tr>
<td>Existing land use designations and the identification of water use sector and water source type.</td>
<td>72, 75: PA-4, PA-7: PA-8</td>
</tr>
<tr>
<td>The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.</td>
<td>74: PA-6</td>
</tr>
<tr>
<td>A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.</td>
<td>36:43, Appendix B, Appendix C, 5.1, Appendix B, Appendix C</td>
</tr>
<tr>
<td>Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.</td>
<td>43:46, Appendix K, 5.2.1, Appendix K</td>
</tr>
<tr>
<td>A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.</td>
<td>46:47 5.2.2</td>
</tr>
<tr>
<td>A description of conjunctive use programs in the basin.</td>
<td>47:50 5.2.3</td>
</tr>
<tr>
<td>A plain language description of the land use elements or topic categories of applicable general plans that includes the following:</td>
<td></td>
</tr>
<tr>
<td>A summary of general plans and other land use plans governing the basin.</td>
<td>50:57 5.3</td>
</tr>
<tr>
<td>A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects</td>
<td>50:57 5.3</td>
</tr>
<tr>
<td>A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.</td>
<td>50:57 5.3</td>
</tr>
<tr>
<td>A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.</td>
<td>57:58 5.3.4</td>
</tr>
<tr>
<td>To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.</td>
<td>57:58 5.3.4</td>
</tr>
<tr>
<td>A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.</td>
<td>58:61 5.4</td>
</tr>
</tbody>
</table>

**Note:** Authority cited: Section 10733.2, Water Code.


### § 354.10. Notice and Communication

Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:
### Article 5. Plan Contents for Sample Basin

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.</td>
</tr>
<tr>
<td>(b)</td>
<td>A list of public meetings at which the Plan was discussed or considered by the Agency.</td>
</tr>
<tr>
<td>(c)</td>
<td>Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.</td>
</tr>
<tr>
<td>(d)</td>
<td>A communication section of the Plan that includes the following:</td>
</tr>
<tr>
<td></td>
<td>(1) An explanation of the Agency's decision-making process.</td>
</tr>
<tr>
<td></td>
<td>(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.</td>
</tr>
<tr>
<td></td>
<td>(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.</td>
</tr>
<tr>
<td></td>
<td>(4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.</td>
</tr>
</tbody>
</table>

**Note:** Authority cited: Section 10733.2, Water Code.
Reference: Sections 10723.2, 10727.8, 10728.4, and 10733.2, Water Code

### SubArticle 2. Basin Setting

#### § 354.12. Introduction to Basin Setting

This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.

**Note:** Authority cited: Section 10733.2, Water Code.


<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.</td>
</tr>
<tr>
<td>(b)</td>
<td>The hydrogeologic conceptual model shall be summarized in a written description that includes the following:</td>
</tr>
<tr>
<td></td>
<td>(1) The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.</td>
</tr>
<tr>
<td></td>
<td>(2) Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.</td>
</tr>
<tr>
<td></td>
<td>(3) The definable bottom of the basin.</td>
</tr>
<tr>
<td></td>
<td>(4) Principal aquifers and aquitards, including the following information:</td>
</tr>
<tr>
<td></td>
<td>(A) Formation names, if defined.</td>
</tr>
<tr>
<td></td>
<td>(B) Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.</td>
</tr>
</tbody>
</table>
### Article 5. Plan Contents for Sample Basin

| (C) | Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features. | 86:87 | 7.1.4  
| (D) | General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs. | 87 | 7.1.4  
| (E) | Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply. | 87 | 7.1.4  
| (5) | Identification of data gaps and uncertainty within the hydrogeologic conceptual model. | 87 | 7.1.5  
| (c) | The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin. | 88:90, 105:108 | 7.2, HCM-12:HCW-15  
| (d) | Physical characteristics of the basin shall be represented on one or more maps that depict the following: |  |
| (1) | Topographic information derived from the U.S. Geological Survey or another reliable source. | 90, 109 | 7.3.1, HCM-16  
| (2) | Surficial geology derived from a qualified map including the locations of cross-sections required by this Section. | 90, 105 | 7.3.2, HCM-12  
| (3) | Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies. | 91, 110:111 | 7.3.3, HCM-17:HCW-18  
| (4) | Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin. | 91:92, 112:113 | 7.3.4, HCM-19:HCW-20  
| (5) | Surface water bodies that are significant to the management of the basin. | 92:93, 114 | 7.3.5, HCM-21  
| (6) | The source and point of delivery for imported water supplies. | 93, 115 | 7.3.6, HCM-22  

Note: Authority cited: Section 10733.2, Water Code.

### Groundwater Conditions

Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

| (a) | Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including: |  |
| (1) | Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin. | 119:121, 132:133, 135 | 8.2, GWC-1:GWC-2, GWC-4, GWC-5  
| (2) | Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers. | 120, 136:137 | 8.2, GWC-5:GWC-6  

| (b) | A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type. | 122:124, 138:139 | 8.3, GWC-7:GWC-8, GWC-2  

| (c) | Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer. | 124 | 8.4  

### § 354.16

### Article 5. Plan Contents for Sample GSP Document

<table>
<thead>
<tr>
<th>Plan</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.</td>
</tr>
<tr>
<td>(e)</td>
<td>The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.</td>
</tr>
<tr>
<td>(f)</td>
<td>Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.</td>
</tr>
<tr>
<td>(g)</td>
<td>Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.</td>
</tr>
</tbody>
</table>

Note: Authority cited: Section 10733.2, Water Code.

#### § 354.18 Water Budget

<p>| (a)  | Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form. | 151:201, Appendix J | 9, Appendix J |
| (b)  | The water budget shall quantify the following, either through direct measurements or estimates based on data: |
| (1)  | Total surface water entering and leaving a basin by water source type. | 157:159, 173, 182:186 | 9.2.1 | WB-3:WB-7 WB-2 |
| (2)  | Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems. | 159:160, 174, 187:188 | 9.2.2 | WB-8:WB-9 WB-3 |
| (3)  | Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow. | 159:160, 174, 187:188 | 9.2.2 | WB-8:WB-9 WB-3 |
| (4)  | The change in the annual volume of groundwater in storage between seasonal high conditions. | 160, 175:177, 189:190 | 9.2.3 | WB-10:WB-11 WB-4:WB-6 |
| (5)  | If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions. | 160:161 | 9.2.4 |
| (6)  | The water year type associated with the annual supply, demand, and change in groundwater stored. | 161:162, 191:192 | 9.2.5 | WB-12:WB-13 |
| (7)  | An estimate of sustainable yield for the basin. | 162:163 | 9.2.6 |
| (c)  | Each Plan shall quantify the current, historical, and projected water budget for the basin as follows: |
| (1)  | Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information. | 164, 194:195 | 9.3.1 | WB-15:WB-16 |</p>
<table>
<thead>
<tr>
<th>Article 5.</th>
<th>Plan Contents for Sample Basin</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:</td>
<td>Page Numbers of Plan: 165,196 Or Section Numbers: 9.3.2 Or Figure Numbers: WB-17</td>
</tr>
<tr>
<td>(A)</td>
<td>A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.</td>
<td>Page Numbers of Plan: 165,198:200 Or Section Numbers: 9.3.2 Or Figure Numbers: WB-19:WB-21</td>
</tr>
<tr>
<td>(B)</td>
<td>A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.</td>
<td></td>
</tr>
<tr>
<td>(C)</td>
<td>A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.</td>
<td>Page Numbers of Plan: 166 Or Section Numbers: 9.3.2</td>
</tr>
<tr>
<td>(3)</td>
<td>Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:</td>
<td></td>
</tr>
<tr>
<td>(A)</td>
<td>Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.</td>
<td>Page Numbers of Plan: 166:172,201 Or Section Numbers: 9.4 Or Figure Numbers: WB-22 WB-7:WB-8</td>
</tr>
<tr>
<td>(B)</td>
<td>Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.</td>
<td>Page Numbers of Plan: 166:172,178:179,201 Or Section Numbers: 9.4 Or Figure Numbers: WB-22 WB-7:WB-8</td>
</tr>
<tr>
<td>(C)</td>
<td>Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.</td>
<td>Page Numbers of Plan: 166:172,178:179,201 Or Section Numbers: 9.4 Or Figure Numbers: WB-22 WB-7:WB-8</td>
</tr>
<tr>
<td>(d)</td>
<td>The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.</td>
<td>Page Numbers of Plan: 155:156 Or Section Numbers: 9.1.2</td>
</tr>
<tr>
<td>Article 5. Plan Contents for Sample Basin</td>
<td>GSP Document References</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------</td>
<td></td>
</tr>
<tr>
<td>(2) Current water budget information for temperature, water year type, evapotranspiration, and land use.</td>
<td>155:156 9.1.2</td>
<td></td>
</tr>
<tr>
<td>(3) Projected water budget information for population, population growth, climate change, and sea level rise.</td>
<td>155:156, 168:169 9.1.2, 9.4.2</td>
<td></td>
</tr>
<tr>
<td>(e) Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.</td>
<td>154:156 9.1</td>
<td></td>
</tr>
<tr>
<td>(f) The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.</td>
<td>151 9</td>
<td></td>
</tr>
</tbody>
</table>

Note: Authority cited: Section 10733.2, Water Code.

§ 354.20. Management Areas

(a) Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.

(b) A basin that includes one or more management areas shall describe the following in the Plan:

(1) The reason for the creation of each management area.

(2) The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.

(3) The level of monitoring and analysis appropriate for each management area.

(4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.

(c) If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.

Note: Authority cited: Section 10733.2, Water Code.
Reference: Sections 10733.2 and 10733.4, Water Code.

SubArticle 3. Sustainable Management Criteria

§ 354.22. Introduction to Sustainable Management Criteria

This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.
### Article 5. Plan Contents for Sample Basin

<table>
<thead>
<tr>
<th>§ 354.24.</th>
<th>Sustainability Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>§ 354.26.</th>
<th>Undesirable Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>(b)</th>
<th>The description of undesirable results shall include the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.</td>
</tr>
</tbody>
</table>


| (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. |


| (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. |


| (c) | The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site. |


| (d) | An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators. |


<table>
<thead>
<tr>
<th>§ 354.28.</th>
<th>Minimum Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.</td>
<td></td>
</tr>
</tbody>
</table>


| (b) | The description of minimum thresholds shall include the following: |


### GSP Document References

<table>
<thead>
<tr>
<th>Page Numbers of Plan</th>
<th>Or Section Numbers</th>
<th>Or Figure Numbers</th>
<th>Or Table Numbers</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>30, 205</td>
<td>2, 12</td>
<td>206:214</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>206:214</td>
<td>13</td>
<td>206:214</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>206:214</td>
<td>13</td>
<td>206:214</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>206:214</td>
<td>13</td>
<td>206:214</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Article 5.</td>
<td>Plan Contents for Sample Basin</td>
<td>GSP Document References</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>The information and criteria relied upon to establish and justify the minimum thresholds 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 the basin setting.</td>
<td>215:225 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.</td>
<td>215:225 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.</td>
<td>215:225 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.</td>
<td>215:225 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>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.</td>
<td>215:225 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.</td>
<td>215:225 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>Minimum thresholds for each sustainability indicator shall be defined as follows:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A)</td>
<td>The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.</td>
<td>216:220 14.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B)</td>
<td>Potential effects on other sustainability indicators.</td>
<td>216:220 14.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>Reduction of Groundwater Storage. The 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 supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.</td>
<td>220:222 14.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>Seawater Intrusion. The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocountour for each principal aquifer where seawater intrusion may lead to undesirable results. Minimum thresholds for seawater intrusion shall be supported by the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A)</td>
<td>Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.</td>
<td>222 14.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B)</td>
<td>A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.</td>
<td>222 14.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Article 5.</td>
<td>Plan Contents for Sample Basin</td>
<td>GSP Document References</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.</td>
<td>222:223 14.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A)</td>
<td>Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency’s rationale for establishing minimum thresholds in light of those effects.</td>
<td>223:224 14.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B)</td>
<td>Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.</td>
<td>223:224 14.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A)</td>
<td>The location, quantity, and timing of depletions of interconnected surface water.</td>
<td>224:225 14.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B)</td>
<td>A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.</td>
<td>224:225 14.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.</td>
<td>220:222 14.2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td>An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.</td>
<td>222, 224 14.3, 14.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Authority cited: Section 10733.2, Water Code.

§ 354.30. Measurable Objectives

(a) Each Agency shall establish measurable objectives, 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. | 226:230 15 |
<table>
<thead>
<tr>
<th>Article 5.</th>
<th>Plan Contents for Sample Basin</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.</td>
<td>226:230 15</td>
</tr>
<tr>
<td></td>
<td>(c) 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.</td>
<td>226:230 15</td>
</tr>
<tr>
<td></td>
<td>(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.</td>
<td>227 15.2</td>
</tr>
<tr>
<td></td>
<td>(e) 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. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.</td>
<td>226:230 15</td>
</tr>
<tr>
<td></td>
<td>(f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.</td>
<td>Not applicable - all measurable objectives tied to reasonable margin of operational flexibility.</td>
</tr>
</tbody>
</table>

**SubArticle 4. Monitoring Networks**

**§ 354.32. Introduction to Monitoring Networks**

This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.

**Reference:** Sections 10733.2, Water Code.

**§ 354.34. Monitoring Network**

(a) Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.

(b) Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:
### Plan Contents for Sample Basin

<table>
<thead>
<tr>
<th>Article 5.</th>
<th>Plan Contents</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Demonstrate progress toward achieving measurable objectives described in the Plan.</td>
<td>241:249 16.1</td>
</tr>
<tr>
<td>(2)</td>
<td>Monitor impacts to the beneficial uses or users of groundwater.</td>
<td>241:249 16.1</td>
</tr>
<tr>
<td>(3)</td>
<td>Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.</td>
<td>241:249 16.1</td>
</tr>
<tr>
<td>(4)</td>
<td>Quantify annual changes in water budget components.</td>
<td>241:249 16.1</td>
</tr>
</tbody>
</table>

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(1) Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:

(A) A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.  
   243:245 MN-1, 243:245 MN-2

(B) Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.  
   243:245 16.1.1

(2) Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.  
   245 16.1.2 MN-1, 245 16.1.2 MN-2

(3) Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.  
   245 16.1.3

(4) Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.  
   246:248 MN-1, 246:248 MN-2, SMC-4

(5) Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.  
   248:249 MN-2, 248:249 MN-3

(6) Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:

(A) Flow conditions including surface water discharge, surface water head, and baseflow contribution.  
   249 16.1.6

(B) Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.  
   249 16.1.6

(C) Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.  
   249 16.1.6

(D) Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.  
   249 16.1.6

(d) The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.  

<table>
<thead>
<tr>
<th>(e)</th>
<th>Expected Impacts</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Demonstrate progress toward achieving measurable objectives described in the Plan.</td>
<td>241:249 16.1</td>
</tr>
<tr>
<td>(2)</td>
<td>Monitor impacts to the beneficial uses or users of groundwater.</td>
<td>241:249 16.1</td>
</tr>
<tr>
<td>(3)</td>
<td>Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.</td>
<td>241:249 16.1</td>
</tr>
<tr>
<td>(4)</td>
<td>Quantify annual changes in water budget components.</td>
<td>241:249 16.1</td>
</tr>
</tbody>
</table>
### Article 5. Plan

<table>
<thead>
<tr>
<th>Plan Contents for Sample Basin</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.</td>
<td>Page Numbers of Plan 241:249 Or Section Numbers 16.1 Or Figure Numbers MN-1, MN-2 Or Table Numbers MN-2</td>
</tr>
<tr>
<td>(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:</td>
<td></td>
</tr>
<tr>
<td>(1) Amount of current and projected groundwater use.</td>
<td></td>
</tr>
<tr>
<td>(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.</td>
<td></td>
</tr>
<tr>
<td>(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.</td>
<td></td>
</tr>
<tr>
<td>(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.</td>
<td></td>
</tr>
<tr>
<td>(g) Each Plan shall describe the following information about the monitoring network:</td>
<td></td>
</tr>
<tr>
<td>(1) Scientific rationale for the monitoring site selection process.</td>
<td></td>
</tr>
<tr>
<td>(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.</td>
<td></td>
</tr>
<tr>
<td>(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.</td>
<td></td>
</tr>
<tr>
<td>(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.</td>
<td></td>
</tr>
<tr>
<td>(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.</td>
<td></td>
</tr>
<tr>
<td>(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Authority cited: Section 10733.2, Water Code.

**Reference:** Sections 10723.2, 10727.2, 10727.4, 10728, 10733, 10733.2, and 10733.8, Water Code.

### § 354.36. Representative Monitoring

Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:

(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.

<table>
<thead>
<tr>
<th>Page Numbers of Plan</th>
<th>Or Section Numbers</th>
<th>Or Figure Numbers</th>
<th>Or Table Numbers</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>249</td>
<td>16.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>249.250</td>
<td>16.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Article 5. Plan</td>
<td>Plan Contents for Sample Basin</td>
<td>GSP Document References</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.</td>
<td>249:250 16.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.</td>
<td>249:250 16.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.</td>
<td>249:250 16.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>§ 354.38.</td>
<td>Assessment and Improvement of Monitoring Network</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.</td>
<td>250:251 16.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>If the monitoring network contains data gaps, the Plan shall include a description of the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>The location and reason for data gaps in the monitoring network.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>Local issues and circumstances that limit or prevent monitoring.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td>Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>Minimum threshold exceedances.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>Highly variable spatial or temporal conditions.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>Adverse impacts to beneficial uses and users of groundwater.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>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.</td>
<td>241:249 16.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>§ 354.40.</td>
<td>Reporting Monitoring Data to the Department</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note: Authority cited: Section 10733.2, Water Code.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Article 5. Plan Contents for Sample Basin


### SubArticle 5. Projects and Management Actions

#### § 354.42. Introduction to Projects and Management Actions

This Subarticle describes the criteria for projects and management actions to be included in a Plan to meet the sustainability goal for the basin in a manner that can be maintained over the planning and implementation horizon.

Note: Authority cited: Section 10733.2, Water Code.

#### § 354.44. Projects and Management Actions

(a) Each Plan shall include a description of the projects and management actions the Agency 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. |

(A) 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.

(B) If overdraft conditions are identified through the analysis required by Section 354.18, 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 time-table 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 be included.

(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.
<table>
<thead>
<tr>
<th>Article 5.</th>
<th>Plan Contents for Sample Basin</th>
<th>GSP Document References</th>
</tr>
</thead>
<tbody>
<tr>
<td>(9)</td>
<td>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.</td>
<td>Page Numbers of Plan: 267-268; Or Section Numbers: 17.12</td>
</tr>
<tr>
<td>(c)</td>
<td>Projects and management actions shall be supported by best available information and best available science.</td>
<td>Page Numbers of Plan: 257-280; Or Section Numbers: 17</td>
</tr>
<tr>
<td>(d)</td>
<td>An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.</td>
<td>Page Numbers of Plan: 257-280; Or Section Numbers: 17</td>
</tr>
</tbody>
</table>

Note: Authority cited: Section 10733.2, Water Code.

Appendix B

Power & Water Resources Pooling Authority Description
The Power & Water Resources Pooling Authority (Authority) was established in 2004 as a public agency pursuant to the Joint Exercise of Powers Act, Articles 1 and 2 of Chapter 5 of Division 7 of Title 1 of the Government Code of the State of California commencing with Section 6500, and all laws which amend or supplement it. The Authority is authorized to, among other things, effectively study, promote, develop, conduct, design, finance, acquire, construct, and operate water and energy-related projects and programs.

The Authority has the right to purchase and lease electric power from any agency or entity, public or private, and the authority to provide for the acquisition, operation, leasing and control of facilities for the generation, transmission, distribution, sale, and lease of electric power. The customers of the Authority utilize electric power to convey and treat water and recognize that water delivery and electric power consumption are directly related and that exchange of water and electric power resources is a variable means of managing both electric power consumption and water supplies.

The Authority is comprised of certain Parties, with additional participation by "Stakeholders", as such terms are defined under the Joint Powers Agreement. Parties include Banta-Carbona Irrigation District, Glenn-Colusa Irrigation District, James Irrigation District, Lower Tule River Irrigation District, Princeton-Codora-Glenn Irrigation District, Provident Irrigation District, The West Side Irrigation District and West Stanislaus Irrigation District. Stakeholders are Arvin-Edison Water Storage District, Cawelo Water District, Reclamation District 108, Santa Clara Valley Water District, Sonoma County Water Agency and Westlands Water District. Parties and Stakeholders are collectively referred to as Project Participants. The Project Participants possess the right to receive capacity and energy from the Western Area Power Administration ("WAPA"), a federal agency engaged in the marketing and distribution of power generated by federally owned facilities, including the Central Valley Project ("CVP"). The Project Participants recognize the benefits of aggregating their individual allocations of CVP resources, as well as other resources, under a service arrangement whereby the Project Participants can optimize available energy and capacity resources. The Authority has established the capability to calculate the Project Participants' hourly loads, aggregate allocations of CVP resources, procure supplemental electricity, schedule resources to meet the combined load of the Project Participants, provide cost accounting, and bill for electric services provided by the Authority. The provision of electric services by the Authority is expected to, among other things to optimize the efficient use of facilities and resources by allowing Project Participants to more efficiently aggregate, schedule, dispatch and deliver energy resources owned, controlled or purchased by the Authority.

The Authority began operations January 1, 2005, delivering power to its Project Participants pursuant to the contracts and agreements put into place during 2004.
Appendix C

White Lands Addendum
<table>
<thead>
<tr>
<th>Entity</th>
<th>Contact</th>
<th>Phone</th>
<th>Email</th>
<th>APN(s)</th>
<th>Acres</th>
<th>Land Use</th>
<th>Zoning</th>
<th>Owner</th>
<th>Well Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Giumarra Vineyards</td>
<td>Jeff Giumarra</td>
<td>661-333-4760</td>
<td><a href="mailto:jef@prspaking.com">jef@prspaking.com</a></td>
<td>179-030-03</td>
<td>80.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Bros Fruit Co</td>
<td>4 Production wells, same PLSS Section with ALJT LLC and Giumarra, per DWR well completion report dataset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>179-030-04</td>
<td>82.64</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Bros Fruit Co</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>179-040-06</td>
<td>40.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Bros Fruit Co</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>179-040-07</td>
<td>10.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Bros Fruit Co</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>179-040-11</td>
<td>10.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Vineyards Corp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>179-040-14</td>
<td>20.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Vineyards Corp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>179-040-20</td>
<td>30.51</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Bros Fruit LLC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>388-065-10</td>
<td>86.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Giumarra Vineyards Corp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Kirshenman Enterprises</td>
<td>Wayne Kirshenman</td>
<td>661-201-6202</td>
<td><a href="mailto:wkirshenman@kaiserpro.com">wkirshenman@kaiserpro.com</a></td>
<td>368-060-04</td>
<td>80.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Kirshenman Enterprises</td>
<td>4 Production wells, same PLSS Section with ALJT LLC and Giumarra, per DWR well completion report dataset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>368-060-06</td>
<td>40.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Kirshenman Enterprises</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>368-060-09</td>
<td>15.00</td>
<td>Irrigated</td>
<td>Agricultural</td>
<td>Kirshenman Enterprises</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 John &amp; Gunilla Byfield Family Trust</td>
<td>Gunilla Byfield</td>
<td>661-871-4359</td>
<td></td>
<td>387-050-07-00-6</td>
<td>19.96</td>
<td>Native</td>
<td></td>
<td>Byfield John &amp; Gunilla Family Trust</td>
<td>1 Domestic well, same PLSS Section with Bay Vista, James L, and Otho Surge, per DWR well completion report dataset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>387-050-17-00-6</td>
<td>27.49</td>
<td>Native</td>
<td></td>
<td>Byfield John &amp; Gunilla Family Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>387-050-18-00-8</td>
<td>19.97</td>
<td>Native</td>
<td></td>
<td>Byfield John &amp; Gunilla Family Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 James L. VanHoozen Trust</td>
<td>Pam Park</td>
<td>661-654-0210</td>
<td>park1@bak rr.com</td>
<td>387-050-19-00-1</td>
<td>19.98</td>
<td>Native</td>
<td></td>
<td>VanHoozen James L Family Trust</td>
<td>1 Domestic well, same PLSS Section with Bay Vista, John &amp; Gunilla, and Otho Surge, per DWR well completion report dataset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>387-050-20-00-3</td>
<td>27.33</td>
<td>Native</td>
<td></td>
<td>VanHoozen James L Family Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Loop Ranch LLC</td>
<td>John Broome</td>
<td></td>
<td><a href="mailto:jbroomeaj@hotmail.com">jbroomeaj@hotmail.com</a></td>
<td>179-280-01</td>
<td>365.98</td>
<td>Undeveloped &gt;20ac Mtn/Desert</td>
<td>LOOP RANCH LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Bay Vista Property Management</td>
<td>Jan Pratt</td>
<td>510-845-1077 ext 201</td>
<td><a href="mailto:jan@bayvistapm.com">jan@bayvistapm.com</a></td>
<td>387-050-05</td>
<td>40.00</td>
<td>Native</td>
<td></td>
<td>Twilight Ride LLC</td>
<td>1 Domestic well, same PLSS Section with James L, John &amp; Gunilla, and Otho Surge, per DWR well completion report dataset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Abercrombie Family Trust</td>
<td>LeBon Abercrombie</td>
<td>531-626-3247</td>
<td><a href="mailto:lebon@faberabercrombie.net">lebon@faberabercrombie.net</a></td>
<td>388-020-04</td>
<td>160.05</td>
<td>Urban Industrial</td>
<td></td>
<td>Abercrombie Family Trust / Susan Abercrombie Revocable Trust</td>
<td>No wells, per DWR well completion report dataset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>388-020-07</td>
<td>10.00</td>
<td>Native</td>
<td></td>
<td>Abercrombie Family Trust / Susan Abercrombie Revocable Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>388-020-08</td>
<td>20.00</td>
<td>Urban Industrial</td>
<td></td>
<td>Abercrombie Family Trust / Susan Abercrombie Revocable Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>388-020-09</td>
<td>20.00</td>
<td>Urban Industrial</td>
<td></td>
<td>Abercrombie Family Trust / Susan Abercrombie Revocable Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>388-020-11</td>
<td>10.00</td>
<td>Native</td>
<td></td>
<td>Abercrombie Family Trust / Susan Abercrombie Revocable Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Mitchell Helen K</td>
<td>Fred Mitchell</td>
<td>540-340-8481 (home)</td>
<td><a href="mailto:fmontch76@gmail.com">fmontch76@gmail.com</a></td>
<td>388-010-10</td>
<td>40.00</td>
<td>Native</td>
<td></td>
<td>Mitchell Helen K</td>
<td>3 Domestic wells, 2 production wells, same PLSS Section with Naftex, per DWR well completion report dataset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Received original signed agreement

GRAND TOTAL 1,855.26

TOTAL IRRIGATED 1,078.95
Abbreviations

APN = Assessor's Parcel Number
DWR = California Department of Water Resources
GSP = Groundwater Sustainability Plan

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. Parcel boundaries are from Kern County Assessor, obtained in June 2018.
3. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2016 Update.
<table>
<thead>
<tr>
<th></th>
<th>Water Demand Evapotranspiration (from ITRC-METRIC) (AFY)</th>
<th>Water Supplies</th>
<th>Change in Groundwater Storage (AFY)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Precipitation (AFY/acre)</td>
<td>KGA-defined &quot;Native Yield&quot; (AFY/acre)</td>
</tr>
<tr>
<td>Historical (DWR WY 1995 - 2014)</td>
<td>2,298</td>
<td>0.63</td>
<td>0.15</td>
</tr>
<tr>
<td>Current (DWR WY 2015)</td>
<td>2,551</td>
<td>0.63</td>
<td>0.15</td>
</tr>
<tr>
<td>Baseline</td>
<td>2,320</td>
<td>0.63</td>
<td>0.15</td>
</tr>
<tr>
<td>2030</td>
<td>2,388</td>
<td>0.63</td>
<td>0.15</td>
</tr>
<tr>
<td>2070</td>
<td>2,480</td>
<td>0.63</td>
<td>0.15</td>
</tr>
</tbody>
</table>

**Abbreviations**

AFY = acre-feet per year  
CIMIS = California Irrigation Management Information System  
DWR = California Department of Water Resources  
ITRC-METRIC = Cal Poly Irrigation Training and Research Center Mapping of Evapotranspiration with Internal Calibration  
GSP = Groundwater Sustainability Plan  
USDA-SCS = United States Department of Agriculture Soil Conservation Service  
WY = Water Year  

**Notes**

(1) The total acreage of undistricted lands ("White Lands") classified as irrigated is 1,074.9 acres. However, not all of these lands appear to have been irrigated during all years throughout the historical period.
(2) Precipitation value based on average yearly precipitation measured at Arvin CIMIS Station 125 for WY 2005-2015.  
(3) A "native yield" factor of 0.3 AFY/acre is assumed, consistent with Basin-wide definition.  
(4) Projected groundwater storage deficit in irrigated white lands areas will be addressed as part of 2020 - 2025 GSP implementation (see Section 18 of Arvin-Edison Management Area Plan).
Re: Undistricted Lands Management Coverage

To Whom It May Concern:

Please find the two attached Sustainable Groundwater Management Act (SGMA) Management Agreements and accompanying Exhibits, to be executed and returned to the District by Tuesday, July 30, 2019. Pursuant to Section 2, please note the $10.00 per acre initial funding payment will be billed upon final execution of the Agreement. As seen in Exhibit A, your combined management coverage will consist of ______ acres, totaling $__________

In addition to the Agreement, please submit your current land use by acreage. For example: Grazing – 50 acres, Native – 100 acres, Agricultural – 200 acres.

If you have a groundwater extraction well located on any of the Exhibit A parcels, we are also requesting the following well supply and/or monitoring well data preferably from 2006 to present:

- Well construction logs, geologic logs, and/or geophysical logs
- Groundwater level data (depth to water and/or elevation)
- Monthly pumping rates and units of measure (gpm or cfs)
- Groundwater quality data
- Aquifer pumping test data and analyses/reports
- Exact well locations (GPS coordinates or detailed maps)
- Well construction information, such as:
  - date of installation
  - primary well use (agricultural, domestic, industrial, monitoring, etc.)
  - total well depth
  - screened intervals
  - casing diameter and material
  - pump intake depth, discharge pipe diameter
  - pump plate info (horsepower)
  - measuring point elevation
  - instrumentation (pressure transducer, flowmeter, airline with gauge)

It is imperative that we obtain this data as it will focus the development of AEWSD’s Groundwater Sustainability Plan (GSP) on locally-defined, quantitative criteria including undesirable results,
minimum thresholds, and measurable objectives. In order to plan for the above-mentioned criteria, having your well supply and monitoring well data in advance will help ensure that sustainable management criteria will accurately reflect historical groundwater conditions in your area.

Again, we appreciate your cooperation in this matter. If you have any questions or require further information, please contact Micah Clark at mclark@aewsd.org or by phone at (661) 854-5573.

Sincerely,

[Signature]

Jeevan Muhar
Engineer-Manager

Enclosure(s)

cc:    Anona Dutton, EKI
       Patty Poire, Kern Groundwater Authority
This Sustainable Groundwater Management Act Management Agreement with Arvin-Edison Water Storage District ("Agreement") is made and entered into this ___ day of __________, 2019, by and between the Arvin-Edison Water Storage District, ("District") and _______ ("Landowners"). District and Landowner are sometimes each individually referred to herein as a “Party” and collectively as the “Parties.”

RECITALS

WHEREAS, Landowner is an individual, or authorized agent of an entity, owning real property in Kern County, California (“Landowner Land”) located outside of the District’s boundaries, which is described on Exhibit A and generally shown on Exhibit B, attached hereto and incorporated by reference.

WHEREAS, District is a Water Storage District comprising approximately 131,600 acres situated in Kern County.

WHEREAS, the Sustainable Groundwater Management Act (“SGMA”) provides that all basins designated as critically overdrafted high-priority basins shall be managed under a Groundwater Sustainability Plan (“GSP”) or a coordinated GSP by January 31, 2020.

WHEREAS, the Landowner Land is overlying the Kern County Sub-basin (Basin Number 5-022.14, DWR Bulletin 118) within the San Joaquin Valley Groundwater Basin (“Basin”), a DWR designated high-priority and critically overdrafted basin and, therefore, the Basin, and all portions thereof, must be managed by a local agency under a GSP by January 31, 2020.

WHEREAS, SGMA allows local agencies to become a groundwater sustainability agency (“GSA”) to engage in the sustainable management of groundwater pursuant to the provisions of SGMA. Private landowners, either individually or collectively, are not local agencies under SGMA, and therefore cannot be members of a GSA.

WHEREAS, District is currently a member of the Kern Groundwater Authority (“KGA”), under which the District will work collaboratively with other interested local agencies to develop and implement a GSP to manage a portion of the Basin.

WHEREAS, with respect to SGMA jurisdictional considerations, the Landowner Land is currently within the jurisdictional boundaries of the KGA.

WHEREAS, the KGA is organizing its GSP in chapters that generally align with district boundaries and that prescribe the management actions to be taken by said districts to comport with the requirements of SGMA. Each chapter will be developed by one or more local agencies that are members of the KGA. In order to comply with SGMA, the
KGA will facilitate the District’s GSP coverage for lands located in close proximity to their jurisdictional boundaries.

WHEREAS, Landowner desires to be included in the chapter to be developed by the District (the “District’s GSP Chapter”) to afford GSP coverage to the Landowner Land. In this respect, Landowner is willing to provide local information and assistance to the development of the GSP that is ultimately adopted by the KGA that will manage the Landowner Land under SGMA. Thus, the Landowner enters into this Agreement for the purpose of enabling Landowner SGMA coverage for its land through the District’s GSP Chapter.

WHEREAS, the Landowner will provide information for its respective real property and funding for the process for the District to include the Landowner Land within the District’s GSP Chapter. The approval of any GSP governing the Landowner Land will ultimately lie with the District, the KGA and the State of California, which will consider the completeness and effectiveness of the GSP to be developed under SGMA. Due to the mandated deadlines of SGMA and its associated regulations, the District will initiate proceedings to amend the area to be covered by District’s GSP Chapter to include Landowner Land, but must also concurrently continue preparation of the District’s GSP Chapter, and thus, the Landowner consents to be included in the District’s GSP Chapter as herein provided. To the extent the District incurs any additional cost to include Landowner Land in its GSP Chapter, such fees or costs shall be borne solely by the Landowner and paid promptly upon being invoiced by either the District or by such consultants directly. The GSP, after being approved and agreed to by the KGA and ultimately the State of California, shall be managed by the District and/or KGA.

WHEREAS, the Landowner shall be independently responsible to provide information and funding at the request of the District to maintain and support the efforts to include the Landowner Land within the District’s GSP Chapter.

WHEREAS, the Parties do not intend that the inclusion of the Landowner Land within the District’s GSP Chapter, or that this Agreement in any way provides Landowner Land with a right to any portion of the water supplies of the District.

WHEREAS, the KGA has entered or will enter into Agreements to indemnify its members against liability from or related to the provision of KGA jurisdiction over Landowner Land. KGA and the District also have entered or will enter into agreements in which the District will indemnify the KGA for provision of jurisdiction to manage Landowner Land. This Agreement and the indemnity provided by the Landowner to the District is intended to include, either through direct indemnification, or otherwise by passing through the indemnification provided herein, the KGA and its members.

NOW, THEREFORE, in consideration of the foregoing Recitals and the following terms and conditions, it is agreed by and between the Parties as follows:

I. PURPOSE OF AGREEMENT
The Parties enter into this Agreement solely for the purpose of providing the Landowner with a process to attempt to comply with SGMA through the inclusion of the Landowner Land within the District’s GSP Chapter. Neither the District nor any landowners within the District’s current boundaries are committing anything to the Landowner Land except for the inclusion of the Landowner Land within the District’s GSP Chapter, provided that all Landowners comply with the terms of this Agreement. This Agreement is intended to form the basis of the Parties’ understanding regarding the terms and conditions of including the Landowner Land within the District’s GSP Chapter, and their individual rights and responsibilities subsequent to such inclusion.

II. TERMS AND CONDITIONS OF INCLUDING LANDOWNER LAND WITHIN THE DISTRICT’S GSP CHAPTER

1. Commitment to Include Landowner Land in District’s GSP Chapter. The District hereby agrees to make reasonable efforts to include the Landowner Land within the District’s GSP Chapter, and the Landowner hereby agrees for the Landowner Land to be included within the District’s GSP Chapter, and Landowner consents to jurisdiction of the District and the KGA to adopt and implement a GSP including the Landowner Land, provided that such inclusion is approved by all necessary governmental bodies and the Parties have complied with all provisions of this Agreement. In that regard, a condition precedent to this Agreement becoming and remaining effective is that KGA maintain SGMA jurisdiction over the Landowner Land. Landowner acknowledges that there might be additional reporting requirements, monetary charges, or compliance measures imposed upon Landowner in connection with SGMA by the California Department of Water Resources (“DWR”), the State Water Resources Control Board, the courts, or other agencies or bodies with the authority to enforce terms and conditions of SGMA separate from the District under this Agreement. Landowner acknowledges and agrees that the District has no duty under this Agreement to prevent such compliance measures from being imposed on Landowner.

2. Regulation Contingent on Funding. The District and the Landowner acknowledge that funding for the District’s efforts hereunder shall be provided on a long-term basis, if possible, through the development and subsequent payment by the Landowner of a land-based assessment and/or water charge as authorized by SGMA or other legally authorized fee or funding mechanism (“Charges”). Prior to the establishment of said Charges, the Landowner acknowledges and agrees that the District’s inclusion of the Landowner Land within the District’s GSP Chapter, and the District’s efforts to include the Landowner Lands within the District’s GSP Chapter pursuant to this Agreement, are contingent upon Landowner’s regular and timely payment of (1) the general administrative expenses of the District that are attributable to the District’s efforts hereunder, (2) the Landowner’s pro-rata share of costs for consultants retained by the District for the purposes of developing or implementing the District’s GSP Chapter, and (3) any administrative or other costs the District incurs in implementing SGMA and coordinating with the KGA (or other GSA’s) for SGMA purposes concerning the Landowner Land.
Upon final execution of this Agreement, District shall bill and Landowners shall pay the District $10.00 per acre of Landowner Land as an initial payment to fund the District’s (and necessary consultants’) efforts made pursuant to this Agreement, and any other activities related to the GSP processes.

3. **Determination of Funding Obligation.** The amount of any additional payments required for Charges and/or services rendered by the District or others for the purposes of fulfilling the obligations set forth herein, or the formula for the calculation of such payments, and the method of such payments, shall be determined by the District, in consultation with the Landowner. Notwithstanding any provision of law, the Landowner consents to a fee, charge and/or assessment being levied on Landowner Land for such Charges.

4. **Failure to Satisfy Funding Obligation & GSP Requirements.** Landowner acknowledges and agrees that if, for any reason, the Landowner refuses or otherwise fails to remit any payment required hereunder, in the amount and using the method determined and requested by the District, or fails to comply with the requirements of the GSP and its management and regulation, (“Defaul ted Landowner”) the District:
   
   (a) shall be relieved of any and all obligation to proceed with including the Defaulted Landowner’s Land within the District’s GSP Chapter; and
   
   (b) shall be relieved of any and all obligation to provide the services and obligations enumerated in this Agreement to a Defaulted Landowner; and
   
   (c) may, in its sole and absolute discretion, seek to remove the Defaulted Landowner’s Land from the District’s GSP Chapter, at Defaulted Landowner’s expense, and in such event the Defaulted Landowner agrees to obtain regulation under SGMA by some other method separate and apart from the District pursuant to the terms for a withdrawing Landowner set forth in Paragraph 8 of this Agreement; and
   
   (d) shall have no obligation to reimburse Landowner for any Charges paid to date.

5. **No Protest in Case of Removal of Defaulted Landowner Land; Duty to Cooperate.** Landowner hereby agrees that, if the Landowner breaches the terms of this Agreement, including but not limited to, by refusing or failing to remit any payment required herein, following thirty (30) days written notice of alleged breach and Defaulted Landowner’s failure to timely cure such breach, the District, may in its sole and absolute discretion, seek to remove the Defaulted Landowner’s Land, at the Defaulted Landowner’s expense, from the District’s GSP Chapter, and if the District does so, the Landowners shall not lodge any protest, participate in any protest hearing, or act in any way to influence the outcome of the District’s decision, and District shall have no further obligation to Landowner to provide any services hereunder.
6. **Disclaim Water Rights.** Landowner expressly disclaims any right to any District water supplies (surface or groundwater) other than through any future negotiated purchase, transfer, or exchange any Landowner has obtained or may obtain wholly outside of this Agreement and not related to this Agreement. Landowner understands and agrees that as a result of the foregoing disclaimer, among other things, inclusion of the Landowner Land within the District’s GSP Chapter will not entitle the Landowner to receive any portion of the District’s water supply or other District assets. Landowner further understands and agrees the sole purpose of this Agreement is to provide the Landowner a process to obtain coverage by the KGA GSP, and thus, SGMA compliance for the Landowner by affording Landowner the benefit of inclusion within the District’s GSP Chapter. Any GSP must ultimately be approved and agreed to by the District and thereafter by the KGA and such GSP shall be solely managed and regulated by the KGA and/or the District, supported in part by information and funds provided by the Landowner. The Landowner further understands and agrees that any other benefits accruing to the Landowner Land and/or to Landowner as a result of this Agreement are purely incidental and shall not give rise to any expectation, entitlement, or right to District water supplies or assets of any kind, including, but not limited to, Kern River water, State Water Project water, Central Valley Project water, carryover supplies, supplies from any lake, river, stream, creek, manmade conveyance, or aquifer that the District purchases, acquires, transfers, exchanges, takes receipt of or otherwise controls, including groundwater supplies or any return flows that may enter the underground aquifer as a result of delivery within District of any of the foregoing water supplies, or any District banked supplies including banking losses of water management programs, or any other designation or classification of District water whatsoever, whether in existence at the time this Agreement is executed or created at some future time. Other than the reservations noted above, nothing in this Agreement is intended to limit current or future groundwater rights of the Landowner beyond that imposed by operation of law; provided, however, the Landowner recognizes that with no imported supplemental surface water supply presently available to Landowner Land, either provided directly by the District or other sources, or indirectly through the District’s project, and through the approved GSP, the Landowner’s ability to pump groundwater for use upon Landowner Land in the future may be limited.

7. **No Voluntary Consent.** Once the Landowner Land is included within the District’s GSP Chapter and the GSP is adopted by the KGA and approved by DWR, the Landowner hereby agrees not to consent to the inclusion of any portion of the Landowner Land within another chapter of the KGA GSP developed by any entity other than the District without the District’s express prior written consent. It is noted that District has the option as a KGA member district to withdraw from KGA and develop its own GSP.

8. **Withdrawal of Landowner.** Until the GSP is adopted by the KGA and approved by DWR, the Landowner may elect to withdraw from this Agreement and be excluded from the District’s GSP Chapter, and instead be included within another chapter of the KGA GSP developed by another member of the KGA or otherwise seek alternative lawful SGMA compliance, by providing written notice to the District. If Landowner elects to withdraw, then the Landowner shall be responsible for advance payment of all costs and
obligations associated with the withdrawal, including but not limited to, any amendments or revisions of the District’s GSP Chapter or the KGA GSP required to maintain compliance with SGMA in the event of their withdrawal. The District may impose additional requirements upon any withdrawing Landowner, to ensure compliance with SGMA, the GSP Chapter or the KGA GSP, and to satisfy any financial obligations resulting from the withdrawal of such Landowner. Upon withdrawal, the Landowner shall arrange for the withdrawn lands to be covered by another chapter of the KGA GSP developed by another member of the KGA or otherwise seek alternative lawful SGMA compliance, so that such lands of the withdrawing Landowner would continue to be compliant with SGMA. Any withdrawal from the District’s GSP Chapter shall not be effective unless and until the withdrawing landowner has made such arrangements and the alternative means of SGMA compliance is effective for such lands of the withdrawing Landowner.

9. **Covenant Not to Sue or Contest.** In consideration of the District’s inclusion of Landowner Land into the District’s GSP Chapter, Landowners shall not (1) sue or take any judicial or administrative action against the District, the KGA, or any other KGA member for any claims related to the KGA GSP or SGMA, or (2) contest or challenge, directly or indirectly, the District GSP Chapter or KGA GSP, as adopted and as may be amended. The Landowner acknowledges and agrees that initiation of a lawsuit, judicial, or administrative action against the District, KGA, or other KGA members for claims related to the KGA GSP or SGMA will render the Landowner initiating the action a Defaulted Landowner (as defined by Section 4 of this Agreement).

10. **Notice of Agreement.** The Landowner agrees to provide a copy of this Agreement to each and every person who receives any interest in any portion of the Landowner Lands

11. **Runs with the Land.** The benefits and burdens of this Agreement are intended to attach to and run with the land particularly described in Exhibit A to this Agreement, are related to the direct benefit, use, maintenance and improvement of the Landowner Land, and shall be binding on and inure to the benefit of the Parties and their respective legal representatives, successors, heirs and assigns. It is the intent of the Landowner from the date of this Agreement, that the equitable servitudes, covenants, conditions, restrictions, assessments and other duties and obligations herein or in the District’s GSP Chapter (so long as such lands have not been withdrawn pursuant to Section 8 hereof) run with the land and shall be binding on any successors or assigns. All persons or entities claiming under the Parties, or who accept deeds, leases, easements or other grants of conveyances to any portion of the Landowner Land, agree that they shall be personally bound by all of the provisions of this Agreement, and shall conform to and observe the provisions of this Agreement and the District’s GSP Chapter and the KGA GSP. The Parties agree that a covenant evidencing this Agreement and its nature as attaching to and running with the land, shall be executed by the Landowner and recorded with the Clerk/Recorder of the County of Kern as a condition to the inclusion of the Landowner Lands within the District’s GSP Chapter and the KGA GSP.
12. ** Entire Agreement; Amendments or Modifications.** The Parties agree that this Agreement contains the entire Agreement and understanding concerning the subject matter among the Parties and supersedes and replaces all prior negotiations of proposed agreements, written or oral, if any. This Agreement shall not be amended or modified except in writing, executed and agreed to by all of the Parties to this Agreement.

13. **Effective Illegality.** If any paragraph, sentence, clause, or phrase becomes illegal, null, or void for any reason or is held by any court of competent jurisdiction to be illegal, null, void, or against public policy, the remaining paragraphs, sentences, clauses, or phrases are not affected, and the Parties must negotiate an equitable adjustment of the affected provision with a view toward effecting the purpose of this Agreement.

14. **Construction.** Headings are used for convenience only and have no force or effect in the construction or interpretation of this Agreement. As used in this Agreement, the singular includes the plural and the masculine includes the feminine and neuter. This Agreement is a joint product of all Parties and is to be interpreted as such. This Agreement: (1) shall not be construed against the Party preparing it; (2) shall be construed as if the Parties had jointly prepared this Agreement; and (3) shall be deemed their joint work product. Each and every provision of this Agreement shall be construed as through the Parties participated equally in the drafting hereof, and, therefore, any uncertainty or ambiguity shall not be interpreted against any one Party. As a result of the foregoing, any rule of construction that a document is to be construed against the drafter shall not be applicable.

15. **No Third-Party Rights.** Nothing in this Agreement, whether expressed or implied, either is intended, or is to be construed, or otherwise interpreted as, conferring any rights or remedies on any third parties. Also, nothing in this Agreement gives any third parties any rights of subrogation against any Party.

16. **Governing Law and Venue.** This Agreement is entered into and performed in the State of California and is to be interpreted pursuant to the internal substantive law, and not the law of conflicts, of the State of California. Venue in any action brought under this Agreement shall be in the Superior Court of the County of Kern, State of California.

17. **Indemnification.** The Landowner (“Indemnifying Party”) shall protect, defend, indemnify and hold harmless the District, the KGA, and the KGA members along with their respective directors, officials, officers, managers, employees, contractors and agents (“Indemnified Party”) from and against all liabilities, obligations, claims, damages, penalties, causes of action, costs and expenses (including, without limitation, attorneys’ fees and expenses) imposed upon, incurred by, or asserted against an Indemnified Party arising out of, resulting from, or in connection with (a) any indemnification obligation undertaken by the District under the KGA Indemnity with respect to the Landowner or the Landowner Land, or (b) any action taken or omitted to be taken by the Indemnifying Party under this Agreement, including but not limited to the following: (i) the actions or omissions by Landowner or Landowner’s affiliates, members, managers, employees, contractors and agents related to this Agreement, the KGA GSP, or SGMA; (ii) the
18. **Effective Date and Term of Agreement.** The effective date of this Agreement shall be the date last signed below. This Agreement shall remain in effect with respect to each particular Landowner unless and until such Landowner fails to perform according to the terms of this Agreement or such Landowner withdrawals from the Agreement pursuant to Section 8 hereof. This Agreement shall have no force or effect upon a determination that the performance of any provision of this Agreement will result or has resulted in the violation of state or federal law.

[signatures and property descriptions on following pages]

[Landowner]

Arvin-Edison Water Storage District

__________________________________________
Signature

__________________________________________
Signature

__________________________________________
Name and Title Jeevan Muhar, Engineer-Manager

__________________________________________
Date

__________________________________________
Date
Appendix D

ACSD 2018 Water Use Summary
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018 Water Pumped by ACSD’s Wells</td>
<td>2,700 acre-feet</td>
</tr>
<tr>
<td>Total Urban Developed Lands in the District</td>
<td>1,500 acres</td>
</tr>
<tr>
<td>Unit Applied Water - Urban Lands within ACSD</td>
<td>1.8 acre-feet/acre</td>
</tr>
<tr>
<td>Amount of Water Treated by City of Arvin WWTP</td>
<td>1,290 acre-feet</td>
</tr>
<tr>
<td>Net Water Use by ACSD’S Water Users</td>
<td>1,410 acre-feet</td>
</tr>
<tr>
<td>Amount of Annual Evaporation from City WWTP Ponds - 2018 Est.</td>
<td>100 acre-feet</td>
</tr>
<tr>
<td>Net Amount of WW Available for Recharge</td>
<td>1,190 acre-feet</td>
</tr>
</tbody>
</table>
Appendix E

Summary of Stakeholder Communications and Engagement
ARVIN-EDISON WATER STORAGE DISTRICT

STAKEHOLDER COMMUNICATION & ENGAGEMENT PLAN

FOR THE PORTION OF AEWSD WITHIN THE KGA

NOVEMBER 2019
# Table of Contents

1. Introduction ............................................................................................................................... 5  
   1.1. SGMA Overview .................................................................................................................. 5  
   1.2. Communication & Engagement Plan .................................................................................. 5  
2. Goals and Desired Outcomes ..................................................................................................... 7  
   2.1. GSA Descriptions and AEWSD Boundary ....................................................................... 7  
   2.2. GSA Structure and Decision-Making Process ................................................................. 7  
   2.3. Desired Outcome ................................................................................................................ 7  
   2.4. Communication Objectives to Support the GSP ............................................................... 8  
   2.5. Challenges for the Plan Area ............................................................................................. 8  
3. Stakeholder Identification .......................................................................................................... 9  
   3.1. Holders of Overlying Groundwater Rights ...................................................................... 9  
   3.2. Municipal Well Operators ............................................................................................... 10  
   3.3. Public Water Systems ....................................................................................................... 10  
   3.4. Local Land Use Planning Agencies .................................................................................. 10  
   3.5. Environmental Users of Groundwater ............................................................................ 10  
   3.6. Surface Water Users ......................................................................................................... 10  
   3.7. The Federal Government .................................................................................................. 11  
   3.8. California Native American Tribes ................................................................................... 11  
   3.9. Disadvantaged Communities ........................................................................................... 11  
   3.10. Groundwater Monitoring Entities .................................................................................. 11  
4. Stakeholder Survey and Mapping .............................................................................................. 12  
5. Messages .................................................................................................................................... 13  
6. Venues for Engaging ................................................................................................................ 14  
   6.1. GSA Board Meetings ......................................................................................................... 14  
   6.2. Stakeholder Workshops ..................................................................................................... 14  
   6.3. Website Communication .................................................................................................... 15  
   6.4. Stakeholder Surveys ........................................................................................................... 15  
   6.5. Stakeholder Outreach ......................................................................................................... 15  
7. Implementation timeline ............................................................................................................ 16  
8. Evaluation and Assessment ........................................................................................................ 17  
References and Technical Studies (Reg. § 354.4) ........................................................................ 18  
APPENDIX A ................................................................................................................................... 19  
APPENDIX B .................................................................................................................................. 20
List of Tables

Table 1  Stakeholder Constituency – “Lay of the Land” Exercise
Table 2  Likely Questions and Responses
Table 3  GSP and C&E Efforts by Phase

List of Figures

Figure 1  GSA Areas
# Arvin-Edison Water Storage District
## Stakeholder Communication and Engagement Plan

### Glossary / Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACSD</td>
<td>Arvin Community Services District</td>
</tr>
<tr>
<td>AEWSD</td>
<td>Arvin-Edison Water Storage District</td>
</tr>
<tr>
<td>CASGEM</td>
<td>California Statewide Groundwater Elevation Monitor</td>
</tr>
<tr>
<td>CC</td>
<td>Coordination Committee</td>
</tr>
<tr>
<td>CCE</td>
<td>California Conservation Easement Database</td>
</tr>
<tr>
<td>CPA</td>
<td>California Protected Areas Database</td>
</tr>
<tr>
<td>CWC</td>
<td>California Water Code</td>
</tr>
<tr>
<td>CWD</td>
<td>Cawelo Water District</td>
</tr>
<tr>
<td>C&amp;E</td>
<td>Communications and Engagement</td>
</tr>
<tr>
<td>DAC</td>
<td>Disadvantaged Communities</td>
</tr>
<tr>
<td>DWR</td>
<td>California Department of Water Resources</td>
</tr>
<tr>
<td>EKI</td>
<td>EKI Environment &amp; Water</td>
</tr>
<tr>
<td>ENCSK</td>
<td>East Niles Community Services District</td>
</tr>
<tr>
<td>GSA</td>
<td>Groundwater Sustainability Agency</td>
</tr>
<tr>
<td>GSP</td>
<td>Groundwater Sustainability Plan</td>
</tr>
<tr>
<td>HCM</td>
<td>Hydrogeologic Conceptual Model</td>
</tr>
<tr>
<td>JPA</td>
<td>Joint Powers Agreement</td>
</tr>
<tr>
<td>KCWA</td>
<td>Kern County Water Agency</td>
</tr>
<tr>
<td>KGA</td>
<td>Kern Groundwater Authority</td>
</tr>
<tr>
<td>KTWD</td>
<td>Kern-Tulare Water District</td>
</tr>
<tr>
<td>KWBA</td>
<td>Kern Water Bank Authority</td>
</tr>
<tr>
<td>NKWSD</td>
<td>North Kern Water Storage District</td>
</tr>
<tr>
<td>PWS</td>
<td>Public Water Systems</td>
</tr>
<tr>
<td>RRBWSD</td>
<td>Rosedale-Rio Bravo Water Storage District</td>
</tr>
<tr>
<td>SB</td>
<td>Senate Bill</td>
</tr>
<tr>
<td>SCEP</td>
<td>Stakeholder Communication and Engagement Plan</td>
</tr>
<tr>
<td>SGMA</td>
<td>Sustainable Groundwater Management Act</td>
</tr>
<tr>
<td>SSJMU</td>
<td>Southern San Joaquin Municipal Utility District</td>
</tr>
<tr>
<td>SWID</td>
<td>Shafter-Wasco Irrigation District</td>
</tr>
<tr>
<td>SWSD</td>
<td>Semitropic Water Storage District</td>
</tr>
<tr>
<td>TCWD</td>
<td>Tejon-Castac Water District</td>
</tr>
<tr>
<td>TT</td>
<td>Tejon Tribe</td>
</tr>
<tr>
<td>WDWA</td>
<td>Westside District Water Authority</td>
</tr>
<tr>
<td>WKWD</td>
<td>West Kern Water District</td>
</tr>
<tr>
<td>WRMWSD</td>
<td>Wheeler Ridge-Maricopa Water Storage District</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

1.1. SGMA Overview

The Sustainable Groundwater Management Act (SGMA) is a combination of three bills signed by the California Governor Jerry Brown in 2014: Assembly Bill (AB) 1739, Senate Bill (SB) 1168, and SB 1319. SGMA provides local agencies with the framework to manage groundwater basins in a sustainable manner. The legislation recognizes that groundwater is most effectively managed at the local level, and local agencies will need to achieve groundwater sustainability by 2040. In SGMA, sustainable groundwater management is defined as management of groundwater supplies in a manner that can be maintained in planning and implementation phases without causing undesirable results. Undesirable results include significant and unreasonable chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and interconnected surface waters.

1.2. Communication & Engagement Plan

Arvin-Edison Water Storage District (AEWSD or District) has developed this Stakeholder Communication and Engagement Plan (SCEP) to describe its approach to Communication & Engagement (C&E) throughout the Groundwater Sustainability Plan (GSP) development process. This SCEP was prepared in accordance with California Water Code (CWC), the GSP Regulations (Title 23 of the California Code of Regulations [CCR] §354.10 [see above]), the California Department of Water Resources (DWR) Guidance Document for Groundwater Sustainability Plan Stakeholder Communication and Engagement (DWR, 2018), EKI Environment & Water (EKI)’s White Wolf basin SCEP (EKI, 2018), Kern Groundwater Authority (KGA)’s Kern County Communication & Engagement Plan (KGA, 2018), and additional reference documents recommended by DWR for guidance.
C&E efforts carried out as described in this SCEP will help to ensure that beneficial uses and users of groundwater are adequately considered in the GSP development process as required by GSP Regulations (23-CCR §354.10). Specifically, in this SCEP:

- Section 2.2 describes the Groundwater Sustainability Agency (GSA) decision-making process (23-CCR §354.10(d)(1));
- Section 6 identifies opportunities for public engagement and how public input and response will be used (23-CCR §354.10(d)(2));
- Section 3 identifies stakeholders and how the District intends to engage with them, and Section 4 describes how the District intends to build upon its current understanding of stakeholders within the Basin (23-CCR §354.10(d)(3) and CWC §10723.4); and
- Section 7 describes the C&E implementation timeline, including when this SCEP will be updated to describe methods to inform the public about GSP implementation progress, including the status of projects and actions (23 CCR §354.10(d)(4)).
2. GOALS AND DESIRED OUTCOMES

This program for C&E is designed to effectively engage a variety of relevant stakeholders in the development of a GSP that will guide all GSAs to demonstrate sustainability by 31 January 2042 and maintain sustainability through SGMA’s 50-year planning timeline.

2.1. GSA Descriptions and AEWSD Boundary

The District is comprised of two Basins; the White Wolf Basin (Basin; DWR 5-022.18) and the Kern County Basin (Basin; DWR 5-022.14) and is a part of three GSAs; the KGA, Kern River GSA and the White Wolf GSA. The White Wolf GSA covers 23,634 acres, or 18% of land within the District as shown in Figure 1. The KGA covers 104,640 acres, or 79% of land within the District, and lastly, the Kern River GSA covers 3,386 acres, or 3% of land within the District.

2.2. GSA Structure and Decision-Making Process

Key GSP development and implementation decisions are made by the GSAs Board of Directors (Board).

2.2.1. KGA Board Structure and Meetings

Per the Joint Powers Agreement (JPA) executed on 22 March 2017, the GSA Board is composed of one representative from each of the general member agencies (Arvin Community Services District (ACSD), AEWSD, Cawelo Water District (CWD), Kern County Water Agency (KCWA), Kern-Tulare Water District (KTWD), Kern Water Bank Authority (KWBA), North Kern Water Storage District (NKWSD), Rosedale-Rio Bravo Water Storage District (RRBWSD), Semitropic Water Storage District (SWSD), Shafter-Wasco Irrigation District (SWID), Southern San Joaquin Municipal Utility District (SSJMUD), TCWD, West Kern Water District (WKWD), Westside District Water Authority (WDWA) and WRMWSD plus one representative from the County as well as the City of Shafter).

Board meetings are held on the fourth Wednesday of every month and are open to the public. Board meeting agendas and packets are posted to the KGA website (www.kerngwa.com/board-of-directors.html).

2.2.1.1. Coordination Committee Structure and Meetings

The Coordination Committee (CC) is composed of one to two (1-2) representatives from each voting party of the GSA and encompass residential, agricultural, environmental, rural, domestic well, and municipal interests. The specific role of the KGA’s CC is to make recommendations to the GSA’s Board of Directors regarding community outreach and adoption of a GSP that accounts for local interests.

The CC meets monthly, on the first Monday of every month unless otherwise posted on the KGA’s website (www.kerngwa.com/committees.html).

2.3. Desired Outcome

AEWSD’s main goal is to establish and execute a plan that will sustain and manage groundwater within the District in a way that is cost-effective with minimal negative impacts to the beneficial
uses and users. The District aims to assist in GSP development that sets the Plan Area on a path to maintain sustainability through SGMA’s 50-year planning timeline.

2.4. Communication Objectives to Support the GSP

The District’s C&E efforts aim to encourage active involvement of diverse, social, cultural, and economic elements of the population within its boundary, by best meeting the needs of beneficial uses and users of groundwater. The District aims to be knowledgeable about and anticipate stakeholder interests and concerns. The District will also give beneficial uses and users of groundwater opportunities to engage in the GSP process and provide educational outreach opportunities for stakeholders while reaching out through specific communication venues discussed in section 6.

2.5. Challenges for the Plan Area

The District is aware of and plans to address the following challenges:

- Several large landowners overlie both the White Wolf Basin and the Kern County Basin. The District will need to coordinate with entities in the Kern County Basin to ensure that C&E conducted by the KGA will align with and complement C&E conducted by entities in the White Wolf GSA. This coordination should be facilitated by the fact that AEWSD and WRMWSD currently overlie both basins. Both agencies will be closely involved in the GSP development process and C&E efforts in either basin. Should substantially different groundwater management decisions be made in each basin, the District will ensure that stakeholders near and straddling the basin boundary understand how GSP implementation in each basin will impact them.

- Irrigated agriculture is the primary land use in the District, and there will be concerns about SGMA compliance. The District will aim to be open and transparent in any decisions that will have a substantial impact on beneficial users of groundwater in the District and will aim to engage stakeholders early in the decision-making process to consider their interests and concerns.

- Economic impacts to the agricultural industry will have direct impacts on Disadvantaged Communities (DAC)s, including loss of jobs and loss of tax revenue due to the decreased land value of fallowed ground. Many DAC residents are employed by the industry, and many infrastructure improvement projects within these communities are facilitated by the County of Kern and are funded through state and federal funding, secured with the assistance of technical providers.
3. STAKEHOLDER IDENTIFICATION

The KGA identified current beneficial uses and users of groundwater in their Basin in their SCEP in accordance with the interests listed in CWC §10723.2. The following are the identified beneficial uses and users of groundwater within the Kern County Basin. Representatives of specific organizations on this list form the basis of the GSA’s list of interested parties, required by CWC §10723.4.

3.1. Holders of Overlying Groundwater Rights

3.1.1. Agricultural Users
Kern County is currently the number one agricultural-producing county in the United States, with its top five commodities being grapes, almonds, citrus, pistachios and milk. These commodities comprise over $4.3 billion of the over $7 billion in gross value of crops produced within Kern County.

AEWSD provides water service to the majority of the agricultural water users in the District. The District maintains a list of landowners within its service area, and input from agricultural groundwater users will be integral to the development of the GSP.

Agricultural groundwater users in areas outside of the AEWSD service area will be engaged through the public outreach process prior to and during the development and implementation of the GSP.

3.1.2. Food Processing Systems
Groundwater is also used by a small number of private commercial entities for industrial use (i.e., food processing). The District seeks to identify and engage these commercial entities during the GSP development process.

3.1.3. Domestic Well Owners
The quantity and distribution of domestic well owners within the District is currently unknown. The District seeks to compile information on the number and location of domestic wells, as well as the concerns and interests of domestic well owners, through the stakeholder survey described in Section 4.

3.1.4. Industrial Users
The District has historically been a productive region for oil and gas exploration. Active oil fields include Edison and Mountain View. Oil and gas groundwater users generally extract water from hydrocarbon-bearing zones beneath the vertical extent of the Basin.

There are currently 1,514 acres of solar farms residing within the District that utilize groundwater for dust control and equipment cleanup.

Representatives of the oil, gas, and solar industry are welcome to participate in the GSP development process by attending GSA Board meetings and stakeholder workshops.
3.2. Municipal Well Operators

ACSD and East Niles Community Services District (ENCSD), are the only municipal well operators within the District.

3.3. Public Water Systems

ACSD and ENCSD are the only Public Water System (PWS) agencies providing potable water service to the AE District. ENCSD services 3%, or 3,386 acres of land within AEWSD, whereas ACSD services 2%, or 2,438 acres. There are also roughly 20 small state water systems that service 48,063 people within the District. These 20 locations are made up of several convenience stores, public schools, private farms, and mutual water companies, among a few others.

While publicly available data have been examined to identify Public Water Systems in the Basin\(^1\), the District acknowledges that these datasets are known to be incomplete and thus seeks to identify and engage any additional water systems during the development and implementation of the GSP.

3.4. Local Land Use Planning Agencies

AEWSD is comprised of unincorporated County land and the City of Arvin (municipality). The Kern County Planning and Community Development is responsible for land use planning in the District. The County will be actively involved in the development and implementation of the GSP through its participation in the GSA.

3.5. Environmental Users of Groundwater

There is minimal interaction between groundwater and surface water in the District. In most of the District, the water table lies between 300 and 400 feet below land surface\(^2\) and thus there is no groundwater contribution to stream flow.

To the extent that additional environmental users of groundwater are identified, they will be considered and engaged during the development and implementation of the GSP.

3.6. Surface Water Users

Surface water features in the District include ephemeral streams draining the Tehachapi Mountains, several small lakes and ponds, the California Aqueduct, and a network of irrigation canals and ditches.

---

\(^{1}\) Including the California Environmental Health Tracking Program Water System Map Viewer (http://www.cehtp.org/page/water/water_system_map_viewer).

3.7. The Federal Government

Within the District, there are several areas of State Ecological Reserves, Nonprofit California Protected Area (CPA) holdings, and California Conservation Easements (CCE) all identified by DWR's SGMA Data Viewer.

3.8. California Native American Tribes

The District has contacted the Tejon Tribe (TT) regarding GSP participation. Land owned by TT resides within the District’s service water service area. Additional Native American Tribes within the KGA boundary will be invited to participate in GSP development. The KGA will reach out to them by sending a letter about SGMA and the KGA along with a stakeholder survey.

3.9. Disadvantaged Communities

US Census Tract 62.01, was identified as a Severely Disadvantaged Community Tract based on an average household income less than 60% of the State median (U.S. Census, 2015). There are currently 4,595 severely disadvantaged households in the City of Arvin, 54 severely disadvantaged households in Edmundson Acres, and 583 severely disadvantaged households in Weedpatch. Mettler is currently only a disadvantaged community with 31 households.

The District aims to engage residents of disadvantaged communities during the development and implementation of the GSP through identification in the stakeholder survey and coordination with relevant community groups.

3.10. Groundwater Monitoring Entities

The District is a Monitoring Entity within the Kern County Basin under the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. AEWSD conducts the CASGEM monitoring effort on behalf of the KGA. AEWSD will be actively involved in the development and implementation of the GSP through its participation in the GSA.
4. STAKEHOLDER SURVEY AND MAPPING

The District intends to frequently update its list of stakeholders based on new information. To learn more about its stakeholders, the District plans to distribute a stakeholder survey (Appendix A) by:

- Having copies of the survey available at all AEWSD Board meetings and stakeholder workshops;
- Sending the survey in water bill mailings;
- Coordinating with the KGA, KRGSA, and White Wolf GSA to distribute the survey to diverse members of the population that may not otherwise be reached; and
- Providing the KGA website link to the digital survey: http://www.kerngwa.com/index.html.

Based on current knowledge of stakeholders, the DWR has completed a “Lay of the Land” exercise in Table 1, identifying specific stakeholder organizations/individuals, stakeholder type, key interests and issues, the sections of the GSP likely to be relevant to this stakeholder, and the level of engagement (e.g., inform, consult, involve) expected with each stakeholder organization/individual.

Given that the KGA will gain more knowledge of the interests, issues, and challenges of stakeholders over the course of GSP development, Table 1 will be updated during each phase of GSP development. Should the GSA need to learn more about specific stakeholders, individual meetings will be arranged to find out more about their issues, interests, and challenges.

In addition to the more detailed stakeholder survey, the KGA intends to maintain a simple form on their webpage for individuals to enroll in the GSA interested parties list and provide their contact information.
5. MESSAGES

The District aims to convey consistent high-level messaging to all stakeholders throughout GSP development and implementation. The following are the key messages that will form the foundation for all C&E efforts:

1. The District aims to engage with diverse stakeholders to best represent their interests in the GSP development process; and
2. The District intends to inform its stakeholders of key GSP development decisions during public AEWSD stakeholder workshops; and

The District will maintain these messages in all venues for engaging, as described in Section 6. Additionally, the District has developed **Table 2 Likely Questions and Responses** to document anticipated questions as well as possible responses. **Table 2** will be updated to add additional, frequently received questions as well as to build upon responses based on GSP development progress.

**Table 2 Likely Questions and Responses**

<table>
<thead>
<tr>
<th>Likely Questions</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>How can I participate in the GSP development and implementation process?</td>
<td>KGA Board meetings are open to the public and held on the fourth Wednesday of every month. Agendas and packets are posted to the KGA website (<a href="http://www.kerngwa.com/board-of-directors.html">www.kerngwa.com/board-of-directors.html</a>).</td>
</tr>
<tr>
<td>Will I have to fallow my land?</td>
<td>That information has not been determined yet, as we are in the preliminary stages of GSP development.</td>
</tr>
<tr>
<td>What types of management actions or projects are going to occur in my area?</td>
<td>That information has not been determined yet, as we are in the preliminary stages of GSP development.</td>
</tr>
<tr>
<td>Are pump meters going to be required? Who will pay for meters?</td>
<td>That information has not been determined yet, as we are in the preliminary stages of GSP development.</td>
</tr>
<tr>
<td>Can groundwater management activities improve water challenges in DACs?</td>
<td>That information has not been determined yet, as we are in the preliminary stages of GSP development.</td>
</tr>
<tr>
<td>Who is paying for GSP development and implementation?</td>
<td>Funding is provided by grant programs and member Districts.</td>
</tr>
</tbody>
</table>
6. VENUES FOR ENGAGING

The District intends to provide a variety of opportunities for engagement with stakeholders. Stakeholder input received will inform and be incorporated into corresponding sections of the GSP as appropriate. Documents will be available in both English and Spanish languages.

6.1. GSA Board Meetings

As described in Section 2.2.1, the GSA Board meetings are open to the public and are a consistent venue for public engagement.

6.2. Stakeholder Workshops

Stakeholder workshops will be held to communicate progress on GSP technical components to stakeholders and to receive input on upcoming decisions and work efforts. Stakeholder and groundwater workshops will been held by the KGA, and all materials can be found on the KGA website:

- **Stakeholder Workshop #1** – SGMA Overview. *(Previously held on 10/24/2016)*
- **Stakeholder Workshop #2** – SGMA Overview and Update of Concerns. *(Previously held on 11/1/2016)*
- **Stakeholder Workshop #3** – Groundwater Basin Stakeholder Assessment. *(Previously held on 11/15/2016)*
- **Stakeholder Workshop #4** – SGMA Compliance, and Surface and Groundwater Relationships. *(Previously held on 11/28/2016)*
- **Stakeholder Workshop #5** – GSA Decision Making, GSP Development, Stakeholder Perspectives, and Sustainability Goals. *(Previously held on 12/5/2016)*
- **Stakeholder Workshop #6** – GSA Formation, SGMA Compliance, GSP Development, and Water Allocations. *(Previously held on 12/20/2016)*
- **Groundwater Workshop #1** – Groundwater Basics, SGMA Overview, Local GSA Boundaries, GSP Overview, and Stakeholder Questionnaire. *(Previously held on 5/21/2018)*
- **Informational Meeting #1** – GSP, Compliance, and State Intervention. *(Previously held on 9/20/2018)*

Stakeholder workshops will be held by the White Wolf GSA during GSP development:

- **Stakeholder Workshop #1** – SGMA Overview. *(Previously held on 6/4/2019)*

At least four District workshops will be held during GSP development:

- **Stakeholder Workshop #1** – SGMA Overview. *(Previously held on 11/17/2016, with 64 total attendees amongst three workshops)*
- **Informational Workshop #1** – Sustainable Management Plan and Criteria. *(Previously held on 10/2/2018, with 94 total attendees amongst three workshops)*
- **Informational Workshop #2** – Sustainable Management Plan and Criteria *(Previously held on 5/30/19, with 54 attendees amongst three workshops)*
• **Stakeholder Workshop #3 / AE Chapter Public Hearing** – Review of the draft GSP. *(Previously held on 9/26/19, with 13 attendees)*

The District will publicize all stakeholder workshops and its list of interested parties and will coordinate with the proper GSA parties and community organizations to send out emails and mailings as appropriate.

Additional stakeholder workshops may be held during GSP implementation. The timing and content of these stakeholder workshops will be determined when the GSP Implementation Plan is developed shortly before GSP submission.

6.3. **Website Communication**

The KGA will update its website with GSA Board meeting materials as described in Section 2.2.1, and will additionally update the website with key GSP updates. The District is in the process of developing its own website, accommodating the needs of SGMA and GSP development.

6.4. **Stakeholder Surveys**

The District intends to learn about stakeholder interests using surveys that will be distributed as discussed in Section 4. Copies of the stakeholder surveys are included as Appendix A.

6.5. **Stakeholder Outreach**

The District will keep record of all stakeholder outreach efforts. A copy of these efforts is included as Appendix B.
7. IMPLEMENTATION TIMELINE

The District’s C&E implementation timeline aligns with a four phase GSP development timeline, as described in Table 3 below.

Table 3 GSP Development and C&E Efforts by Phase

<table>
<thead>
<tr>
<th>Phase</th>
<th>Timeframe</th>
<th>Overall GSP Efforts</th>
<th>C&amp;E Efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSP Foundation</td>
<td>May 2018 – July 2018</td>
<td>• Evaluate basin management activities</td>
<td>• Develop SCEP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Conduct data gaps assessment</td>
<td>• Distribute Stakeholder Survey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Develop Hydrogeologic Conceptual Model (HCM) and definition of groundwater conditions</td>
<td>• Assess C&amp;E progress based on survey results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Develop water budget</td>
<td>• Update Stakeholder Constituency Table</td>
</tr>
<tr>
<td>District Analysis</td>
<td>July 2018 – Jan 2019</td>
<td>• Implement plan for filling data gaps</td>
<td>• Conduct Stakeholder Workshop #2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Develop sustainable management criteria and undesirable results</td>
<td>• Assess C&amp;E progress based on results of Stakeholder Workshop #2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Assess and finalize existing monitoring network and protocols</td>
<td>• Update Stakeholder Constituency Table</td>
</tr>
<tr>
<td>Sustainability Planning</td>
<td>Jan 2019 – July 2019</td>
<td>• Finalize sustainable management criteria</td>
<td>• Conduct Stakeholder Workshop #3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Finalize monitoring network and protocols</td>
<td>• Assess C&amp;E progress based on results of Stakeholder Workshop #3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Identify projects and management actions</td>
<td>• Update Stakeholder Constituency Table</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Create GSP implementation plan</td>
<td>• Update SCEP to reflect C&amp;E efforts during GSP Implementation</td>
</tr>
<tr>
<td>GSP Preparation and Submittal</td>
<td>July 2019 – Jan 2020</td>
<td>• Compile complete draft GSP</td>
<td>• Distribute draft GSPs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Revise draft GSP (if necessary) per stakeholder feedback</td>
<td>• Hold Public Hearing on draft GSP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Finalize GSP Chapter and submit to DWR</td>
<td>• Assess C&amp;E progress and plan for C&amp;E related to GSP Implementation</td>
</tr>
</tbody>
</table>

The District will update this SCEP while helping to create a GSP implementation plan. This update will focus on informing the public about GSP implementation progress, including the status of projects and actions (23-CCR §354.10(d)(4)).
8. EVALUATION AND ASSESSMENT

The District intends to assess its C&E implementation during each phase of GSP development, as shown in Table 3. The District will present brief summaries of C&E progress at AEWSD Board meetings and will lead a discussion about lessons learned and what can be improved in the next phase of GSP development. The following questions will guide C&E evaluation:

- What worked well?
  - What allowed us insight into stakeholder concerns?
  - What types of materials best communicated GSP development to stakeholders?
- What didn’t work as planned?
  - Could materials (e.g., presentation slides, fact sheets, website pages) have been improved to better communicate GSP development progress?
  - Are certain stakeholder groups less represented in the GSP development process than they should be?
- What do we plan on doing differently during the next phase based on what we have learned?
- How much of our C&E budget have we spent relative to work completed? Do we have enough remaining budget to complete our C&E plan?
- Are there any outreach venues that need to be added to the implementation timeline?
- What are the next steps?
REFERENCES AND TECHNICAL STUDIES (REG. § 354.4)


## Table 1
Stakeholder Constituency – “Lay of the Land” Exercise

<table>
<thead>
<tr>
<th>Organization/Individual</th>
<th>Type of Stakeholder (a)</th>
<th>Anticipated Key Interests</th>
<th>Anticipated Key Issues (b)</th>
<th>Relevant GSP Sections</th>
<th>Level of Engagement and Rationale (c)</th>
</tr>
</thead>
</table>
| Agricultural Water Users Users | Agricultural Users | Preserving access to high quality groundwater for irrigation | • Potential curtailment of pumping  
• GSP development and implementation costs | • Sustainable Management Criteria  
• Projects and Management Actions | Collaborate to ensure sustainable management of groundwater |
| Domestic Well Users Owners | Domestic Well Owners | Preserving access to high quality groundwater for domestic users | • Water quality degradation  
• Declining water levels  
• GSP development and implementation costs | • Sustainable Management Criteria  
• Projects and Management Actions | Inform and involve to avoid negative impact to these users |
| Kern County Planning and Community Development Planning Agency | Local Land Use Planning Agency | Managing County-wide land use | Need to identify | • Plan Area  
• Projects and Management Actions | Consult and involve to ensure land use policies are supporting GSPs |
| Food Processing Systems Industrial Users | Food Processing | | • Definition of vertical extent of the groundwater basin based on salinity | • Basin Setting  
• Sustainable Management Criteria  
• Projects and Management Actions | Inform and involve to avoid negative impact to these users |
| Active oil field operators and solar farms Users | Industrial Users | Continue to operate oil, gas and solar fields | • Definition of vertical extent of the groundwater basin based on salinity | • Basin Setting  
• Sustainable Management Criteria  
• Projects and Management Actions | Inform and involve to avoid negative impact to these users |
| Arvin Community Services District Municipal Well Users; Public Water System | Municipal Well Users; Public Water System | Preserving access to high quality groundwater for municipal uses | • Water quality degradation | • Plan Area  
• Basin Setting  
• Sustainable Management Criteria  
• Projects and Management Actions | Collaborate to ensure sustainable management of groundwater |
| East Niles Community Services District Municipal Well Users; Public Water System | Municipal Well Users; Public Water System | Preserving access to high quality groundwater for municipal uses | • Water quality degradation  
• Declining water levels | • Basin Setting  
• Sustainable Management Criteria | Inform and involve to avoid negative impact to these users |
| Tejon Tribe Tribe | Tribe | Preserving access to high quality groundwater for domestic and irrigation uses | • Water quality degradation  
• Declining water levels  
• Potential curtailment of pumping | • Basin Setting  
• Sustainable Management Criteria  
• Projects and Management Actions | Inform and involve to avoid negative impact to these users |
| US Census Tract 62.01 Disadvantaged Communities | Disadvantaged Communities | Preserving access to high quality groundwater for domestic and municipal uses | • GSP development and implementation costs | • Sustainable Management Criteria  
• Projects and Management Actions | Inform and involve to avoid negative impact to these users |
Table 1
Stakeholder Constituency – “Lay of the Land” Exercise

Abbreviations:
CWC = California Water Code
DWR = California Department of Water Resources
GSA = Groundwater Sustainability Agency
GSP = Groundwater Sustainability Plan
SGMA = Sustainable Groundwater Management Act

Notes:
(a) Type of stakeholder based on CWC §10723.2 (e.g., agricultural groundwater users, municipal well operators, etc.).
(b) Any documented issues (media coverage, statements, reports, etc.), specific issues such as past events, or issues that have been otherwise communicated to or are anticipated by the GSA.
(c) Level of engagement based on the International Association of Public Participation Spectrum of Public Participation, as referenced in DWR’s Guidance Document for Groundwater Sustainability Plan Stakeholder Communication and Engagement (DWR, 2018).
Arvin-Edison Water Storage District
Stakeholder Communication and Engagement Plan

APPENDIX A

KGA Stakeholder Survey (English & Spanish)
KGA Agriculture Stakeholder Survey
**Stakeholder Survey**

Date: __________________________

**Stakeholder Type (check all that apply):**

- Agricultural User
- Domestic Well Owner/User
- Municipal Well Operator
- Public Water Systems
- Local Land Use Planning Agency
- Environmental User
- Surface Water User
- Native American Tribe
- Disadvantaged/Rural Community Resident
- City Resident
- Food Processor
- Industrial User/Oil Producer

Entity monitoring and reporting groundwater elevations in all or part of the groundwater basin

Note: Please complete your name and contact information if you’d like to be added to the GSA’s email and mailing list for future updates and information regarding Sustainable Groundwater Management Act (SGMA) and the Kern Groundwater Authority.

Name: __________________________

Address: __________________________

City: __________________________ State: __________ Zip: __________

Email: __________________________ Telephone: __________________________

1. Are you familiar with Sustainable Groundwater Management Act (SGMA) regulations?  
   - [ ] Yes  
   - [ ] No

2. Are you currently working on or discussing groundwater management in this region?  
   - [ ] Yes  
   - [ ] No

3. Do you own or manage/operate land in this region?  
   - [ ] Yes  
   - [ ] No

4. Where are you getting your water supply?  
   - [ ] City or Community Water System  
   - [ ] Surface  
   - [ ] Groundwater  
   - [ ] Both Groundwater & Surface Water  
   - [ ] Unknown

5. Agriculture & Domestic Well Users: What is your well(s) depth? __________________________

6. Agriculture & Domestic Well Users: Has your well(s) ever gone dry?  
   - [ ] Yes  
   - [ ] No

   *If yes, when (month/year)? __________________________*

7. If you are an Agricultural User, do you:  
   - [ ] Irrigate  
   - [ ] Dry Farm  
   - [ ] Graze Livestock  
   - [ ] Other: __________________________

8. How reliable is your current groundwater supply? __________________________

9. If you grow crops, do you use irrigation for frost protection?  
   - [ ] Yes  
   - [ ] No

10. Do you manage water resources?  
    - [ ] Yes  
    - [ ] No

   *If yes, what is your role? __________________________*
11. What is your primary interest in land or water resources management?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

12. Do you have concerns about groundwater management?  □ Yes  □ No
   If so, what are they?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

13. Do you have requests or recommendations regarding groundwater management?  □ Yes  □ No
   If so, what are they?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

14. Any other information the Kern Groundwater Authority should be aware of or take into consideration while developing the Groundwater Sustainability Plan (GSP)?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Please return completed surveys to the Kern Groundwater Authority by emailing tbarton@ppeng.com, faxing to (661) 479-7172, or mail to Kern Groundwater Authority, 1800 30th Street, Suite 280, Bakersfield, CA 93301. Stakeholder Surveys may also be completed online by visiting www.kerngwa.com.
Fecha: _______________________________________

Tipo de Interesado (marque todas que apliquen):

<table>
<thead>
<tr>
<th>Usuario agrícola</th>
<th>Propietario / usuario de pozo doméstico</th>
<th>Operador municipal de pozos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sistema de agua público</td>
<td>Agencia local de planificación del uso de la tierra</td>
<td>Usuario ambiental</td>
</tr>
<tr>
<td>Usuario de agua superficial</td>
<td>Tribu native americana</td>
<td>Residente de comunidad desventajada/ rural</td>
</tr>
<tr>
<td>Residente de la ciudad</td>
<td>Procesador de alimentos</td>
<td>Usuario industrial/Productor de petróleo</td>
</tr>
</tbody>
</table>

Entidad que monitorea y reporta elevaciones de aguas subterráneas en toda o parte de la cuenca de agua subterránea

Nota: Por favor complete su nombre y la información de contacto si desea ser agregado a la lista de correo electrónico de la GSA y lista de correo para futuras actualizaciones e información sobre la Ley del Manejo Sostenible del Agua Subterránea (SGMA) y la Autoridad de Aguas Subterráneas de Kern (KGA GSA).

Nombre: _______________________________________________________________________________________

Dirección Postal: ____________________________________________________________________________

Ciudad: ___________________________ Estado: ___________ Código postal: ______________

Correo Electrónico: ___________________________ Teléfono: _______________________

1. ¿Está usted familiarizado con las regulaciones de la ley de Manejo Sostenible del Agua Subterránea (SGMA)?
   - [ ] Sí
   - [ ] No

2. ¿Está usted actualmente involucrado en actividades o discusiones sobre el manejo de aguas subterráneas en esta región?
   - [ ] Sí
   - [ ] No

3. ¿Usted es propietario o administra/opera tierra en esta región?
   - [ ] Sí
   - [ ] No

4. ¿De dónde recibe su suministro de agua?
   - [ ] Sistema de agua de la ciudad o la comunidad
   - [ ] Superficie
   - [ ] Agua subterránea
   - [ ] Agua subterránea y superficial
   - [ ] No sé

5. Usuarios de pozos Agrícolas Y Domésticos: ¿Cuál es la profundidad de su pozo(s)?

6. Usuarios de pozo Agrícolas Y Domésticos: ¿Alguna vez se ha secado su pozo(s)?
   - [ ] Sí
   - [ ] No
   ¿Si la respuesta es sí, cuándo (mes/año)? ___________________________

7. Si eres un usuario agrícola, qual haces:
   - [ ] Irrigar
   - [ ] Granja seca
   - [ ] Pastoreo
   - [ ] Otro: ___________________________

8. ¿Qué tan seguro es su suministro de agua subterránea, corrientemente?
   __________________________________________________________________________
   __________________________________________________________________________

9. Si cultiva, ¿utiliza el riego para la protección contra las heladas?
   - [ ] Sí
   - [ ] No

10. ¿Usted administra recursos de agua?
    - [ ] Sí
    - [ ] No
    Si la respuesta es sí, ¿cuál es su papel? ___________________________
11. ¿Cuál es su interés principal en el manejo de recursos de agua o tierra? __________________________________________ 
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________

12. ¿Tiene preocupaciones acerca el manejo de las aguas subterráneas?  
☐ Sí  ☐ No 
Si la respuesta es sí, ¿cuáles son? __________________________________________ 
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________

13. ¿Tiene used alguna recomendación sobre el manejo de agua subterráneas?  
☐ Sí  ☐ No 
Si la respuesta es sí, ¿cuáles son? __________________________________________ 
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________

14. ¿Tiene used alguna otra información pertinente que debería tener en cuenta el Kern Groundwater Authority GSA para desarrollar el Plan de Sostenibilidad de Aguas Subterráneas (GSP)? 
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________
________________________________________________________________________________________________________

Por favor regrese la encuesta terminada al Kern Groundwater Authority GSA enviando un corre electrónico a tbarton@ppeng.com, mandando un fax al (661) 478-7172, o por correo a Kern Groundwater Authority GSA, 1800 30th Street, Suite 280, Bakersfield, CA 93301. 
Esta Encuesta de Partes Interesadas también se puede completer visitando la página www.kerngwa.com.
Agriculture Stakeholder Survey

Please return completed surveys to the Kern Groundwater Authority by emailing tbarton@ppeng.com, fax to (661) 479-7172, or mail to Kern Groundwater Authority, 1800 30th Street, Suite 280, Bakersfield, CA 93301. Stakeholder Surveys may also be completed online by visiting www.kerngwa.com.

Date: _______________________________________

Note: Please complete your name and contact information if you’d like to be added to the GSA’s email and mailing list for future updates and information regarding Sustainable Groundwater Management Act (SGMA) and the Kern Groundwater Authority.

Name: _______________________________________________________________________________________________________________

Address: ___________________________________________________________________________________________________________

City: __________________________ State: __________________ Zip: ______________

Email: __________________________ Telephone: __________________

APN(s) for lands farmed/managed: __________________________________________________________

1. We have included a map of the Kern Groundwater Authority irrigation and water districts. Please indicate below which districts in which you have land parcels. **Check all that apply.**

- [ ] Arvin Community Services District (ACSD)
- [ ] City of Shafter
- [ ] Kern-Tulare Water District (KTWD)
- [ ] Rosedale-Rio Bravo Water Storage District (RRBWSD)
- [ ] Southern San Joaquin Municipal Utility District (SSJMUD)
- [ ] Westside District Water Authority (WDWA)
- [ ] Arvin-Edison Water Storage District (AEWSD)
- [ ] County of Kern
- [ ] Kern Water Bank Authority (KWBA)
- [ ] Semitropic Water Storage District (SWSD)
- [ ] South Kern Municipal Utility District (SSJMUD)
- [ ] Tejon-Castaic Water District (TCWD)
- [ ] Wheeler Ridge-Maricopa Water Storage District (WRMWSD)
- [ ] Cawelo Water District (CWD)
- [ ] Kern County Water Agency (KCWA)
- [ ] North Kern Water Storage District (NKWSD)
- [ ] Shafter-Wasco Irrigation District (SWID)
- [ ] West Kern Water District (WKWD)

Kern Groundwater Authority

Water Districts within KGA

Source: Esri, USGS, NOAA
2. How many total acres do you farm (all land owned, leased and/or managed)? ____________________________

3. In a typical year, how much of the following crops, animals or land do you manage/own?

<table>
<thead>
<tr>
<th>Crop or Land Type</th>
<th>Acres Managed or Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit trees</td>
<td></td>
</tr>
<tr>
<td>Nut trees</td>
<td></td>
</tr>
<tr>
<td>Row crops</td>
<td></td>
</tr>
<tr>
<td>Seed crops</td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td></td>
</tr>
<tr>
<td>Grapes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crop or Land Type</th>
<th>Acres Managed or Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay/alfalfa</td>
<td></td>
</tr>
<tr>
<td>Livestock on pasture/rangeland</td>
<td></td>
</tr>
<tr>
<td>Dairy (total head)</td>
<td></td>
</tr>
<tr>
<td>Food Processor/Production</td>
<td></td>
</tr>
<tr>
<td>Other land use (please indicate):</td>
<td></td>
</tr>
</tbody>
</table>

4. Which of the following sources of water and management do you typically utilize under the following conditions?

<table>
<thead>
<tr>
<th>Water Source/Management</th>
<th>Dry Years</th>
<th>Normal Years</th>
<th>Wet Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation through surface water only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation through groundwater only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation through a mixture of surface and groundwater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater land applied</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No irrigation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. If you do use irrigation, which of the following methods of delivery do you use? Check all that apply.

- [ ] Furrow/flood
- [ ] Sprinklers
- [ ] Drip
- [ ] Microsprinkler
- [ ] Center pivot

[ ] Other (please indicate): ____________________________________________

6. In response to water scarcity, please indicate if you currently use the following practices and your likelihood to use the following practices in the future.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Currently Use</th>
<th>Future Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very Unlikely</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drill more wells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restore existing wells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make existing wells deeper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump more groundwater than previous years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drip irrigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water monitoring technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fallow fields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil moisture sensors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change to a less water intensive crop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce livestock stocking rates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaf sampling to measure plant-water status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase additional water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase crop insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Page 2 of 4
7. Please rate the level of importance these potential groundwater conditions are to you (with “1” being the most concerning, 5 being the least concerning). If you have additional concerns, please indicate them in the “Other” category.

<table>
<thead>
<tr>
<th>Groundwater Condition</th>
<th>Rating of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering of groundwater levels</td>
<td></td>
</tr>
<tr>
<td>Reduction in groundwater storage</td>
<td></td>
</tr>
<tr>
<td>Water quality degradation</td>
<td></td>
</tr>
<tr>
<td>Local subsidence</td>
<td></td>
</tr>
<tr>
<td>Depletions of surface water</td>
<td></td>
</tr>
<tr>
<td>Other (your opinion):</td>
<td></td>
</tr>
<tr>
<td>Other (your opinion):</td>
<td></td>
</tr>
</tbody>
</table>

8. The following are a list of management options that have been used on the West Coast for water management. Please provide your level of preference for these types of management:

<table>
<thead>
<tr>
<th>Management Option</th>
<th>Strongly Against</th>
<th>Against</th>
<th>Somewhat Against</th>
<th>Somewhat Support</th>
<th>Support</th>
<th>Strongly Support</th>
<th>Not Familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual recharge credits (i.e. winter flooding)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water metering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water trading through markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public program highlighting farmers implementing water saving practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmer adoption of water management practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District investment in conjunctive use infrastructure (i.e. water storage)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater replenishment fees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed quota for water pumping allocated to each farmer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incentives for water saving practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moratorium on drilling new wells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permits for drilling new wells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (your opinion):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (your opinion):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. If groundwater monitoring is required in the future, which of the following monitoring methods would you prefer?

<table>
<thead>
<tr>
<th>Method of Determining Water Allocation</th>
<th>Strongly Not Preferred</th>
<th>Not Preferred</th>
<th>Somewhat Not Preferred</th>
<th>Somewhat Preferred</th>
<th>Preferred</th>
<th>Strongly Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well metering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use satellite estimates and ground truth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use standard crop water requirement indexes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10. Should disputes arise over SGMA implementation, what is your preferred means of reconciliation?

<table>
<thead>
<tr>
<th>Dispute Option</th>
<th>Strongly Not Preferred</th>
<th>Not Preferred</th>
<th>Somewhat Not Preferred</th>
<th>Somewhat Preferred</th>
<th>Preferred</th>
<th>Strongly Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Water Resources Control Board</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater Sustainability Agency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>County Board of Supervisors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superior Court System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arbitration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. If you have any additional information or feedback regarding SGMA, water management or farming in Kern County that should be taken into consideration while developing the Groundwater Sustainability Plan (GSP), please provide the information below:

__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________
__________________________________________________________________________________________________________________

Please return completed surveys to the Kern Groundwater Authority by emailing tbarton@ppeng.com, fax to (661) 479-7172, or mail to Kern Groundwater Authority, 1800 30th Street, Suite 280, Bakersfield, CA 93301.

Stakeholder Surveys may also be completed online by visiting www.kerngwa.com.
## Stakeholder Outreach Efforts (updated 11/20/2019)

<table>
<thead>
<tr>
<th>Date</th>
<th>Stakeholder</th>
<th>Outreach Efforts</th>
<th>Contacted</th>
<th>Outreach Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 16, 2016</td>
<td>Landowners</td>
<td>• Landowner meetings</td>
<td>• Sandridge Partners</td>
<td></td>
</tr>
<tr>
<td>Oct 24, 2016</td>
<td>All</td>
<td>• Stakeholder Workshop #1</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>Nov 1, 2016</td>
<td>All</td>
<td>• Stakeholder Workshop #2</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>Nov 15, 2016</td>
<td>All</td>
<td>• Stakeholder Workshop #3</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>Nov 17, 2016</td>
<td>All</td>
<td>• AEWSD Stakeholder Workshop #1</td>
<td>• Landowners</td>
<td>• 64 attendees amongst 3 sessions</td>
</tr>
<tr>
<td>Nov 28, 2016</td>
<td>All</td>
<td>• Stakeholder Workshop #4</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>Dec 5, 2016</td>
<td>All</td>
<td>• Stakeholder Workshop #5</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>Dec 20, 2016</td>
<td>All</td>
<td>• Stakeholder Workshop #6</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>May 21, 2018</td>
<td>All</td>
<td>• Groundwater Workshop #1</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>June 4, 2018</td>
<td>Food Processing Systems</td>
<td>• Water Use Demands</td>
<td>• ACSD</td>
<td>(Minute) Feedback on Demand and Capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Food Processing Capacity</td>
<td>• Grimmway Farms</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• W.M Bolthouse Farms</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Val Mar Farms</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Johnston Farms</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Lehr Bros</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Moore Farms</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Tasteful Selections</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Brian Kirschenmann</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Thomson International</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Stakeholder</td>
<td>Event Description</td>
<td>Attendees/Responses</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td>June 7, 2018</td>
<td>Agricultural Users</td>
<td>• Distribute Stakeholder Survey (District May Billing Statement)</td>
<td>• Heck Cellars</td>
<td></td>
</tr>
<tr>
<td>June 13, 2018</td>
<td>CA Native American Tribes</td>
<td>• Meeting with Tejon Tribe</td>
<td>• Received 34 completed surveys</td>
<td></td>
</tr>
<tr>
<td>July 6, 2018</td>
<td>Municipal Well Operators</td>
<td>• Distribute KGA Informational Meeting Flyer (Email &amp; Board Packet)</td>
<td>• Feedback on Tribal Land Status</td>
<td></td>
</tr>
<tr>
<td>Sept 6, 2018</td>
<td>Landowners</td>
<td>• ACSD Well Locations</td>
<td>• GPS &amp; Irrigation Samples of Well Sites</td>
<td></td>
</tr>
<tr>
<td>Sept 20, 2018</td>
<td>All</td>
<td>• KGA Informational Meeting</td>
<td>• N/A</td>
<td></td>
</tr>
<tr>
<td>Sept 20, 2018</td>
<td>All</td>
<td>• Distribute AEWSD/ACSD/SHE Informational Meeting Flyer</td>
<td>• Landowners</td>
<td></td>
</tr>
<tr>
<td>Oct 2, 2018</td>
<td>All</td>
<td>• AEWSD/ACSD/SHE Informational Meeting</td>
<td>• Landowners</td>
<td></td>
</tr>
<tr>
<td>Oct 2-3, 2018</td>
<td>Landowners</td>
<td>• Sent copies of AEWSD/ACSD/SHE Informational Meeting Presentations</td>
<td>• Brad DeBranch</td>
<td></td>
</tr>
<tr>
<td>Oct 29, 2018</td>
<td>Public Water Systems</td>
<td>• 1st Letter for Confirmation of PWS • Distribute Stakeholder Survey</td>
<td>• Kyle Moeller</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Small PWS (20) – excluding ACSD &amp; ENCSD</td>
<td>• Catherine Fanucchi</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No responses</td>
<td>• Paul Biane</td>
<td></td>
</tr>
<tr>
<td>Nov 5, 2018</td>
<td>Public Water Systems</td>
<td>• 1st Letter for Confirmation of PWS • Distribute Stakeholder Survey</td>
<td>• Orange Grove RV Park</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prince Truck Stop</td>
<td>• 1st letter came back &quot;return to sender”</td>
<td></td>
</tr>
<tr>
<td>Dec, 2018</td>
<td>Landowners</td>
<td>• Emailed Ag Stakeholder Survey</td>
<td>• AEWSD Landowners</td>
<td></td>
</tr>
<tr>
<td>Jan 21, 2019</td>
<td>Public Water Systems</td>
<td>• 2nd Letter for PWS well data</td>
<td>• Small PWS (19) – excluding ACSD, ENCSD, Grimmway &amp; Mettler WD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Added Shell Comanche Station • Del Oro WC (Bob Portino) reached</td>
<td>11 completed</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Group</td>
<td>Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb 8-10, 2019</td>
<td>Monitoring Network</td>
<td>Phone contact / site visit • Rene Carreon • Matt Pandol • Ron Lehr • John Moore (domestic) • Vignolo</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Site visit w/Rene Carreon to discuss District access lock</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Matt Pandol wants to move forward in program – convert</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>John Moore wants to move forward in program – plug placed on well for WL’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vignolo is considering involvement of converted monitor program pending contract review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb 13, 2019</td>
<td>Monitoring Network</td>
<td>Phone contact / site visit • Ron Lehr / Shae Lehr</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Met with Ron and Shae at monitor site to confirm plans to move forward in program – convert</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr 24, 2019</td>
<td>Landowners</td>
<td>Distribute KGA SGMA Open House Flyer • Landowners</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emailed to 189</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

out to say he agrees w/AEWSD

• Shae Lehr sent over their declassification documents. 1/29/19.
• Sonshine (Wayne Kirschenman) stated their water comes from the Kirschenman Ent well. Pending hook up w/ACSD, they will be removed as PWS.
• Paul Loeffel reached out via email to say their well is used for the cold storage and not drinking water, and that he agrees w/AEWSD implementation. 2/16/19.
<table>
<thead>
<tr>
<th>Date</th>
<th>Group/Party</th>
<th>Actions</th>
<th>Noted</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1, 2019</td>
<td>CA Native American Tribes</td>
<td>Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer</td>
<td>Scott Neilson, David Zweig</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emailed to 2</td>
</tr>
<tr>
<td>May 6, 2019</td>
<td>All</td>
<td>Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer</td>
<td>Landowners</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emailed to 189</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer</td>
<td>Mailed to ~7,548</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACSD mailed 4,130</td>
</tr>
<tr>
<td>May 6, 2019</td>
<td>All</td>
<td>Distribute White Wolf Stakeholder Workshop</td>
<td>Landowners</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emailed to 189</td>
</tr>
<tr>
<td>May 7, 2019</td>
<td>KGA</td>
<td>Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer</td>
<td>Patty Poire</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emailed to 1</td>
</tr>
<tr>
<td>May 14, 2019</td>
<td>All</td>
<td>Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer</td>
<td>KGA SGMA Open House</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Landowners</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Neighboring Districts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leadership Counsel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distributed AEWSD Fact Sheet ~30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distributed AEWSD/ACSD/SHE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Informational Meeting #2 Flyer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>~20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distributed WW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stakeholder Workshop Flyer ~15</td>
</tr>
<tr>
<td>May 24, 2019</td>
<td>Neighboring Districts</td>
<td>Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer</td>
<td>Chris Bellue &amp; Mark Mulkay (KDWD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Angelica Martin (Tejon Ranch)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sheridan Nicholas (WRMWSWSD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emailed to 4</td>
</tr>
<tr>
<td>May 28, 2019</td>
<td>Landowners</td>
<td>Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer</td>
<td>Opal Fry &amp; Son</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Corotto Co</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tehachapi Bench</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Garcia</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Laut Farms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>San Diablo</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wonderful Citrus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wonderful Ranch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sandridge Partners</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Granite Construction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ALG Arvin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stull Vineyards</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lynn Reade Trust</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Steven Goddard Co</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bhogal Farms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Gibraltar Ranch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Edison Hwy Ranch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nickel Family</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emailed flyer to 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Spoke to 13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Left voicemail for 6</td>
</tr>
<tr>
<td>Date</td>
<td>Category</td>
<td>Actions</td>
<td>Remarks</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| May 29, 2018 | Landowners       | Distribute AEWSD/ACSD/SHE Informational Meeting #2 Flyer                | • Hunter Edison Oil  
• Southern Cherry Inv.                                            |
|            |                   |                                                                         | • Spoke to 1  
• Attempted to call 1  
• No contact info for 3  
• Emailed to 2 |
| May 30, 2019 | All               | AEWSD/ACSD/SHE Informational Meeting #2                                 | • Landowners  
• ACSD Residents                                                   |
| May 30-June 1, 2019 | Landowners | Sent copies of AEWSD/ACSD/SHE Informational Meeting #2 Presentation | • Randy Horne  
• Brad DeBranch                                                   |
| June 4, 2019 | Landowners       | White Wolf Stakeholder Workshop #1                                      | • Landowners  
• District staff attended event  
• ACSD attended event                                               |
| June 11-July 1, 2019 | White Lands | Received management coverage requests                                   | • Abercrombie Family Trust  
• ALJT LLC  
• B&C Land LLC / Baroncini Tommye Joe Trust  
• Bena LLC  
• Byfield John & Gunilla Family Trust  
• Chevron USA Inc  
• GGA Reddy Family LP  
• Gillet Phillip W Jr  
• Giumarra Vineyards Corp / Giumarra Bros Fruit Co / Giumarra Bro Fruit LLC  
• Graham Raymond E & Rosemary  
• Kirschenman Enterprises Sales  
• Loop Ranch LLP  
• Mitchell Helen K  
• Naftex Dev LLC  
• Ortho Surge Tek LLC  
• Peirce Ron & Carol |
<p>| | | | |
|            |                   |                                                                         |                                                                         |</p>
<table>
<thead>
<tr>
<th>Date</th>
<th>Group</th>
<th>Action 1</th>
<th>Action 2</th>
<th>Action 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 18, 2019</td>
<td>Landowners</td>
<td>Distribute AEWSD SGMA Update Letter</td>
<td>Landowners</td>
<td>Mailed to 7,290</td>
</tr>
<tr>
<td>June 20, 2019</td>
<td>Landowners</td>
<td>Landowner meetings</td>
<td>Hamilton Resources (representing various)</td>
<td></td>
</tr>
<tr>
<td>June 26, 2019</td>
<td>Landowners</td>
<td>Sent copies of AEWSD/ACSD/SHE Informational Meeting #2 Presentation</td>
<td>Wyatt Shipley</td>
<td>Emailed</td>
</tr>
<tr>
<td>July 11, 2019</td>
<td>Landowners</td>
<td>Landowner meetings</td>
<td>Grimmway Farms</td>
<td></td>
</tr>
<tr>
<td>July 16-17, 2019</td>
<td>White Lands</td>
<td>Distribute formal agreements and exhibits</td>
<td>Abercrombie Family Trust</td>
<td>Emailed 21 agreements and exhibits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ALJT LLC</td>
<td>Mailed 3 agreements and exhibits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B&amp;G Land LLC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Baroncini Tommaye Joe Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bena LLC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Byfield John &amp; Gunilla Family Trust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GGA Reddy Family LP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Gillet Phillip W Jr</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Giumarra Vineyards Corp / Giumarra Bros Fruit Co / Giumarra Bro Fruit LLC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Graham Raymond E &amp; Rosemary</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Kirschenman Enterprises Sales</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loop Ranch LLP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mitchell Helen K</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Naftex Dev LLC</td>
<td></td>
</tr>
<tr>
<td>Date Range</td>
<td>Location(s)</td>
<td>Actions and Details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>-------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 17 - Oct 7, 2019</td>
<td>Elevation Network</td>
<td>- Distribute formal agreements and exhibits</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Ortho Surge Tek LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Peirce Ron &amp; Carol Onsum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Racetrack 27 Estates LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Redfeairn Michael J &amp; Candra N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Twilight Ride LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Valley Waste Disposal Co</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Van Hoozen James L Family Trust</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Anthony Vineyards Inc (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CAK Farms Inc</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Carreon Vineyards Inc</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- DJGJ Family LP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Foster Tyler Living Trust et al</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Grimmway Enterprises Inc</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Kooner Gurmit S &amp; Baljeet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Lehr Ronald R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Moore John &amp; Kristin Family Trust</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pandol Matt Jr &amp; Linda Family</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Storm Stormy Lee</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Stull Family Trust</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sunridge Vineyards LP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Vignolo Farms T 1 LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Received final agreements for all 15 well sites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 23, 2019</td>
<td>White Lands</td>
<td>- Distribute formal agreements and exhibits</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tejon Ranch Conservancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Emailed 1 agreement and exhibits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 24-31, 2019</td>
<td>White Lands</td>
<td>- Follow up on agreements</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- GGA Reddy Family LP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Gillett Phillip W Jr</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Giumarra Vineyards Corp / Giumarra Bros Fruit Co / Giumarra Bro Fruit LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Graham Raymond E &amp; Rosemary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Kirschenman Enterprises Sales</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 3 phone calls</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 5 emails</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Location</td>
<td>Participants</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>July 24-30, 2019</td>
<td>White Lands</td>
<td>• Received signed agreements and exhibits</td>
<td>• Received initial funding payment from Loop Ranch LLC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug 15 - Oct 8, 2019</td>
<td>White Lands</td>
<td>• Follow up on agreements &amp; request notary signatures</td>
<td>• Emailed to 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Mailed to 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Received final agreements for all 10 entities</td>
<td></td>
</tr>
<tr>
<td>Aug 15, 2019</td>
<td>All</td>
<td>• GSP Plan Presentation</td>
<td>• Landowners</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• AEWSD BOD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 13 attendees</td>
<td></td>
</tr>
<tr>
<td>Aug 16, 2019</td>
<td>Landowners</td>
<td>• Distribute KGA SGMA Open House Flyer – GSP Review</td>
<td>• Landowners</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Emailed to 193</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Audience</td>
<td>Event/Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept 26, 2019</td>
<td>All</td>
<td>• KGA SGMA Open House Flyer – GSP Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Landowners</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 13 attendees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct 8 - Current, 2019</td>
<td>Water Quality Network</td>
<td>• Distribute formal agreements and exhibits</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Arvin Community Services District</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ashley Lane LP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Bag Katu LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• George Noroian Family Farms LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hronis Land Co</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Kepler Karen J Family Trust</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sunridge Vineyards LP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Way Gin LP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Received 5/8 agreements</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Public Meetings Summary

The list below identifies public meetings, workshops, and direct outreach specific to GSP Chapter development. Detailed meeting minutes and materials are available by request to the District.

**AEWSD Board Meetings**

2/9/16 – EKI presentation
4/12/16
5/10/16
6/14/16
7/12/16
9/13/16
10/11/16
11/8/16
1/10/17
2/14/17
3/14/17
4/11/17
5/9/17
6/13/17
7/11/17 – EKI presentation
9/12/17
10/10/17
11/14/17
12/12/17
1/9/18
2/13/18
3/13/18
4/10/18 – EKI presentation
6/12/18 – EKI presentation
7/10/18
9/11/18
10/9/18
11/13/18 – EKI presentation
12/11/18
2/12/19 – EKI presentation
3/12/19 – EKI presentation
4/9/19 – EKI presentation
5/14/19 – EKI presentation
6/11/19
7/9/19 – EKI presentation
The list above will be updated throughout GSP chapter development and/or implementation.

*Miscellaneous Meetings*

11/17/16 – Farm Bureau Workshop at Ag Pavilion
2/21/17 – SGMA workshop at Ag Pavilion
2/22/17 – GSA mapping at RRB
2/23/17 – SGMA w/ EKI
3/2/17 – SGMA w/ EKI & P&P at Village Grill
3/2/17 – Todd GW modeling at KCWA
3/13/17 – SGMA w/ EKI & P&P – TC
3/28/17 – SGMA w/ACSD
4/4/17 – GSP outline at RRB
4/4/17 – SGMA update w/ EKI
4/13/17 – AE 101 & SGMA update
4/18/17 – AE 101 & SGMA update at Ag Wise
4/20/17 – FKC subsidence update at Visalia
4/28/17 – SGMA update w/ EKI – TC
5/8/17 – Wegis/Sandridge SGMA Q’s
5/17/17 – SGMA HCM w/ EKI – TC
6/15/17 – FKC subsidence update at Visalia
6/28/17 – SGMA w/EKI at Starbucks
7/5/17 – EKI SGMA presentation review – TC
8/3/17 – SGMA workshop at Hodels
8/8/17 – SGMA ITRC data review w/EKI
8/9/17 – SGMA update w/ACSD at Young Woolridge
8/23/17 – SGMA workshop at Ag Pavilion
8/25/17 – AEWSD SGMA presentation w/Wheeler Ridge – TC
9/6/17 – SGMA meeting with City of Arvin & ACSD at AEWSD
9/14/17 – SGMA next steps w/EKI – TC
9/14/17 – Prop 1 SGMA coordination w/managers at KCWA
9/14/17 – Kern River GSA outreach at City Hall
9/18/17 – SGMA discussion w/EKI & Terry Erlinwine – TC
9/19/17 – SGMA issues at Black Bear
9/20/17 – SGMA GSP workshop at Clovis
10/4/17 – GSP workshop – Young allocation model at RRB
10/17/17 – RMC scope of work re SGMA modeling at RRB
10/19/17 – SGMA discussion w/EKI & Terry Erlinwine – TC
10/25/17 – SGMA discussion w/EKI & Terry Erlinwine at P&P
11/15/17 – Preliminary WQ results w/EKI – TC
12/13/17 – EKI WQ update – TC
1/24/18 – WQ w/EKI – TC
1/26/18 – SGMA issues w/EKI & YW at Young Woolridge
1/29/18 – SGMA issues w/EKI & YW at AEWSD
2/7/18 – SGMA coordination w/EKI at Kern Delta
2/27/18 – WQ w/EKI – TC
2/28/18 – mini tour w/DWR SGMA staff at AEWSD
3/2/18 – Tejon White Lands w/Martin at Bakersfield
3/21/18 – ACSD coordination at Harvest Steakhouse
4/5/18 – WQ update w/EKI – TC
4/17/18 – WQ w/EKI & YW – TC
4/24/18 – Surface water accounting w/GEI & EKI – TC
5/3/18 – KRWCA CVSALTS workshop at KCWA
5/7/18 – WQ w/EKI & YW – TC
5/9/18 – WQ w/SJRRP & EKI at Sacramento
5/14/18 – FWA Ad Hoc WQ w/EKI at Visalia
5/30/18 – WQ policy w/EKI – TC
6/6/18 – SGMA update w/EKI – TC
6/12/18 – SGMA questions w/New Current – TC
6/13/18 – Tejon Tribe development at Bakersfield
6/14/18 – SGMA water markets at RRB
6/21/18 – GSP coordination w/ACSD at YW
6/21/18 – SGMA questions w/Sun Pacific at Bakersfield
6/28/18 – EKI pump back webinar and follow up – TC
7/11/18 – Debrief w/EKI – TC
7/20/18 – GSP stakeholder w/EKI – TC
7/23/18 – Future Friant deliveries (SGMA) – TC
8/6/18 – Todd GW modeling at RRB
8/7/18 – Sustainable management criteria w/EKI – TC
8/10/18 – Overlap lands w/Wheeler Ridge at RRB
8/21/18 – Subsidence workshop at Lindsay
8/29/18 – SGMA undesirable results & min. thresholds w/EKI – TC
9/6/18 – SGMA w/ACSD at YW
9/19/18 – SGMA land use w/Kern County – TC
9/20/18 – SGMA w/DWR & SWRCB at Farm Bureau
9/26/18 – Landowner workshop prep w/EKI – TC
10/16/18 – AEWSD GSP coordination w/EKI – TC
10/18/18 – FKC pump back w/Stantec & EKI - TC
10/19/18 – FKC pump back w/Stantec & EKI - TC
10/24/18 – FKC pump back w/Stantec & EKI – TC
10/30/18 – ACSD MOU at YW
10/30/18 – Mettler County WD re SGMA at P&P
11/7/18 – EKI draft presentation – Webinar
11/13/18 – KRGSA outreach at Lamont
11/14/18 – Future Friant supplies & SGMA – Webinar
12/13/18 – CVSALTS workshop at Tulare Ag Center
12/18/18 – South Valley SGMA workshop at Tulare Ag Center
1/3/19 – KRWCA at KCWA
1/29/19 – GSP w/EKI – TC
2/14/19 – KRWCA at RRBWSD
2/14/19 – Water quality w/EKI – TC
3/5/19 - SGMA planning w/ Arvin CSD - Grapevine
3/7/19 - GSP Chapter w/ EKI - TC
3/14/19 - GSP Chapter w/ EKI - TC
3/21/19 - GSP Chapter w/ EKI - TC
3/28/19 - GSP Chapter w/ EKI - TC
4/8/19 - SGMA Projects and Management Actions - HQ
5/15/19 - Kern GSP w/ Oil Interest & DWR
4/4/19 - GSP Check-in Call
4/11/19 - GSP Check-in Call
4/18/19 - GSP Check-in Call
4/25/19 - GSP Check-in Call
5/2/19 - GSP Coordination Call
5/14/19 - SGMA Open House – Arvin Veteran’s Hall
5/23/19 - GSP Coordination Call
This list will be populated throughout GSP chapter development and/or implementation.

**KGA Miscellaneous Meetings**
4/1/16 – KGA whitepapers
4/4/16 – KGA whitepapers
11/1/16 – Workshop at KCWA
11/15/16 – Workshop at Ag Pavilion
11/28/16 – Workshop at Kern County
12/5/16 – Workshop at Ag Pavilion
12/20/16 – Workshop at Kern County
1/24/17 – Technical Session at KWB
5/2/17 – KGA update – TC
6/19/17 – KGA special meeting at Kern County
7/18/17 – KGA issues list
11/1/17 – KGA issues – TC
11/30/17 – KGA issues list #2 – TC
12/21/17 – KGA issues list – TC
1/15/18 – KGA special activities – TC
2/22/18 – KGA update Terry Erlinwine at P&P
3/14/18 – KGA data management system – TC
5/21/18 – KGA sustainable management criteria at RRB
5/21/18 – KGA public outreach at Arvin
6/19/18 – KGA managers meeting at RRB
7/24/18 – KGA managers meeting at RRB
7/27/18 – KGA managers meeting at RRB
8/3/18 – KGA managers meeting at RRB
8/10/18 – KGA managers meeting (undesirable results) at RRB
8/17/18 – KGA managers meeting (undesirable results) at RRB
8/21/18 – KGA managers meeting w/Kern County Health (well permits) at RRB
8/24/18 – KGA managers meeting (undesirable results) at RRB
9/13/18 – KGA managers meeting at RRB
9/20/18 – DWR & SWRCB s/KGA at RRB
9/28/18 – KGA managers meeting at RRB
10/12/18 – KGA managers meeting at RRB
10/26/18 – KGA managers meeting at RRB
11/2/18 – KGA managers meeting at RRB
11/9/18 – KGA managers meeting at RRB
11/16/18 – KGA managers meeting at Semitropic
12/7/18 – KGA managers meeting at KCWA
12/14/18 – KGA managers meeting – TC
12/21/18 – KGA managers meeting at KCWA
1/7/19 – KGA Stakeholder’s meeting at RRB
1/11/19 – KGA managers meeting at RRB
1/18/19 – KGA managers meeting at RRB
1/25/19 – KGA managers meeting – TC
2/1/19 – KGA managers meeting at RRB
2/8/19 – KGA managers meeting at RRB
2/15/19 – KGA managers meeting at RRB
2/22/19 – KGA managers meeting at RRB
2/1/19 – KGA managers meeting at RRB
2/8/19 – KGA managers meeting at RRB
2/25/19 – KGA review w/Patty Piore at P&P
3/1/19 - KGA Manager’s Meeting at RRBWSD
3/8/19 - KGA Manager’s Meeting at TC
3/15/19 - KGA Manager’s Meeting at RRBWSD
3/22/19 - KGA Manager’s Meeting at RRBWSD
3/29/19 - KGA Manager’s Meeting at RRBWSD
4/12/19 - KGA Manager’s Meeting at TC
4/19/19 - KGA Manager’s Meeting at RRBWSD
4/26/19 - KGA Manager’s Meeting at RRBWSD
5/3/19 - KGA Manager’s Meeting at RRBWSD
5/15/19 - KGA Manager’s Meeting w/ DWR at RRBWSD
5/24/19 - KGA Manager’s Meeting at RRBWSD
5/31/19 - KGA Manager’s Meeting at RRBWSD
6/7/19 - KGA Manager’s Meeting at RRBWSD
6/14/19 - KGA Manager’s Meeting at RRBWSD
6/21/19 - KGA Manager’s Meeting at RRBWSD
6/28/19 - KGA Manager’s Meeting at RRBWSD
7/5/10 – KGA Manager’s Meeting at RRBWSD
7/12/19 – KGA Manager’s Meeting at RRBWSD
This list will be populated throughout GSP chapter development and/or implementation.

**KGA Board Meetings**
3/21/16 at Kern County
8/24/16 at Kern County
9/25/16 at Kern County
11/14/16 at Kern County
12/19/16 at Kern County
1/25/17 at Kern County
2/22/17 at Kern County
3/22/17 at Kern County
4/26/17 at Kern County
7/19/17 at Kern County
8/23/17 at Kern County
10/25/17 at Kern County
11/16/17 at Kern County
12/20/17 at Kern County
1/28/18 at Kern County
3/28/18 at Kern County
4/25/18 at Kern County
5/23/18 at Kern County
6/27/18 at Kern County
7/25/18 at Kern County
8/22/18 at Kern County
9/26/18 at Kern County
10/24/18 at Kern County
2/27/19 at Bakersfield Chamber
3/27/19 at Bakersfield Chamber
4/24/19 at Kern County
5/22/19 at Chamber
6/26/19 at Kern County
This list will be populated throughout GSP chapter development and/or implementation.

KGA Coordination Committee Meetings
3/7/16 at GEI
4/4/16 at GEI
9/12/16 at RRB
10/3/16 at RRB
11/7/16 at RRB w/Todd GW model
12/5/16 at RRB
2/6/17 at RRB
3/6/17 at RRB
4/3/17 at RRB
5/1/17 at RRB
6/5/17 at RRB
8/7/17 at RRB
9/11/17 at RRB – EKI to present ITRC & HCM
10/2/17 at RRB
11/28/17 – w/managers at Anaheim
12/11/17 at RRB
1/8/18 at RRB
2/5/18 at RRB
3/5/18 at RRB
4/2/18 at RRB
5/7/18 at RRB
6/4/18 at RRB
7/2/18 at RRB
10/1/18 at RRB
6/3/19 at RRB
This list will be populated throughout GSP chapter development and/or implementation.

*Kern Delta Meetings*
3/7/16 at Molly J
11/7/16 at Molly J
8/3/17 – KD programs – TC
8/22/17 at Molly J
10/24/17 at Molly J
11/15/17 – KD AE EA at KDWD
1/23/18 at Molly J
4/5/18 at Molly J
5/17/18 – AE & KD w/USBR on EA at Fresno
5/22/18 – WMP at Molly J
7/11/18 – AE/KD joint GW contours - TC
1/22/19 at Molly J
2/26/19 at Molly J
3/26/19 at Molly J
4/23/19 at Molly J
5/28/19 at Molly J
6/25/19 at Molly J
This list will be populated throughout GSP chapter development and/or implementation.

*Stakeholder Workshops*
- AEWSD SGMA Landowner Workshop #1 – 11/17/2016
- SGMA Landowner Workshop #2 – 12/8/16
- AEWSD SGMA Landowner Workshop #3 – 10/02/18
- AEWSD SGMA Landowner Workshop #4 – 5/30/19
This list will be populated throughout GSP chapter development and/or implementation.

Recycled Water Programs
10/5/16 – Recycled water w/ RMC
11/16/16 – TC
12/12/16 – Bakersfield City Hall
5/5/17 – City of Arvin recycled water – TC
6/1/17 – City of Arvin recycled water – TC
6/7/17 – City of Arvin recycled water - TC
This list will be populated throughout GSP chapter development and/or implementation.

Inter/Intra-basin Meetings
10/28/16 – White Wolf at Tejon
11/21/16 – White Wolf – TC
12/6/16 – White Wolf GSA MOU – TC
1/16/17 – White Wolf – TC
1/23/17 – White Wolf – TC
1/25/17 – White Wolf Public Hearing at Iron Skillet
4/3/17 – White Wolf GSA – TC
6/27/17 – White Wolf Basin coordination – TC
6/28/17 – CASGEM w/White Wolf Basin – TC
8/8/17 – White Wolf GSA draft agenda – TC
8/22/17 – White Wolf GSA at Iron Skillet
9/19/17 – White Wolf GSA at Iron Skillet
10/25/17 – White Wolf Prop 1 – TC
2/12/17 – White Wolf GSA technical meeting – TC
3/20/18 – White Wolf GSA board meeting at Iron Skillet
4/11/18 – White Wolf GSA special board meeting at Iron Skillet
6/5/18 – White Wolf Basin board meeting at Iron Skillet
7/2/18 – White Wolf technical committee at Wheeler Ridge
8/15/18 – Tule Sub basin coordination at Pixley
9/4/18 – White Wolf GSA at Iron Skillet
9/12/18 – Southern Kern Sub basin coordination at AEWSD
9/28/18 – Tule GSA coordination at Semitropic
10/11/18 – White Wolf technical committee – TC
11/15/18 - South basin coordination - TC
1/16/19 – Tule Basin TAC at Pixley
3/5/19 - WWB update
3/5/19 - WWB BOD
3/6/19 - SGMA planning w/ Semitropic – 24th street
6/4/19 - White Wolf Basin BOD at Wheeler Ridge Maricopa
This list will be populated throughout GSP chapter development and/or implementation.

**Direct Outreach**

- KGA stakeholder survey distribution and respondence (May 2018 - July 2018)
- KGA agricultural stakeholder survey distribution and respondence (December 2018 – January 2019)
- Public water system data request (October 2018-January 2019)

The list above will be updated throughout GSP chapter development and/or implementation.
Arvin Water Resources
Public Workshop

Wednesday September 26
6:00 PM @ Arvin City Council Chambers
200 Campus Drive

Vision Statement:

“Arvin is safe, healthy, vibrant and economically diverse with a sense of community and where quality of life is valued”

- Come **learn** about Australia’s 12 year drought and lessons learned that can be applied to Arvin
- **Hear** about the 5 Golden Goals that will help Arvin realize its Vision
- **Participate** in an interactive exercise to help choose options that will achieve Arvin’s Vision and Mission Statements
- **Discuss** which options will best achieve the Mission Statement

Mission Statement:

“Our mission is to provide responsive, quality service to our community—environmentally sound—innovative solutions—in an economically sustainable manner.”
Taller Público de Recursos Hídricos de Arvin

Miércoles 26 de septiembre

6:00 PM en la Cámara del Concejo Municipal – 200 Campus Drive

Declaración de vision:

“Arvin es seguro, sano, vibrante y económicamente diverso con un sentido de comunidad y donde la calidad de vida es valorada”

Venga a conocer la sequía de 12 años de Australia y las lecciones aprendidas que se pueden aplicar a Arvin

Participe en un ejercicio interactivo para ayudar a elegir opciones que logren la visión de Arvin y las declaraciones de la mission

Conversar sobre qué opciones mejor lograrán la declaración de la misión

Misión:

“Nuestra misión es brindar un servicio receptivo y de calidad a nuestra comunidad - ambiente sano - soluciones innovadoras - de una manera económicamente sostenible”
October 29, 2018

Owner/Manager
Company
Address
Arvin, CA 93203

Re: Groundwater Sustainability Plan (GSP) Development

To Whom It May Concern:

To demonstrate sustainability by January 31, 2040, and maintain sustainability through the Sustainable Groundwater Management Act (SGMA)’s 50-year planning timeline, the District aims to engage in stakeholder interests and concerns. The District will also provide beneficial groundwater users an opportunity to engage in the GSP process as well as provide educational outreach opportunities, of which includes Public Water Systems (PWS).

Given the California Water Code 116275(h), “a public water system means a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year.”

Your water system has been identified to be a PWS within District boundaries. Therefore, the District seeks to solicit your input during the development and implementation of the GSP. Please complete the attached stakeholder survey and return to the District. You are encouraged to identify key concerns that pertain to PWS and groundwater in general. (The survey can also be found on the Kern Groundwater Authority website: http://www.kerngwa.com/index.html). A District map and PWS Classification fact sheet are attached for your reference.

We appreciate your cooperation in this matter. If you have any questions or require further information, please contact Micah Clark at mclark@aewsd.org or by phone at (661) 854-5573.

Sincerely,

Jeevan Muhar
Engineer-Manager

Enclosure(s)

cc: Anona Dutton, EKI
    Patty Piore, Kern Groundwater Authority

D:\Micah\Documents\EKI\SCEP\PWS Letters
DEcision tree for classification of water systems

Does the system serve 25 people per day at least 60 days per year?

Yes

Water system is a public water system

Yes

Does the system serve 25 or more yearlong residents?

Yes

Classified as a community WS (CWS)

No

Are there 15 or more service connections used by yearlong residents?

Yes

Classified as a community WS (CWS)

No

Water system is a public water system

Yes

Are there 15 or more service connections?

Yes

Are there 15 or more service connections used by yearlong residents?

Yes

Classified as a community WS (CWS)

No

Classified as a transient noncommunity WS (TNCWS)

No

Classified as a state small WS

No

Unregulated

No

Are there 5 or more service connections?

Yes

Classified as a state small WS

No

Unregulated

No

Are there 15 or more service connections?

No

Classified as a transient noncommunity WS (TNCWS)

Yes

Are there 15 or more service connections used by yearlong residents?

Yes

Classified as a community WS (CWS)

No

Classified as a transient noncommunity WS (TNCWS)

Yes

Are the system serve 25 or more of the same people at least 6 months of the year?

Yes

Classified as a nontransient noncommunity WS (NTNCWS)

No

Classified as a transient noncommunity WS (TNCWS)

“Public water system” means a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year.

Public water systems with 200 or less service connections may be regulated by a local primacy agency (county).

State small water systems are not public water systems (Refer to CCR Sections 64211-64217).

Yearlong resident ≥ 183 days/year.
California Health and Safety Code §116275

(e) “Human consumption” means the use of water for drinking, bathing or showering, hand washing, oral hygiene, or cooking, including, but not limited to, preparing food and washing dishes.

(h) “Public water system” means a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A public water system includes the following:

(1) Any collection, treatment, storage, and distribution facilities under control of the operator of the system that are used primarily in connection with the system.

(2) Any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system.

(3) Any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption.

(i) “Community water system” means a public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents of the area served by the system.

(j) “Noncommunity water system” means a public water system that is not a community water system.

(k) “Nontransient noncommunity water system” means a public water system that is not a community water system and that regularly serves at least 25 of the same persons over six months per year.

(n) “State small water system” means a system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year.

(o) “Transient noncommunity water system” means a noncommunity water system that does not regularly serve at least 25 of the same persons over six months per year.

(s) “Service connection” means the point of connection between the customer’s piping or constructed conveyance, and the water system’s meter, service pipe, or constructed conveyance.

http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=116275
January 21, 2019

Owner/Manager
Company
Address
Arvin, CA 93203

Re:  Groundwater Sustainability Plan (GSP) Development

To Whom It May Concern:

We have yet to hear from you regarding our last letter dated October 29, 2018 to better clarify our needs of incorporating Public Water Systems (PWS) within the District’s GSP. We are requesting the following well supply and/or monitoring well data preferably from 2006 to present:

- Well construction logs, geologic logs, and/or geophysical logs
- Groundwater level data (depth to water and/or elevation)
- Monthly pumping rates and units of measure (gpm or cfs)
- Groundwater quality data
- Aquifer pumping test data and analyses/reports
- Exact well locations as GPS coordinates or detailed maps
- Well construction information, such as:
  - date of installation
  - primary well use (agricultural, domestic, industrial, monitoring, etc.)
  - total well depth
  - screened intervals
  - casing diameter and material
  - pump intake depth, discharge pipe diameter
  - pump plate info (horsepower)
  - measuring point elevation
  - instrumentation (e.g., pressure transducer, flowmeter, airline with gauge)

It is imperative that we obtain this data as it will focus the development of AEWSD’s GSP on locally-defined, quantitative criteria, including undesirable results, minimum thresholds, and measurable objectives. In order to plan for these undesirable results, minimum thresholds, and measurable objectives that may occur, having your well supply and monitoring well data in advance will help ensure that sustainable management criteria will accurately reflect historical groundwater conditions in your service area.

We will assume that a non-response means you do not have any information and that you agree with our current SGMA planning and implementation activities. Again, we appreciate your cooperation in this matter. If you have any questions or require further information, please contact Micah Clark at mclark@aewsd.org or by phone at (661) 854-5573.

Sincerely,

Jeevan Muhar
Engineer-Manager

cc: Anona Dutton, EKI
    Patty Poire, Kern Groundwater Authority

Micah/Documents/EKI/SCEP/Water/Landowner Letters/Well Data Letter
May 31, 2019

Landowner

Re: Sustainable Groundwater Management Act Compliance and Coverage

Dear Landowner,

The Sustainable Groundwater Management Act (SGMA) went into effect on January 1, 2015 and requires the formation of Groundwater Sustainability Agencies (GSA) to sustainably manage all groundwater basins in California including the Kern Sub-Basin. SGMA authorizes public agencies with land use or water management authority to become a GSA and manage groundwater. If no agency or group of agencies elects to be a GSA for the entire basin, SGMA designates the county as the default GSA to manage groundwater sustainably for the unmanaged lands in the basin. If the county declines to act as the GSA, SGMA requires the unmanaged lands report groundwater pumping directly to the State Water Resources Control Board and pay applicable fees.

The Kern Groundwater Authority (KGA) was formed on April 26, 2017 by several public agencies, which included the County of Kern, through a joint power agreement (JPA). Pursuant to the JPA and SGMA requirements, each member district of the KGA is responsible for the management of the groundwater within its respective jurisdiction and the County was responsible for managing groundwater in the areas not otherwise included in the jurisdiction of a member district (“undistricted lands”).

On December 11, 2018, Kern County Board of Supervisors voted to withdraw from the KGA and stated that it would no longer manage groundwater in the undistricted lands of the Kern Sub-Basin. The County sent a notice of withdrawal to the KGA dated December 12, 2018. However, the County did not provide written notice to the affected landowners regarding its withdrawal from the KGA or of its decision to not provide SGMA coverage to those landowners not within the jurisdiction of a member district.

In response to the County’s withdrawal, the KGA and its members have been working diligently to provide a means for those undistricted lands to have SGMA coverage. Accordingly, the KGA and its member districts are allowing landowners in these areas the opportunity to sign up to be managed by neighboring KGA member districts. Landowners who do not sign up with KGA member districts will be removed from the KGA GSA boundary and will be designated as unmanaged by the State Water Board.

You are receiving this letter because your property, or a portion thereof, has been identified as unmanaged land due to the County’s action to withdraw from the KGA and by its decision to no longer provide SGMA management. This letter provides you notice that the opportunity to obtain coverage through the KGA will be closed on July 1, 2019. If you would like to avoid being designated as unmanaged by the State Water Board (see attachment 1 [State Water Board unmanaged notice]), please contact the KGA member closest to your property (see attachment 2 [Kern Basin Map]) and execute the necessary management documents by July 1, 2019. If you have questions regarding this notice, please contact Patty Poire at 661-479-7171.

Respectfully,
Kern Groundwater Authority

1800 30th Street, Suite 280, Bakersfield, CA 93301 • Tel: (661) 616-5900 • Fax: (661) 316-5890 • www.kernqwa.com
NOTICE OF GROUNDWATER EXTRACTION REPORTING UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT (SGMA).

This letter requires your immediate attention. This letter provides notice that you may be required to file one or more groundwater extraction reports with the State Water Resources Control Board (Board) pursuant to the Sustainable Groundwater Management Act (SGMA). Failure to file a required report may result in penalties of up to $500 per day.

Para obtener más información en español (formularios u otra información), nos puede llamar al (916) 322-6508 o enviar un mensaje a: groundwater_management@waterboards.ca.gov.

Why you are receiving this notice

This Notice is being sent to persons who may own property or operate a public water supply system in an unmanaged area where groundwater was extracted on or after DATE through DATE. An unmanaged area is an area within a high- or medium-priority groundwater basin that is outside the jurisdiction of any groundwater sustainability agency (GSA) and not subject to an alternative or other exemption from SGMA requirements.

Data indicate that you own or are responsible for the parcel(s) or public water supply system(s) listed at the end of this notice. The Board has identified this parcel(s) or water supply system(s) as located within an unmanaged area. If you extract groundwater from an unmanaged area and you are not a small domestic user, SGMA requires that you file an annual groundwater extraction report for extractions made during the previous water year.
If you have questions regarding this notice or need assistance completing the online groundwater extraction report, please contact Board staff by email at groundwater_management@waterboards.ca.gov or by phone at 916-322-6508.

Enclosures: Groundwater Extraction Report Quick Guide

The following Assessor's Parcel Numbers (APN) prompted this letter:

- APN_1
- APN_2
- APN_3
- APN_4
- APN_4
- APN_5
- APN_6
- APN_7
- APN_8
- APN_9
- APN_10
- APN_11
- APN_12
- APN_13
- APN_14
- APN_15
- APN_16
- APN_17
- APN_18
- APN_19
- APN_20
June 18, 2019

RE: SUSTAINABLE GROUNDWATER MANAGEMENT ACT UPDATE

Dear Landowner or Water User:

The Sustainable Groundwater Management Act (SGMA) is upon us. The saving grace with SGMA is that local agencies are provided an opportunity to develop the rules under which we must operate and define what would constitute "significant and unreasonable" groundwater conditions locally as well as basin-wide. SGMA essentially requires agencies to balance water supplies and water demands while ultimately maintaining sustainable groundwater conditions by 2040 and beyond.

Arvin-Edison Water Storage District's (AE) initial SGMA Groundwater Sustainability Plan (GSP) Chapter for its service area, which is being developed in conjunction with the Kern Groundwater Authority Groundwater Sustainability Agency, will prioritize the construction of new Projects and investigate new water management Programs before implementing groundwater Management Actions.

Projects/Programs in AE's GSP Chapter are focused on fully utilizing AE's federal water supplies both within and outside of AE. The Projects/Programs currently include, but are not limited to, (1) development of additional recharge sites (i.e., increases supply but also decreases demand); and (2) expansion of in-lieu deliveries (i.e., reducing groundwater extractions during wet periods by providing surface water deliveries). In fact, in partnership with Kern Delta Water District, AE recently purchased 150 acres that was historically a vineyard property and the districts are planning to jointly develop the property into recharge basins. The property is located near the adjoining district boundaries where groundwater levels have consistently declined over time.

Management Actions will be part of the AE GSP Chapter that will provide for the flexibility and future ability for AE to reduce demand and potentially place restrictions on overall water use (i.e., an allocation system for both groundwater and surface water users). That being said, there remains significant data gaps across the basin and a multitude of questions about any GSP-mandated reductions in light of current and future uncertainties (i.e., climate change, hydrologic time periods used for evaluation purposes, lack of basin-wide modeling calibration/validation, etc.).

Accordingly, AE is prioritizing the development of Projects/Programs over Management Actions in its GSP Chapter until questions/uncertainties are better understood, while also evaluating potential Project/Program costs and benefits.

Following are answers to frequently asked questions:

How will the state confirm SGMA compliance?

SGMA requires evaluation of six (6) sustainability indicators: “significant and unreasonable” lowering of water levels, reduction of groundwater storage, land subsidence, water quality degradation, surface water depletion and seawater intrusion.

For the AE GSP Chapter, the ultimate test will be the achievement of sustainable groundwater levels, which are also a proxy for groundwater storage and subsidence (surface water depletion and sea water intrusion are not of concern in our area). The sixth test, water quality, is still under evaluation but currently is not considered to be a controlling criterion. AE has established an initial monitoring network of fifteen (15) well sites that will track representative water levels relative to established measurable objectives (a target goal)
and minimum thresholds (below which an undesirable result could occur). AE’s monitoring network will be the first test for SGMA compliance (i.e., 40% of the wells are not to exceed the minimum threshold). If minimum thresholds are exceeded, AE must implement action(s) to remedy the situation.

A second and concurrent test will be based on a Kern County basin-wide condition (30% of the basin area or 3 adjacent management areas can’t exceed minimum thresholds). If the basin fails this test, the state would designate the basin as probationary and state intervention could likely occur including taking local control of the basin. The basin does have the ability to perform adaptive management and justify changing its sustainability goals on five (5) year increments.

Who is responsible for SGMA?

Currently, AE is assuming responsibility for compliance with all SGMA-related regulations and associated management thereof including aggregation of necessary data within its service area (i.e., supply/demand info, data collection, advocacy, stakeholder outreach, etc.). It is noted that there are currently NO individual Landowner/Water User requirements or reporting necessary, except continuation of paying the normal assessment charges, cooperation with property access, and responses to any specific requests to support filling data gaps, as appropriate. However, additional Landowner/Water User reporting and information may be necessary in the future as we continue navigating this new regulation. Furthermore, SGMA costs to date (over $2.6 million since 2014), are being absorbed and allocated within AE’s general rate setting process; in the near future additional Proposition 218 elections may be necessary to increase assessments and thus continue this practice.

AE is engaged in basin-wide coordination efforts including specifically with agencies south of Kern River. AE has hosted multiple stakeholder workshops and presented SGMA updates on a monthly basis. Individual landowner engagement is highly recommended, and we value your feedback and constructive criticism. A draft GSP for public review followed by a public hearing is forthcoming in Summer/Fall 2019. The final GSP must be submitted to the state, in coordination with all other GSPs in the basin, by January 31, 2020!

You will continue to be informed of AE’s efforts to comply with the SGMA regulations. In the interim, local agencies are now informed if new well permit applications are requested within the basin and therefore provides agencies an opportunity to comment on the permit application. In order to preserve AE’s SGMA compliance efforts, for example with respect to achieving measurable objectives and minimum thresholds, future well permit applicants may receive a letter from AE with specific comments on assumptions being made and additional information related to potential SGMA-related issues. Please note that this comment letter does NOT imply a moratorium on drilling wells. The comment letter will merely act to protect AE and its Landowners/Water Users, while also reminding the well applicant of the new SGMA world and the potential actions that could be necessary in the future to achieve sustainability. A template copy of such letter is attached for reference.

Thank you, and please call with questions, comments, or concerns.

Sincerely,

Edwin Camp  
Board President

cc:  Board of Directors  
Scott Kuney, Young Wooldridge  
Anona Dutton, EKI  
All Employees

JSM:sj\AEWSD\Landowner\Corresp\SGMA\SGMA GSP.letter.06.19.dotx
June 18, 2019

Amy Rutledge
County of Kern, Department of Public Health Services
Environmental Health Division
2700 M Street Suite 300
Bakersfield, CA 93301

Subject: Comments on Water Well Permit Application No. XXXX

Dear Ms. Rutledge:

Per the Overdrafted Basin Supplemental Well Application Process, the Kern Groundwater Authority (KGA) has provided to Arvin-Edison Water Storage District (AEWSD) for review a copy of the well application materials for Permit/Well Number XXXX that were submitted by APPLICANT to the County of Kern Department of Public Health Services on DATE.

Based on AEWSD’s review of said materials, we understand the following to be true:

Proposed Well Location:
- Township/Range/Section: TXXS/RXXE/SXX
- Assessor's Parcel Number: XXX-XX-XX
- Latitude/Longitude: X deg N, X deg W
- Description: "INSERT"

Proposed Well Design/Construction:
- Total Depth (ft): 1,000
- Screen/Perforation Depth (ft): 500 to 1,000
- Seal Depth (ft): "as directed"
- Casing Diameter, nominal (in): 16

Proposed Well Use:
- Intended Use: Agricultural (irrigation) or industrial
- Area to be Served by Well (acres): 375
- Well Capacity (gpm): 2,200
- Estimated Pumping Rate (gpd): 22,000
- Proposed Pumping Schedule: 5 days per week
- Estimated Annual Extraction Volume (AF): 32.42

Abbreviations:
- deg = degrees, ft = feet, in = inches, gpm = gallons per minute, gpd = gallons per day, AF = acre-feet
Based on the above information, AEWSD has the following specific comments related to this Water Well Permit Application No. XXXXX:

1. The Estimated Annual Extraction Volume (32.42 AF) is inconsistent with the estimated pumping rate (22,000 gpd) and proposed pumping schedule (5 days per week).
2. The Area to be Served by Well (375 acres) appears inconsistent with the Estimated Annual Extraction Volume (32.42 AF), given typical crop water requirements, so we assume the well will be for Industrial use.

In addition, AEWSD has the following general comment related to implementation of the Sustainable Groundwater Management Act (SGMA) within AEWSD: SGMA requires, among other things, the formation of Groundwater Sustainability Agencies (GSAs), the development of Groundwater Sustainability Plans (GSPs), and the establishment and achievement of Sustainability Goals by the 31 January 2040 SGMA implementation deadline. As a member of the KGA GSA, which is preparing a GSP for an area within Kern County that includes AEWSD service area (with the exception of the portion underlying the East Niles Community Services District and the White Wolf sub-basin), AEWSD has the authority to implement Projects and Management Actions identified within the GSP in order to achieve the Sustainability Goals defined therein. While the exact nature of the Projects and Management Actions that the KGA and AEWSD may choose to implement in the AEWSD service area is not known at this time, these actions may include, but are not limited to, the following:

- Registration of water wells (California Water Code [CWC] Sec. 10725.6)
- Requiring water meters on wells (CWC Sec. 10725.8(a))
- Requiring individual well owners to file annual statements of groundwater extraction (CWC Sec. 10725.8(c))
- Acquisition of lands, easements, additional water supplies (CWC Sec. 10726.2(a), 10730.2), and water rights (Section 10726.2(b))
- Programs for voluntary fallowing of agricultural lands (CWC Sec. 10726.2(c))
- Well spacing requirements (CWC Sec. 10726.4(a)(1))
- Regulating, limiting, or suspending groundwater extractions, and establishment of groundwater extraction allocations, consistent with a city or county general plan (CWC Sec. 10726.4(a)(2))
- Transfers of groundwater allocations (CWC Sec. 10726.4(a)(3))
- Fees on groundwater extraction (CWC Sec. 10730 through 10730.6)

We hope that this information will help you understand the challenges we will face going forward and the tools that may be applied to achieve the long-term health and sustainability of our shared groundwater basin.

Please let us know if you have any questions regarding these comments.

Sincerely,

Management

cc: Landowner
### SGMA LANDOWNER WORKSHOP ATTENDANCE (98 to date)

<table>
<thead>
<tr>
<th>32 on 11-17-16 @ 10:30</th>
<th>15 on 11-17-16 @ 3:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charles Fanucchi</td>
<td>Dennis Frick</td>
</tr>
<tr>
<td>John Moore Jr.</td>
<td>Grant Frick</td>
</tr>
<tr>
<td>Ariadne Cimental</td>
<td>Ismael Alvarez</td>
</tr>
<tr>
<td>Natalie Sorhout</td>
<td>Kent Stenderup</td>
</tr>
<tr>
<td>Tom Bracken</td>
<td>Andy Stenderup</td>
</tr>
<tr>
<td>Lawrence Haycock</td>
<td>Verner</td>
</tr>
<tr>
<td>Bruce Frost</td>
<td>B.J. Eucce</td>
</tr>
<tr>
<td>John Kovacevich</td>
<td>Blake Campbell</td>
</tr>
<tr>
<td>Joe Fanucchi</td>
<td>John Dennison</td>
</tr>
<tr>
<td>Mark Fanucchi</td>
<td>Mary Dennison</td>
</tr>
<tr>
<td>Wayde Kirshenman</td>
<td>Fred Johnston</td>
</tr>
<tr>
<td>Wayne Kirschenman</td>
<td>Lefty Delis</td>
</tr>
<tr>
<td>Jeff Rasmussen</td>
<td>Joe Giumarra</td>
</tr>
<tr>
<td>Matt Surber</td>
<td>Patty Poire</td>
</tr>
<tr>
<td>Raul Garcia</td>
<td>Kyle Richard</td>
</tr>
<tr>
<td>Doug Gosling</td>
<td>Lynn Kritsch</td>
</tr>
<tr>
<td><strong>20 on 11-17-16 @ 1:30</strong></td>
<td><strong>Future Dates - 7</strong></td>
</tr>
<tr>
<td>Tito Martinez</td>
<td>Leonard Bidart</td>
</tr>
<tr>
<td>Matt Pandol Jr.</td>
<td>Wyatt Shipley</td>
</tr>
<tr>
<td>Kyle Moeller</td>
<td>Chuck Kirschenmann</td>
</tr>
<tr>
<td>Robert Bender</td>
<td>Donald Urfrig</td>
</tr>
<tr>
<td>Jimmy Barlett</td>
<td>David Blaskley</td>
</tr>
<tr>
<td>Tom Fry</td>
<td>Kyle Richardson</td>
</tr>
<tr>
<td>Jed Kern</td>
<td>Ned Harris</td>
</tr>
<tr>
<td>Mario Vasquez</td>
<td>Micah Clark</td>
</tr>
<tr>
<td>Steve Murray</td>
<td>Fernando Ceja</td>
</tr>
<tr>
<td>Ryon Ottoman</td>
<td>Mark Dawson</td>
</tr>
</tbody>
</table>

**Board Member**

- Kent Stephens
- Vince Mazzetti
- Ryan Niese
- Paramjit Dosanjh
### ARVIN-EDISON WATER STORAGE DISTRICT
### INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
### GUEST LIST
### Tuesday, October 02, 2018 @ 8:00 A.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Kovacevich</td>
<td>EL Amigo (Anthony Vineyard)</td>
<td><a href="mailto:Kovacevich@anthonyvinyard.com">Kovacevich@anthonyvinyard.com</a></td>
</tr>
<tr>
<td>Millie Kovacevich</td>
<td></td>
<td>cell 854-5573</td>
</tr>
<tr>
<td>Ron Lehr Jr</td>
<td>Lehr Brothers Inc.</td>
<td>cell 661-366-3244</td>
</tr>
<tr>
<td>Jess Ortiz</td>
<td>City of Arvin</td>
<td>661-854-2367</td>
</tr>
<tr>
<td>Dan Ela</td>
<td>Garrett Lakes Owners Assoc.</td>
<td>661-364-7119, <a href="mailto:zdela@icloud.com">zdela@icloud.com</a></td>
</tr>
<tr>
<td>Tim Coblen</td>
<td>WUNDERFUL</td>
<td>661-381-0775</td>
</tr>
<tr>
<td>Paramjit S. Dasan</td>
<td>Dosarigl Blues</td>
<td>661-333-2065</td>
</tr>
<tr>
<td>Cecilia Aguilar</td>
<td>RESIDENT</td>
<td>914/883-9018</td>
</tr>
<tr>
<td>Dale Jasper</td>
<td>DJA / ACSD</td>
<td>djasper@jacivil-in</td>
</tr>
<tr>
<td>Patty TOLE</td>
<td>KGA</td>
<td><a href="mailto:ptole@kernsga.com">ptole@kernsga.com</a></td>
</tr>
</tbody>
</table>
ARVIN-EDISON WATER STORAGE DISTRICT
INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
GUEST LIST
Tuesday, October 02, 2018 @ 8:00 A.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve Rodrigues</td>
<td>Bjo Seed Co.</td>
<td><a href="mailto:srodrigues@bjoind.com">srodrigues@bjoind.com</a></td>
</tr>
<tr>
<td>Catalino Martinez</td>
<td>Valprado ETAL</td>
<td></td>
</tr>
<tr>
<td>Matt Surace</td>
<td>Caciente Farms</td>
<td></td>
</tr>
<tr>
<td>Ron Lehr</td>
<td>Lehr Bros</td>
<td>661-619-6064 <a href="mailto:mrsurace@mcmoran.com">mrsurace@mcmoran.com</a></td>
</tr>
<tr>
<td>Anora Dutton</td>
<td>E&amp;I</td>
<td></td>
</tr>
<tr>
<td>Ernest Conant</td>
<td>Young Woolridge</td>
<td></td>
</tr>
<tr>
<td>Dave Nixon</td>
<td>E&amp;I</td>
<td></td>
</tr>
<tr>
<td>Jeevan Mahar</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>Micah Clark</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>Steve Collum</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>PRINT NAME</td>
<td>COMPANY/ENTITY</td>
<td>TELEPHONE AND/OR EMAIL</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Rebeca Urzua</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olivia Trujillo</td>
<td></td>
<td>557-5846</td>
</tr>
<tr>
<td>Salvador Melendez</td>
<td></td>
<td>557-4348</td>
</tr>
<tr>
<td>Raul Baraza</td>
<td>AWD</td>
<td></td>
</tr>
<tr>
<td>Maria Carreño</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caterina Gomez</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maria</td>
<td>SHE</td>
<td></td>
</tr>
</tbody>
</table>

ARVIN-EDISON WATER STORAGE DISTRICT
INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
GUEST LIST
Tuesday, October 02, 2018 @ 8:00 A.M. - 9:30 A.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theresa Bernard</td>
<td></td>
<td>(661) 489-9388</td>
</tr>
<tr>
<td>Maria Benmosco</td>
<td></td>
<td>(661) 489-9382</td>
</tr>
<tr>
<td>Katelyn Michele Kana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRINT NAME</td>
<td>COMPANY/ENTITY</td>
<td>TELEPHONE AND/OR EMAIL</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Brian Palla</td>
<td>Palla Ag Services</td>
<td><a href="mailto:Brian@PallaAg.com">Brian@PallaAg.com</a></td>
</tr>
<tr>
<td>Jeevan Mihar</td>
<td>AEWSD</td>
<td></td>
</tr>
<tr>
<td>Anona Dutton</td>
<td>EKI</td>
<td></td>
</tr>
<tr>
<td>Rafel Barraza</td>
<td>AGSD</td>
<td></td>
</tr>
<tr>
<td>Jeff Giurina</td>
<td>Gimnara Farms</td>
<td></td>
</tr>
<tr>
<td>Translator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+1 (unknown)</td>
<td>&quot;Walkin&quot;</td>
<td></td>
</tr>
<tr>
<td>Dennis Fox</td>
<td>SWCS 661 366 4093</td>
<td>918 Blassem 8306-</td>
</tr>
<tr>
<td>+1 (unknown)</td>
<td>&quot;Walkin&quot;</td>
<td></td>
</tr>
</tbody>
</table>
## ARVIN-EDISON WATER STORAGE DISTRICT
### INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
### GUEST LIST
**Tuesday, October 02, 2018 @ 1:00 P.M.**

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe Bresson</td>
<td>Hronis, Inc</td>
<td>(661) 378-0830 / <a href="mailto:jbronn@hronis.net">jbronn@hronis.net</a></td>
</tr>
<tr>
<td>James Guzman</td>
<td>Resident</td>
<td>(661) 484-0249</td>
</tr>
<tr>
<td>Elvira T concerted</td>
<td>Resident</td>
<td>(661) 854-9434</td>
</tr>
<tr>
<td>Brad De Brancha</td>
<td>Bolthouse</td>
<td><a href="mailto:debranch@bolthouse.com">debranch@bolthouse.com</a></td>
</tr>
<tr>
<td>Julie Finzel</td>
<td>UC Cooperative Extension</td>
<td>(661) 868-6219</td>
</tr>
<tr>
<td>Perry Finze</td>
<td>CA-21 Congresswoman</td>
<td>(661) 476-5575</td>
</tr>
<tr>
<td>Daniel Elliott</td>
<td>TASTEFUL SELECTIONS</td>
<td>(661) 301-1910</td>
</tr>
<tr>
<td>Ruth Harris</td>
<td>Resident</td>
<td>8521-5136</td>
</tr>
<tr>
<td>Maria Herrera</td>
<td>SHE</td>
<td></td>
</tr>
<tr>
<td>Micah Clark</td>
<td>AED</td>
<td></td>
</tr>
<tr>
<td>PRINT NAME</td>
<td>COMPANY/ENTITY</td>
<td>TELEPHONE AND/OR EMAIL</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Kyle Moelle</td>
<td>Fowler Packing</td>
<td><a href="mailto:kyle@fowlepacking.com">kyle@fowlepacking.com</a></td>
</tr>
<tr>
<td>Jack Breech</td>
<td>Kirschenman Ent., Inc.</td>
<td><a href="mailto:jbrech@keiproduce.com">jbrech@keiproduce.com</a></td>
</tr>
<tr>
<td>John Moore</td>
<td><a href="mailto:smear@moorefarmson.com">smear@moorefarmson.com</a></td>
<td></td>
</tr>
<tr>
<td>Fernando Cuja</td>
<td>AEWSP</td>
<td></td>
</tr>
<tr>
<td>Kent Standley</td>
<td>Standers Ag Partners</td>
<td><a href="mailto:standersag@gmail.com">standersag@gmail.com</a></td>
</tr>
<tr>
<td>Wayde Kirschen</td>
<td>Kirschenman Ent., Inc.</td>
<td><a href="mailto:wkirschenman@keiproduce.com">wkirschenman@keiproduce.com</a></td>
</tr>
<tr>
<td>Craig Underwood</td>
<td>Underwood Ranches</td>
<td><a href="mailto:craig@underwoodranches.com">craig@underwoodranches.com</a></td>
</tr>
<tr>
<td>Scott Gurnett</td>
<td>Gurnett Lakes HBA</td>
<td>661-556-3048</td>
</tr>
<tr>
<td>Matt Pandol Jr</td>
<td>Pandol &amp; Sons</td>
<td><a href="mailto:matt@pandol.com">matt@pandol.com</a></td>
</tr>
<tr>
<td>Joy Kennedy</td>
<td>self</td>
<td><a href="mailto:joy.kennedy4@gmail.com">joy.kennedy4@gmail.com</a></td>
</tr>
<tr>
<td>PRINT NAME</td>
<td>COMPANY/ENTITY</td>
<td>TELEPHONE AND/OR EMAIL</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>ALEJANDRO VILLANUEVA</td>
<td>Comunidad de Arvin</td>
<td>(661) 376-2077</td>
</tr>
<tr>
<td>C. Fanucchi</td>
<td>Jie Fanucchi</td>
<td>838 2264</td>
</tr>
<tr>
<td>Dean Christian</td>
<td>Christian Fam. Trust</td>
<td>854 2808</td>
</tr>
<tr>
<td>Aaron McKay</td>
<td>Boothouse Farms</td>
<td>549 0762</td>
</tr>
<tr>
<td>Charles Fanucchi</td>
<td>Tru - Fanucchi</td>
<td></td>
</tr>
<tr>
<td>Adam Icardo</td>
<td>Gary Icardo Farms, Inc</td>
<td>Gary Icardo Farms, Inc</td>
</tr>
<tr>
<td>Mary Hough</td>
<td>Arvin - Edison WD</td>
<td>661-654-5573</td>
</tr>
<tr>
<td>Wayne Kirchner</td>
<td>K. E. C.</td>
<td>661-201-6202</td>
</tr>
<tr>
<td>Derek Meade</td>
<td>Battleship Properties</td>
<td>661-330-2652</td>
</tr>
<tr>
<td>Laird Meadows</td>
<td>AEWSD</td>
<td></td>
</tr>
</tbody>
</table>
## ARVIN-EDISON WATER STORAGE DISTRICT
### INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
#### GUEST LIST
**Tuesday, October 02, 2018 @ 1:00 P.M.**

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raul Garcia</td>
<td>Gless Ranch, Inc</td>
<td>(661) 343-0713</td>
</tr>
<tr>
<td>JOHN S. GLESS</td>
<td>GLESS RANCH INC.</td>
<td><a href="mailto:jsgless@glessranch.com">jsgless@glessranch.com</a></td>
</tr>
<tr>
<td>Petra Villanueva</td>
<td>Resident de Arvin</td>
<td>(951) 453-2591</td>
</tr>
<tr>
<td>David Blakeslee</td>
<td>Sun Pacif..</td>
<td>661-436-6986</td>
</tr>
<tr>
<td>Fernando A.</td>
<td>Maricopa Orchards</td>
<td>661-479-5531</td>
</tr>
<tr>
<td>Torio Pichardo</td>
<td>Resident</td>
<td>661-343-5291</td>
</tr>
<tr>
<td>Lupe Pichardo</td>
<td>Resident</td>
<td>661-201-9319</td>
</tr>
<tr>
<td>Peter Bellnerini</td>
<td>Lehr</td>
<td>661-201-8085</td>
</tr>
<tr>
<td>Shae Lehr</td>
<td>Lehra Brothers</td>
<td>661-201-8085</td>
</tr>
<tr>
<td>Granita Benavides</td>
<td>737 monroe st</td>
<td></td>
</tr>
</tbody>
</table>
# ARVIN-EDISON WATER STORAGE DISTRICT

**INFORMATIONAL LANDOWNER WORKSHOP – SGMA PLAN & COMPLIANCE**

**GUEST LIST**

**Tuesday, October 02, 2018 @ 5:00 P.M.**

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Rodriguez</td>
<td>ARVIN WATER SERVICE</td>
<td>747-9440</td>
</tr>
<tr>
<td>Max Aguirre</td>
<td>Resident</td>
<td></td>
</tr>
<tr>
<td>Jesus Huizar</td>
<td>Resident</td>
<td></td>
</tr>
<tr>
<td>Maria Francovich</td>
<td><a href="mailto:mariafrancovich@gmail.com">mariafrancovich@gmail.com</a></td>
<td></td>
</tr>
<tr>
<td>Bruttao Chacon</td>
<td>Resident</td>
<td>(661) 803-1322</td>
</tr>
<tr>
<td>Selena Cruz</td>
<td>Resident</td>
<td>(661) 703-1335</td>
</tr>
<tr>
<td>Moreno (attending)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don Urberg</td>
<td>Grower-Wine Grapes</td>
<td>(310) 837-2222</td>
</tr>
</tbody>
</table>
ARVIN-EDISON WATER STORAGE DISTRICT
INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
GUEST LIST
Tuesday, October 02, 2018 @ 5:00 P.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guillermo Nolasco</td>
<td>Igles. da Norriex</td>
<td>661-473-9315</td>
</tr>
</tbody>
</table>
ARVIN-EDISON WATER STORAGE DISTRICT
INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
GUEST LIST
Tuesday, October 02, 2018 @ 5:00 P.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeevan Mubhar</td>
<td>AEWSD</td>
<td></td>
</tr>
<tr>
<td>Micah Clark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amanda Dutton</td>
<td>EYI</td>
<td></td>
</tr>
<tr>
<td>Raul Barraza</td>
<td>AEGSD</td>
<td></td>
</tr>
<tr>
<td>Maria Herrera</td>
<td>SHE</td>
<td></td>
</tr>
<tr>
<td>Translator-ReyOA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruben Moreno</td>
<td>Resident</td>
<td></td>
</tr>
<tr>
<td>Richard Wood</td>
<td>Landowner/Resident</td>
<td></td>
</tr>
<tr>
<td>Edna Hamilton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jose Armijo</td>
<td>Resident</td>
<td></td>
</tr>
</tbody>
</table>
# ARVIN-EDISON WATER STORAGE DISTRICT
# INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
# GUEST LIST
Thursday, May 30, 2019 @ 8:00 A.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randy Horne</td>
<td>NAFTEX</td>
<td><a href="mailto:rhorne@naftek.com">rhorne@naftek.com</a> 661 363 8861 x215</td>
</tr>
<tr>
<td>Joe Bresson</td>
<td>Hronis, Inc.</td>
<td><a href="mailto:joe.bresson@hronis.net">joe.bresson@hronis.net</a> 661-378-0880</td>
</tr>
<tr>
<td>Jess Orsini</td>
<td>ARU</td>
<td>661 854-2867</td>
</tr>
<tr>
<td>Don Urenko</td>
<td>self</td>
<td>510-497-3112</td>
</tr>
<tr>
<td>Kevin Pacoe</td>
<td>AENGD BOD</td>
<td><a href="mailto:DISURF@aol.com">DISURF@aol.com</a></td>
</tr>
<tr>
<td>Bill Galli</td>
<td>Garrett Lakes</td>
<td>559-287-3780 <a href="mailto:bill.galli@nutriod.com">bill.galli@nutriod.com</a></td>
</tr>
</tbody>
</table>

*Future project for recharge*
# ARVIN-EDISON WATER STORAGE DISTRICT
INFORMATIONAL LANDOWNER WORKSHOP – SGMA PLAN & COMPLIANCE
GUEST LIST
Thursday, May 30, 2019 @ 8:00 A.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>George Capello</td>
<td>Grimmway</td>
<td><a href="mailto:gcappello@grimmway.com">gcappello@grimmway.com</a></td>
</tr>
<tr>
<td>Jeff Looker</td>
<td>Sunview</td>
<td><a href="mailto:jlooker@sunviewvineyards.com">jlooker@sunviewvineyards.com</a></td>
</tr>
<tr>
<td>Jeenam Mihar</td>
<td>AEWSD</td>
<td></td>
</tr>
<tr>
<td>Micah Clark</td>
<td>AEWSD</td>
<td></td>
</tr>
<tr>
<td>Anona Dutton</td>
<td>EWI</td>
<td></td>
</tr>
<tr>
<td>Raul Barraza</td>
<td>AGSD</td>
<td></td>
</tr>
<tr>
<td>Paul Bianc</td>
<td>Almonds Eight</td>
<td></td>
</tr>
<tr>
<td>Dennis Fox</td>
<td>WCS</td>
<td>661 366 4093</td>
</tr>
<tr>
<td>Keira</td>
<td>SHE - TRANSLATOR</td>
<td></td>
</tr>
</tbody>
</table>
## ARVIN-EDISON WATER STORAGE DISTRICT
### INFORMATIONAL LANDOWNER WORKSHOP – SGMA PLAN & COMPLIANCE
### GUEST LIST
**Thursday, May 30, 2019 @ 1:00 P.M.**

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Letter for MWD</td>
<td>Mettler Co. Water</td>
<td><a href="mailto:agcenter@bakersrs.com">agcenter@bakersrs.com</a>, 661-764-5273</td>
</tr>
<tr>
<td>Regina Houckin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>David Overstreet</td>
<td>West Coast Grape Farming Inc.</td>
<td><a href="mailto:david.overstreet@wcfci.com">david.overstreet@wcfci.com</a></td>
</tr>
<tr>
<td>Scott Gisbertz</td>
<td>Bollthouse Farms</td>
<td><a href="mailto:sgisbertz@bollthouse.com">sgisbertz@bollthouse.com</a></td>
</tr>
<tr>
<td>Catalino Martinez</td>
<td>VAL-Mar Farms</td>
<td></td>
</tr>
<tr>
<td>Taher Merchant</td>
<td>Tayyeba Farms</td>
<td>cherries@tayyeba farms.com</td>
</tr>
<tr>
<td>A2izu Qusbaumi</td>
<td>Tayyeba Farms</td>
<td>661-525-2226</td>
</tr>
<tr>
<td>Joel Akerkrecht</td>
<td>DMCamp</td>
<td><a href="mailto:joel@dmcamp.com">joel@dmcamp.com</a></td>
</tr>
<tr>
<td>Mary Hough</td>
<td>AEWSD</td>
<td></td>
</tr>
<tr>
<td>Millie Boise</td>
<td>KBA</td>
<td></td>
</tr>
<tr>
<td>Jose Santana</td>
<td>AEWSD</td>
<td></td>
</tr>
<tr>
<td>PRINT NAME</td>
<td>COMPANY/ENTITY</td>
<td>TELEPHONE AND/OR EMAIL</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Aaron Masry</td>
<td>Bocchuse Farms</td>
<td>(661) 549-0762</td>
</tr>
<tr>
<td>Dick Porter</td>
<td>Porter Citrus, Inc.</td>
<td>661-747-4921</td>
</tr>
<tr>
<td>John S. Gless</td>
<td>Gless Ranch</td>
<td><a href="mailto:jsgless@eaglessranch.com">jsgless@eaglessranch.com</a></td>
</tr>
<tr>
<td>Mark Fanucchi</td>
<td>Tri Fanucchi Farms</td>
<td>(661) 878-2264</td>
</tr>
<tr>
<td>Ethan Balderman</td>
<td>Tri Fanucchi Farms</td>
<td></td>
</tr>
<tr>
<td>Jeff Ginnavara</td>
<td>AENSCD Bod</td>
<td></td>
</tr>
<tr>
<td>Fernando Cuja</td>
<td>AECUSD</td>
<td><a href="mailto:fcuja@aecusd.org">fcuja@aecusd.org</a></td>
</tr>
<tr>
<td>Dave Nixon</td>
<td>AENSCD</td>
<td></td>
</tr>
<tr>
<td>Jeevan Munar</td>
<td>AENSCD</td>
<td></td>
</tr>
</tbody>
</table>
ARVIN-EDISON WATER STORAGE DISTRICT
INFORMATIONAL LANDOWNER WORKSHOP – SGMA PLAN & COMPLIANCE
GUEST LIST
Thursday, May 30, 2019 @ 1:00 P.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Justin Golding</td>
<td>Wonderful Citrus</td>
<td>559-700-1913 <a href="mailto:justin.golding@wonderful.com">justin.golding@wonderful.com</a></td>
</tr>
<tr>
<td>Micah Clark</td>
<td>ABNSD</td>
<td></td>
</tr>
<tr>
<td>Amona Dutton</td>
<td>EKI</td>
<td></td>
</tr>
<tr>
<td>Raul Barraza</td>
<td>AGSD</td>
<td></td>
</tr>
<tr>
<td>Rema</td>
<td>SHE - Translator</td>
<td></td>
</tr>
<tr>
<td>Carlos</td>
<td>SHE - Translator</td>
<td></td>
</tr>
<tr>
<td>Dave Laut.</td>
<td>Laut Farm</td>
<td></td>
</tr>
<tr>
<td>PRINT NAME</td>
<td>COMPANY/ENTITY</td>
<td>TELEPHONE AND/OR EMAIL</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Kyle McClintock</td>
<td>IB Farming</td>
<td>(61-858-7323)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:Kyle.mcclintock@sjfertilization.com">Kyle.mcclintock@sjfertilization.com</a></td>
</tr>
<tr>
<td>PRINT NAME</td>
<td>COMPANY/ENTITY</td>
<td>TELEPHONE AND/OR EMAIL</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Ana Contrera</td>
<td>Armon (Resident)</td>
<td>854-5537</td>
</tr>
<tr>
<td>Left arc P De J</td>
<td>Sun Pacific &amp; Kern Ranchy</td>
<td>661-978-7650</td>
</tr>
<tr>
<td>Edwin C.</td>
<td>DM George &amp; Sons</td>
<td>661-978-8341</td>
</tr>
<tr>
<td>Scott Reade</td>
<td>Reade Ventures</td>
<td>661-845-1755</td>
</tr>
<tr>
<td>Steve Murray</td>
<td>Murray Family Farms</td>
<td>661-330-3030</td>
</tr>
<tr>
<td>Jeevan Munar</td>
<td>AESCD</td>
<td></td>
</tr>
<tr>
<td>Micah Clark</td>
<td>AESCD</td>
<td></td>
</tr>
<tr>
<td>Ansona Dutton</td>
<td>EKI</td>
<td></td>
</tr>
<tr>
<td>Raul Barrera</td>
<td>ACSD</td>
<td></td>
</tr>
<tr>
<td>Carlos</td>
<td>SHE - Translator</td>
<td></td>
</tr>
</tbody>
</table>

11 total
# ARVIN-EDISON WATER STORAGE DISTRICT
# INFORMATIONAL LANDOWNER WORKSHOP - SGMA PLAN & COMPLIANCE
# GUEST LIST

Thursday, May 30, 2019 @ 5:00 P.M.

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>COMPANY/ENTITY</th>
<th>TELEPHONE AND/OR EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estela Escolt</td>
<td>CBA</td>
<td>(661) 954-1581</td>
</tr>
<tr>
<td>Bob Rodriguez</td>
<td>ACSO</td>
<td>661-747-9440</td>
</tr>
</tbody>
</table>
1. Is the District’s water budget related to the Todd model?  
   a. The District’s chapter-level water budget is based on a calibrated analytical model that follows the requirements of the Groundwater Sustainability Plan (GSP) Regulations Section 354.18 and is consistent with the Best Management Practices (BMP) document developed by the California Department of Water Resources (DWR). The Todd model is also compliant with the GSP Regulations, but is a refinement of the beta-version of the Central Valley scale numerical model developed by DWR and has not been calibrated to local conditions. The Todd model is being applied to evaluate basin-scale conditions in the Kern Subbasin. That being said, the individual water budgets calculated for the District using the two modeling approaches are generally consistent when the long-term average conditions are compared.

2. Climate change implementation?  
   a. Yes, per the GSP Regulations, climate change impacts were taken into consideration for the District’s future water budget estimates (as well as incorporated into the Todd model). In summary, climate change decreases precipitation, changes snowmelt timing (earlier), and increases evapotranspiration (warmer temperatures). Climate change is also expected to impact the reliability of surface water deliveries in the future.

3. Does this model include water banking?  
   a. Yes, the District’s local groundwater recharge efforts are accounted for within both the District and basin-scale models.
4. Includes rainfall, watershed, and creeks?
   a. Yes, the benefits to the local groundwater system from rainfall and inflows from the surrounding watershed are both explicitly accounted for in both the District and basin-scale models.

5. Where do climate change numbers come from?
   a. Climate change factors were provided by DWR and impact several different water budget components: precipitation, evapotranspiration, surface water imports, natural surface water inflows, net inflow, exports and deliveries, groundwater outflows, etc.

6. Water level versus check book
   a. SGMA implementation and the related “sustainability test” thereof will be based on water level monitoring (among other items like water quality and subsidence monitoring). However, the checkbook approach being used in parallel by entities within the Kern Subbasin does provide a tool to assist with understanding of the basin-scale water budget and related surplus/deficit condition and continues to be work in progress.
7. Are we making decisions today based on the “what-if”? 
   a. The GSP Regulations require that the District predict and manage to anticipated future conditions scenarios out to 2070. The information to make such predictions is imperfect, but the District is relying on the best-available information, which as this point includes historical records and estimates provided by DWR and the Friant Water Authority (FWA) related to future water supplies. The GSP does allow for adaptive management and the District’s GSP will be revised and updated at five (5) year intervals including review of mandated regulations (i.e. climate change assumptions, hydrologic periods, etc.).
8. Are water levels monitored?
   a. Currently District water levels are monitored on a monthly basis, and landowner wells are monitored twice a year (Spring and Fall). The District intends to monitor its SGMA network on similar frequencies.
9. How close are we to the threshold?
   a. This answer is dependent on which area of the District we are referring to. Slide 25 (below) shows us that different minimum thresholds (MT) and measurable objectives (MO) zones have been developed to reflect varying conditions throughout the District. These MTs factored in historical variability, used a 10-year trend analysis, and considered subsidence near critical infrastructure. The MOs considered 2015 water levels. These MTs/MOs are considered to be protective of all of the other sustainability indicators.

10. Different colored zones are treated differently within the District?
    a. Yes, due to the water levels and elevation contours of different areas within the District, MTs/MOs were developed to be more representative of each area.
11. Can legislation assist the process?
   a. We understand that there was some talk about requesting a time extension, especially in dealing with the “white lands” but a bill was not advanced through the State legislature.

12. How many acres will AEWSD accept?
   a. The AEWSD Board of Directors has only approved the irrigated lands portion of “white lands” to join the District. Roughly 1,000+ acres have been approved. However, as of June 11 Board of Director’s meeting, all “white lands” north of the district boundary will be considered provided they make contact with District by July 1, 2019.

13. Does the methodology dewatered wells?
   a. It is unknown at this time exactly how many wells may be dewatered, if any. However, the District will institute a mitigation policy that will address wells that were dewatered as a result of management to the established MTs/MOs.

14. How are we paying for all of this (SGMA)?
   a. AEWSD has currently absorbed all SGMA related costs into its annual budget, but in the future the District may hold a Prop 218 election to support additional assessments related to GSP implementation.

15. What Projects and Management Actions do you have set up for the white lands?
   a. SGMA implementation for the white lands is unknown at this time and likely won’t be addressed until 2025. However, some white lands, mainly irrigated parcels, will likely have to reduce pumping or make additional investments if their pumping exceeds the native safe yield value established for the Kern Subbasin.
16. Will there be a conservation of water use?
   a. There is a potential to increase water conservation in the future. The District is currently focusing on the implementation of water supply projects in the areas of the District that have a history of declining water levels.

17. What percentage of acreage will be retired / fallowed?
   a. It is unknown at this time how much land will be retired/fallowed. There will likely be a tradeoff between the costs to support supply augmentation vs. to reduce demands. District landowners will be part of that decision making.

18. Who has jurisdiction of the white lands?
   a. Kern County no longer is providing coverage for the white lands pursuant to SGMA. Kern County Water Agency (KCWA) is providing jurisdictional coverage provided several agreements are executed.

19. SWRCB can just come in and put the entire basin in probation?
   a. Given the white lands issues in the Kern Subbasin, it is likely that the State Water Resources Control Board (SWRCB) will have some role in the basin. The SWRCB will have the discretion to declare the basin to be in probation.

20. Who will be in charge of well monitoring?
   a. AEWSD currently monitors landowner water levels and water quality on a voluntary basis and will continue to take the lead on monitoring for SGMA within the District. Arvin CSD will conduct monitoring within its service area. Should SGMA require well metering, it is unknown at this time who will be in charge of regulating said meters.

21. Are there any regulations on new wells?
   a. There are not currently any new regulations on wells. However, new well permits submitted to Kern County are also sent to the Kern Groundwater Authority (KGA) and the District for review/comments.

22. How are you going to budget for SGMA? Budget cuts?
   a. The District has currently absorbed all SGMA related costs into its annual budget. However, in the future, SGMA costs could be separated from the District’s annual budget and/or could require a Prop 218 election to support necessary funding.

23. Will the Districts start combining and working together to stay out of probation and take over the white lands?
   a. We will continue to work together with the KGA members and other basin GSAs to keep the Kern Subbasin in compliance and out of probation to the extent feasible.

24. Make it clear to the white lands that there is no plan to supply them water. They get no share of AE water.
   a. The current agreement that allows the District to provide SGMA coverage to the white lands clarifies that those lands will not have access to AEWSD water supplies and only will have access to their share of the limited groundwater supply.

25. Will there be a land tax / water tax for the white lands?
   a. That is unknown at this time.
26. Since Kern County pulled out, does that put the whole basin in non-compliance?
   a. If all of the remaining land gets covered by another District, the KCWA or the KGA, then we understand that the Kern Subbasin will be in compliance with the SGMA requirement of “full coverage” by one or more GSPs.

27. Regarding well monitoring, does 1 well out of compliance but a hold on the entire basin?
   a. One non-compliant well will not put the entire Kern Subbasin in probation. The District’s definition of “Undesirable Result” (UR) allows up to 40% of the District’s SGMA monitoring wells to drop below an MT over a 2-year period before it would trigger local non-compliance. However, the Kern Subbasin has an additional definition of basin-scale UR, which is that 30% or more of the basin area or three adjacent management areas would have to be below their respective UR definitions before the basin UR would be triggered.

28. Can we recharge into the creek in the future towards “credits”?
   a. Not at this time, but that doesn’t mean that projects such as this won’t be considered in the future.

29. What will be the future cost of water? And water tax?
   a. The future cost of water is unknown at this time. The District strives to provide affordable, reliable and high-quality water to its landowners.

30. Regarding SWSA / GWSA, how will both worlds be treated in the future?
   a. Both the Surface Water Service Area (SWSA) and the Groundwater Service Area (GWSA) of the District have always been given an “equal” share of available supplies. At this time the District is not planning to change its policy in this regard.

ARVIN COMMUNITY SERVICE DISTRICT

1. What happens during a power failure?
   a. Emergency generators are being installed at all new Arvin CSD well sites and hopefully at all existing sites.

2. Is the water agency (KCWA) part of AEWSD?
   a. AEWSD works with the KCWA with respect to some of its water supplies, but they are separate entities.

3. Do the citizens of Arvin understand where their water comes from?
   a. The citizens of Arvin may not be fully aware of where the AEWSD water supply comes from and how recharge activities by AEWSD benefit Arvin both in terms of stabilizing water levels and improving water quality. Most residents of Arvin know that their urban water comes from the Arvin CSD groundwater wells.

4. Are there education efforts being made?
   a. Currently, SGMA landowner workshops and AEWSD and Arvin CSD Board meetings provide the public with information pertaining to their water supply and SGMA. Any additional education questions can be answered by District staff.

5. Education of treatment occurring to water supply?
   a. Arvin CSD sends out quarterly letters informing them of District news. In these letters, the district has provided information regarding the new treatment facility located on Well No. 13 and an outline of the Arsenic Mitigation Project Phase II.
October 27, 2018

Dear Mr. Erlewine,

As you move forward in developing your groundwater sustainability plans (GSPs), we hope that you are using the Groundwater Resource Hub as a resource. The Hub provides information and tools that can help you comply with SGMA requirements to identify and address groundwater dependent ecosystems (GDEs).

The Conservancy worked with the water community to create this time and money saving resource, which includes a GDE Guidance Document for GSPs to help GSAs create a localized, systematic and defensible framework for including GDEs in GSPs.

SGMA requires that GDEs be identified (23 CCR §354.16(g)) and addressed as a beneficial use (see, DWR Sustainable Management Criteria Best Management Practices, p. 12). The following SGMA provisions for GDEs are found in the California Water Code:

§10723.2 Consideration of All Interests of All Beneficial Uses and Users of Groundwater
The groundwater sustainability agency shall consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans. These interests include, but are not limited to, all the following:
...(e) Environmental users of groundwater.

§10727.2 Required Plan Elements
A groundwater sustainability plan shall include all of the following:
...(b)(2) A description of how the plan helps meet each objective and how each objective is intended to achieve the sustainability goal for the basin for the long-term beneficial uses of groundwater.

§10727.4 Additional Plan Elements In addition to the requirements of Section
10727.2, a groundwater sustainability plan shall include, where appropriate and in collaboration with the appropriate local agencies, all of the following:
...(l) Impacts on groundwater dependent ecosystems.

§10933 Groundwater Elevation Monitoring; Prioritization of Basins by the Department (b)
The department shall prioritize groundwater basins and subbasins for the purpose of implementing this section. In prioritizing the basins and subbasins, the department shall, to the extent data are available, consider all of the following:
...(8) Any other information determined to be relevant by the department, including adverse impacts on local habitat and local streamflows.

§354.10 Notice and Communication
Each plan shall include a summary of information relating to the notification and communication by the Agency with other agencies and interested parties including the following:
(a) A description of the beneficial uses and users of groundwater, including the land uses and property interests potentially affected by the use of the groundwater in the basin....

§354.14 Hydrogeologic Conceptual Model
(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:
...(4) Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.

§354.16 Groundwater Conditions
Each Plan shall provide a description of current and historical groundwater conditions in the basin,...[based on the best available information] that includes the following:
...(f) Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.
...(g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

§354.26 Undesirable Results
(b) The description of undesirable results shall include the following:
...(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.

§354.28 Minimum Thresholds
(b) The description of minimum thresholds shall include the following:
...(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.
(c) Minimum thresholds for each sustainability indicator shall be defined as follows:
...(6) Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results.

The Conservancy, in partnership with the Departments of Water Resources and Fish and Wildlife, completed statewide mapping of indicators of groundwater dependent ecosystems (GDEs)\[^1\]. The Groundwater Resource Hub contains the [GDE mapping](#) in addition to other valuable information including an online tutorial about what GDEs are and case studies and references to additional resources on GDEs.

We believe that as you move forward with your basin’s plan, you may find these resources quite helpful in fulfilling SGMA’s requirements related to GDEs and achieving sustainable groundwater conditions. If you are contracting with a consulting firm to develop your GSP, please share this letter with them.

Local stakeholders who are familiar with the basin’s natural resources can be an important source of expertise and data on GDEs, and we urge you to include environmental representation in your groundwater sustainability planning process. This model for governing the process of developing a GSP is being successfully implemented in several basins, including in [Ventura County](#).
If you would like more information about the Groundwater Resource Hub or have any questions related to our work on GDEs, please contact us.

Very truly yours,

\[Signature\]

Sandi Matsumoto  
Associate Director, California Water Program  
The Nature Conservancy  
555 Capitol Mall, Suite 1290  
Sacramento, CA 95814  
(916) 596-6671 (office)  
(805) 746-6664 (Mobile)

\[Footnote\]: DWR refers to the iGDE database as the Natural Communities Commonly Associated with Groundwater, or NC Dataset. The NC Dataset and the iGDE database are the same.
Attn: Kern Groundwater Authority, Board of Directors
1115 Truxtun Ave, Bakersfield, Ca 93301
December 19, 2018

Board of Directors,

After reviewing the undesirable results provided in the agenda for today’s meeting, we strongly urge the board not to approve these undesirable results for three reasons: first, undesirable results are required to be a definition of what the GSA hopes to avoid by implementing sustainable groundwater management. For example, the GSA could define the undesirable result for groundwater levels to be that a certain number of wells go dry. The GSA could define the undesirable result for land subsidence to be that a certain amount or area of infrastructure is damaged from subsidence. This should be a values-based conversation that determines what the GSA deems to be a significant and unreasonable harm to beneficial users. Here, the GSA seems to be setting a minimum threshold, and not an undesirable result. Instead of focusing on quantitative measures, we ask the GSA board to define the undesirable results in broader, more values-based terms that go to the actual tangible impact on beneficial users in the GSA.

Second, undesirable results must be defined in a way that ensures sustainability in the GSA area. While the GSA has the discretion to define sustainability by defining undesirable results, minimum thresholds and measurable objectives, it must do so within reason. Here, the undesirable results will not be violated unless a very large area - three adjacent Management Areas making up at least 15% or 30% of the sub-basin - within the GSA are violating their Minimum Thresholds. If, for example, groundwater levels, groundwater quality, or land subsidence were to exceed Minimum Thresholds in a third of the sub-basin but in Management Areas that are not adjacent, the undesirable results will still not be triggered, and the GSA will not be responsible for improving its management of those areas. This definition of sustainability is not reasonable, since it would allow widespread environmental and public health and safety impacts to occur. We ask that the GSA revise these undesirable results to ensure sustainability. We encourage the GSA to instead consider defining undesirable impacts based on the reasonable impact to beneficial users: for instance, the GSA could define the undesirable result for groundwater quality based on the number of homes affected by drinking water contamination. It could define the undesirable result for groundwater levels based on the number of wells that have gone dry and the lack of sufficient water supply to a certain amount of important habitats. It could define the undesirable result for subsidence based on the land area
and infrastructure impacted by subsidence, regardless of whether it spans adjacent Management Areas. These would all be reasonable definitions of undesirable results. We are glad to collaborate with the GSA to improve these important standards.

Lastly, there has been little to no public engagement in the development of these undesirable results. SGMA requires the GSA to consult with a wide variety of stakeholders, and to hold meetings at “key junctures” in the GSP development process. Since the definition of undesirable results shapes the priorities of the GSP, the GSA was required to consult with a wide variety of stakeholders and had a public hearing before submitting these undesirable results for approval. We would like to ask the board how these undesirable results were drafted, who was consulted in this process, and if you have included feedback or reached out to the public or individuals other than industries and local agencies.

These undesirable results share similar if not identical characteristics with Kern River undesirable results, of which we also strongly believe do not fulfill the purpose or requirements for establishing undesirable results. We are concerned with both the content of these undesirable results as well as the process through which they were developed. We ask that the board not approve these definitions for undesirable results as presented to you today. We ask that you draft new undesirable results that protect communities’ drinking water resources and the human right to safe and affordable drinking water, and take these out to the public for feedback.

Thank you,

Jasmene del Aguila
Policy Advocate
Leadership Counsel for Justice & Accountability
Dear Ms. Poire, Ms. Gomez and Kern Groundwater Authority GSA,

Our organization works alongside low income communities of color in the San Joaquin Valley and the Eastern Coachella Valley to advocate for local, regional and state government entities to address their communities’ needs for the basic elements that make up a safe and healthy community, including clean, safe, reliable and affordable drinking water, affordable housing, effective and safe transportation, efficient and affordable energy, green spaces, clean air, and more. We have been engaged in the Sustainable Groundwater Management Act (SGMA) implementation process because many of the communities with whom we work are dependent on groundwater for their drinking water supplies, and often have already experienced groundwater quality and supply issues. Historically, communities we work with have not been included in decision-making about their previous water resources, and their needs have not been at the forefront of such decisions. In 2012, California recognized the Human Right to Drinking Water as a statewide goal. Now, because of SGMA’s requirements for a transparent and inclusive process, groundwater management under the new law has the opportunity to include disadvantaged communities in decision-making and create groundwater management plans that understand their unique vulnerabilities and are sensitive to their drinking water needs.

We are concerned that drinking water impacts and disadvantaged community input have not been adequately analyzed and incorporated into the draft GSP, and recommend the following actions to ensure that drinking water is protected, especially for the communities whose drinking water is severely at risk from groundwater management activities, and who are the least able to pay for solutions for clean and reliable drinking water.
**Development of Sustainable Management Criteria**

In order to “consider the interests of”\(^1\) disadvantaged communities in developing sustainable management criteria, GSAs must address the impacts of the six sustainability indicators, engage residents of disadvantaged communities to understand their groundwater issues and needs and get input on how to shape sustainable management criteria, and analyze the impact of preliminary minimum thresholds on drinking water users before establishing minimum thresholds.

Under SGMA, *all sustainable management criteria must be based on the GSA’s determination of what will cause a “significant and unreasonable” impact on each of the six sustainability indicators.*\(^2\) This determination of what is “significant and unreasonable” must be based on the needs of all beneficial users.\(^3\) Without first consulting beneficial users, including disadvantaged communities, to understand what groundwater impacts those individuals and communities want to avoid, the GSA cannot make a valid determination of what is “significant and unreasonable”, and thus cannot set valid sustainable management criteria.

As a result of its unique tiered structure that the Kern Groundwater Authority GSA has decided to follow to address the creation of a GSP under SGMA, Kern Groundwater Authority GSA (KGA), among other GSAs within the Kern Basin, have created and approved very broad undesirable results that will encompass the diverse terrain that exists within the Kern Basin, and have deferred to individual water districts within the GSA to determine their own minimum thresholds. The GSA-wide undesirable results are difficult to trigger in order to avoid state intervention, and are not based on a public and participatory discussion on what the “significant and unreasonable” impacts are that stakeholders in the GSA want to avoid. Undesirable results should be shaped by a values-based conversation that determines what the GSA deems to be a significant and unreasonable harm to beneficial users, including disadvantaged communities rather than focusing on quantitative measures. To the best of our knowledge, we are not aware of any efforts that the GSA has made to reach out to members of disadvantaged communities in shaping its undesirable results.

The GSA has delegated decisions about minimum thresholds to water districts within the GSA. These water districts are determining minimum thresholds for their own areas without reaching out to stakeholders, and outside of public meetings, so it is impossible for advocates and stakeholders to know how these minimum thresholds are being shaped, and whose interests and what factors are being considered.

*In order to effectively “consider the interests of” all beneficial users, GSAs must analyze how preliminary sustainable management criteria will affect drinking water users before reaching proposed*

---

\(^1\) Water Code sec. 10723.2

\(^2\) CCR sec. 352.28(a), 354.30(b), 354.26(a)

\(^3\) CCR sec. 352.28(b)(4)
**final sustainable management criteria.** Before deciding on sustainable management criteria, GSAs must be equipped with information about how potential minimum thresholds will impact access to drinking water for domestic well owners and communities on small community water systems. Kern Groundwater GSA has not prepared any analysis to help inform how preliminary sustainable management criteria will affect drinking water users. We recommend that the KGA take steps towards a robust analysis that will inform the GSA and help ensure the access to safe drinking water to the most vulnerable and disadvantaged communities.

The GSP development process must be representative of the interests of all beneficial users named in the Act. When board members do not come from disadvantaged communities or understand the unique groundwater needs of such communities, as is the case more often than not, *it is imperative for the agency to reach out to disadvantaged community members for input* before making key decisions such as recommending or proposing draft sustainable management criteria. We understand that under Kern Groundwater Authority GSA’s approach to SGMA, the responsibility for community engagement lies onto the local water districts where more detailed decisions will be made. These water districts are not reaching out to beneficial users for their input on minimum threshold development, and are making decisions about minimum thresholds outside of public meetings. This makes it impossible for beneficial users’ needs to be considered, and does not “encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin prior to and during the development and implementation of the groundwater sustainability plan.” We recommend that the GSA require water districts to make decisions in public meetings, report back on their sustainable management criteria development on a regular basis in KGA GSA meetings, and solicit feedback on their preliminary sustainable management criteria from all types of beneficial users in their service areas. We also recommend that the GSA as well as the water districts engage with community based organizations that can help with outreach efforts and soliciting feedback from disadvantaged community residents and domestic well owners.

**Groundwater Quality Minimum Threshold Recommendation**

Groundwater quality has been a particularly complex issue for GSAs. In determining how they will set their sustainable management criteria for groundwater quality, GSAs have considered many factors, including the state Maximum Contaminant Levels (MCLs), other agencies monitoring and regulating groundwater contaminants in the region, areas where MCLs are already exceeded, and ways that groundwater management could impact the concentration and movement of groundwater contaminants.

---

4 California Department of Water Resources, Sustainable Management Criteria Best Management Practices, p. 9. The GSP must discuss how groundwater conditions at a selected minimum threshold could affect beneficial uses and users. This information should be supported by a description of the beneficial uses and identification of beneficial uses, which should be developed through communication, outreach, and/or engagement with parties representing those beneficial uses and users, along with any additional information the GSA used when developing the minimum threshold.

5 Water Code sec. 10727.8
We understand the complexity of setting groundwater quality SMC that are accurate, attainable, and measurable, and we are eager to work with the Kern Groundwater Authority GSA to ensure that groundwater management does not increase groundwater contamination, especially where groundwater is being used as a drinking water source. Given the need for a concrete minimum threshold that strongly protects the human right to drinking water, we recommend that the Kern Groundwater Authority GSA instead implement the following minimum thresholds:

- Minimum thresholds for water quality should be set at the best water quality since 2015 for each constituent.
- Where the minimum threshold exceeds the public health goal for any constituent, the GSP should, at a minimum, include a policy to strive for improvements to water quality to the point of meeting the relevant public health goal(s).

The reasoning behind these minimum thresholds is that the GSA is tasked with avoiding any undesirable results, and contamination of groundwater and other drinking water sources is a “significant and unreasonable” impact to the resource that we all need to drink, cook, bathe, grow food, and more. Accordingly, minimum thresholds must ensure protection from and prevention of contamination of groundwater and other drinking water sources. DWR instructs GSAs to look to existing groundwater regulatory programs and water quality standards. Many GSAs have proposed incorporating the existing MCLs into their minimum thresholds, however reliance on an MCL is not sufficiently protective of drinking water sources, and does not prevent contamination of our critical resources. An appropriate standard in the context of groundwater protections is the state’s anti-degradation policy, which is used by the SWRCB and regional water boards, and does not allow for further contamination of groundwater based on the best quality of the water since 1968. In the SGMA context, it is key to prevent further degradation of groundwater quality to protect drinking water. We are asking the GSA to specifically look at protecting the highest quality of groundwater achieved since 2015, based on the year that SGMA was passed. Another rule commonly used in environmental law is the precautionary principle, which prohibits activities that could cause harm when the amount of potential harm is unknown. We urge the GSA to use these two rules, combined with seeking to remediate groundwater to the public health goal, as laid out above, to ensure that groundwater management does not cause degradation of groundwater quality.

GSAs should monitor all primary drinking water contaminants, as well as chrome-6, which is known has significant health effects but is undergoing a new process to set the MCL because of procedural flaws. It is widely known that the San Joaquin Valley experiences widespread water quality issues from nitrates, DBCP, 123-TCP and other contaminants, and the GSA’s groundwater

---

management activities could impact the concentration and location of those contaminants. Where relevant, GSAs should also consider monitoring for PFOA and PFOS as the EPA has established a Lifetime Health Advisory for them due to their potential impacts on drinking water systems. GSAs should also monitor contaminants that are proven to increase from groundwater management, such as arsenic and uranium, increased contamination from recharge, movement of contaminant plumes from groundwater pumping, and other groundwater management activities.

**Water Quality Considerations for Groundwater Management Actions**

To establish causality between groundwater management activities and groundwater contamination, GSAs should look to (1) whether there has been a correlation in groundwater management activities and an increase in contamination that could result from groundwater management activities, (2) relevant scientific studies that show proven mechanisms by which causation can be established between groundwater management activities and groundwater contamination, and (3) data and samples collected showing a causal nexus in the case at hand.

Finally, in order to effectively protect drinking water resources, GSAs should establish Management Areas in areas that are more vulnerable to groundwater contamination, such as communities with many shallow wells and communities that cannot afford to install drinking water filters or treatment facilities.

The KGA has decided to define management areas based on already established water districts within the GSA. This approach does not highlight the importance of monitoring to ensure and protect safe groundwater for individuals who still rely on water wells. KGA should instead place management areas around areas where there are a high number of vulnerable private well owners and community water systems.

**Groundwater Levels Minimum Threshold Recommendation**

---


GSAs must protect drinking water, and must consider the needs of disadvantaged communities and domestic well users in creating their GSPs. The California legislature has stated that the use of water for domestic purposes is the highest use of water,17 and passed the Human Right to Drinking Water in 2012.18 After the passage of SGMA, GSAs now have the responsibility to protect drinking water through groundwater management. If they choose to allow individuals to keep pumping at the expense of severe drinking water impacts, that is a groundwater management decision that violates their obligation to protect drinking water resources. GSAs must therefore have strong minimum thresholds that protect all drinking water wells from dewatering.

Minimum thresholds are the most pivotal measure for how a GSA will prevent impacts from a sustainability indicator. This is the point that a GSA must avoid, and could necessitate state intervention. There is some flexibility, however; for groundwater levels, DWR shows in its Sustainable Management Criteria Best Management Practices guide that it will allow a GSA to dip below its minimum threshold for groundwater levels in some cases, as long as its GSP will ensure that it comes back up and towards its measurable objective. Therefore, GSAs should strive to set minimum thresholds at levels that they seek to avoid.

GSAs should set minimum thresholds for groundwater levels at the level of the shallowest existing wells in use, with a buffer above the depth of the top of the screen. If GSAs choose not to do so, they must take on the responsibility for the wells that do go dry from this policy choice. If proposed minimum thresholds allow wells to go dry, a GSA must conduct a drinking water impact analysis to evaluate how many drinking water wells will go dry, set management areas for shallower minimum thresholds where there are more concentrated shallow domestic wells, and ensure that drinking water is protected by implementing preventive actions such as digging deeper wells and assisting with consolidation projects. It is important to note that prevention, not mitigation, is the only way to effectively protect drinking water resources.

We have not seen that the KGA take any steps in ensuring that no wells servicing individuals and communities go dry through computational modeling assessments or analysis. KGA under SGMA holds the responsibility to ensure clean groundwater management to all its current water beneficiaries which includes individuals on private wells as well as small water districts. It is important for minimum thresholds to be placed at a level that ensure access to water to the most vulnerable populations who most often rely on private wells or small water districts that tend to have more shallow wells than those used for agriculture purposes.

In setting groundwater levels minimum thresholds, GSAs should also set minimum thresholds high enough as to avoid groundwater contamination from overpumping. They should also set minimum thresholds that ensure that rural communities have equitable access to groundwater resources, and have enough for current needs and future growth. GSAs must also factor in the increased costs of pumping and

17 Water Code sec. 106.
18 Water Code sec. 106.3
installing new wells if groundwater levels decrease, and avoid additional costs in groundwater access for low income communities dependent on groundwater for drinking water resources. GSAs should also set minimum thresholds for groundwater levels that will prevent subsidence from occurring and disrupting infrastructure that is critical to the health and safety of vulnerable communities, such as private wells, roads, and homes.

**Monitoring Network**

Broadly, the GSAs must develop actionable steps to fill data gaps and monitor groundwater levels and groundwater quality. In order to protect drinking water resources, monitoring networks should be closely monitoring impacts on drinking water. In particular to water quality, GSAs should monitor for contaminant concentrations quarterly, and increase monitoring to every month if a water quality test detects higher contamination concentration than the previous water quality test. Testing should also robustly monitor plume migration especially given the high number of homes that use groundwater for drinking water in the Kern subbasin.

As a result, the GSP should fund a water quality testing program for strategically identified domestic wells to complement data from small water systems and disadvantaged communities in order to fill existing data gaps as well as begin to identify contaminant plumes. To track these concerns the GSA should place monitoring wells near DACs and clusters of domestic wells.

We look forward to providing further recommendations on the monitoring network in the future.

**Transparency and Inclusivity**

As public agencies, GSAs are subject to the requirements of the Ralph M. Brown Act, which requires transparency of public agencies through notice of meetings and prior posting of agendas, posting of meeting minutes after meetings, and public access to meeting materials upon request by a member of the public. In addition to Brown Act requirements, GSAs must also adhere to the specific public participation and inclusivity requirements for GSP development laid out in SGMA. SGMA expands the public participation requirements of GSAs to also “encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin prior to and during the development and implementation of the groundwater sustainability plan.” (Water Code sec. 10727.8) To assist in GSAs complying with this requirement, DWR has published guidance on public notice and engagement, highlighting good practices for effective engagement. Both the letter and spirit of SGMA communicate that GSAs must conduct GSP development in an open and inclusive way.

*A best practice to ensure authentic, meaningful input as required by SGMA is to post meeting materials before the meeting,* so that these materials are available to the public for feedback and engagement. The Brown Act requires these materials to be made available after the meeting upon written request of the public. Paired with SGMA’s requirements for robust community engagement, the most effective way to ensure that the public is aware of what will be talked about at meetings, and to access critical GSP development information despite not being able to attend one meeting, is to post all meeting materials online before the meeting. KGA posts meeting materials and presentations on the website and
distributes these materials via email after meetings, but does not send meeting materials and presentations before the meeting. Agendas released before the meetings alert us to the topics to be discussed, but having the actual materials and presentations to be presented at the meetings would allow our organization and other stakeholders to much more meaningfully engage and give effective feedback.

GSAs should also dedicate sufficient funding to ensure meaningful, effective, and accessible engagement of the public. Given the type of outreach that is necessary in order to engage disadvantaged communities, GSAs should work with local community-based organizations to conduct outreach and organize meetings in a way that is accessible for disadvantaged communities, should also hire bilingual staff or consultants who can help conduct door-to-door outreach, attend community meetings, translate materials, and interpret at all GSA meetings. In creating annual operating budgets, GSAs should prioritize funding for these necessary outreach activities. We are aware of KGAs partnership with Self-Help Enterprise for a Lamont Workshop on SGMA late 2018. The GSA should conduct more workshops to ensure that the public is aware of GSP development status and is able to give meaningful feedback to inform the development of the GSP. Another tool that the KGA has created for public engagement is their online stakeholder survey. This tool, however, is not accessible for folks who are computer illiterate and the modes of distribution of this information through agricultural and water associations do not reach the average water consumer. For this reason we strongly encourage and recommend that the GSAs as well as the water districts to work with local community based organizations to engage community residents.

Lastly, and most importantly, the GSA must make GSP development decisions at public meetings, and must not make decisions behind closed doors. Making substantive GSP development decisions outside of public meetings goes against the requirements of the Brown Act, as well as SGMA’s requirements for “consideration of all interests” and “encourage[ment] of active involvement” of the public “during the development...of the groundwater sustainability plan.” Water districts are currently making key decisions about minimum thresholds outside of public meetings and without engaging beneficial users. As stated above, we recommend that the GSA require water districts to report back on their sustainable management criteria development on a regular basis in public spaces, and solicit feedback on their preliminary sustainable management criteria from all types of beneficial users in their service areas.

Projects and Management Actions

Projects and Management Actions are a crucial part of the GSP, since they demonstrate how the GSA plans on attaining the sustainability goals that they have set out. Therefore, GSAs should set specific timelines and triggers for projects.

We look forward to commenting further on recommendations for projects and management actions that will protect drinking water for the most vulnerable groundwater users.

Groundwater Markets
We have engaged in many discussions around the state about groundwater markets, and continue to warn against them. Commoditizing precious drinking water resources is dangerous and inequitable, since it lets those with more purchasing power have access to more water, and more likely than not will lead to concentrations of over-pumping by large agribusinesses, leaving nearby communities without drinking water. Furthermore, given all GSAs’ severe lack of data on domestic wells and water use in their service areas, and our region’s lack of understanding of how a market could impact groundwater use and subsurface groundwater flows, implementing groundwater markets now would be precipitous and reckless.

If the GSA decides to look into designing and implementing groundwater markets, we look forward to giving more feedback on the impact of groundwater market on drinking water resources in the GSA area.

~ ~ ~ ~ ~ ~ ~

We look forward to speaking more in depth with consultants and the coordinating committee about our recommendations. We hope that the Kern Groundwater Authority GSA will consider the above recommendations, and hope to collaborate with the GSA to ensure that the GSP protects the subbasin’s most vulnerable drinking water users.

We are also in communication with the Department of Water Resources about current GSP development activities in the San Joaquin Valley, and hope to successfully work with GSAs, communities and DWR to ensure that groundwater management is equitable and sufficiently protective of vital drinking water resources.

Sincerely,

Jasmene del Aguila and Amanda Monaco
Leadership Counsel for Justice and Accountability
Appendix F

Detailed Responses to Selected Comments Received Regarding the MA Plan
## Appendix F

**Detailed Responses to Selected Comments Received on the Public Draft Arvin-Edison Management Area Plan**

Summary of Comments in the Leadership Counsel for Justice and Accountability (LCJA) Comment Letter (11/26/2019) to KGA, and Responses from AEWSD/ACSD

<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 3                          | The Draft GSP is Incomplete, and Must Include Additional Information For the Public to Evaluate the GSP | • The Arvin-Edison MA Plan includes complete information on consideration of drinking water impacts as disadvantaged communities, sustainable management criteria, and Projects and Management Actions (P/MAs)  
• See further comment responses below.  
• See KGA response to this comment for further information. |
| 3                          | The Kern Groundwater Authority GSA Is Responsible for the Disproportionate and Disparate Impacts That Its Policies and Activities Will Have on Disadvantaged Communities Belonging to Protected Groups | • See KGA response to this comment. |
| 4                          | The Coordination Agreement Does Not “Explain How the Plans Implemented Together, Satisfy the Requirements of the Act” | • See KGA response to this comment. |
| 5                          | Inadequate Consideration of Public Input Undermines the Validity and Efficacy of the Draft GSP | • See comment response below.  
• See KGA response to this comment for further information. |
<p>| 6                          | The GSP states that the JPA was “written to provide open communication to all beneficial users,” and “each member of the KGA held their own outreach programs and opportunities for beneficial | AEWSD conducted substantial stakeholder outreach and engagement during the Arvin-Edison Management Area Plan (MA Plan) development process. This outreach is described in |</p>
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
|                           | users to participate in the development of their individual management area plans, which is included in their individual management area plans; however, this was not the case. For example, the member agency that has jurisdiction over residents with whom we work in the GSA area, the Arvin-Edison Water Storage District, did not adequately reach out to disadvantaged community residents or include their feedback in their GSP. For example, the Arvin WSD’s website contains no information on SGMA or GSP meetings. We understand from conversations with staff that the agency sent notices to its list serv, but there is no way to sign up for the list serv on the website, and without knowing when and where meetings are occurring the public could not go to a meeting to sign up and be added to the interested parties list serv. Therefore the GSA’s choice to delegate GSP development to member agencies did not provide an open and transparent process as required under SGMA. | in Section 5.5 of the MA Plan, as well as the Stakeholder Communication and Engagement Plan (SCEP) included as Appendix E. AEWSD outreach efforts included:  
• letters sent to all landowners and all interested parties;  
• distribution and compilation of a Stakeholder Survey (direct mail in AEWSD billing statements);  
• AEWSD website does include an email and AEWSD Executive Secretary maintains a list of interested parties for mass emails regarding notices;  
• Multiple AEWSD/ACSD informational meetings with flyers mailed and emailed ahead of time, including one to LCJA on 29 May 2019;  
• Multiple letters sent to all Public Water Systems in the MA Plan area;  
• Site visits to certain well owners to discuss domestic well status and location and regarding development of a monitoring network;  
• Letters to “white land” owners;  
• Multiple public stakeholder workshops, some held in triplicate (including with some outside of regular business hours) in the City of Arvin with Spanish language translation. The group Self Help Enterprises (SHE) attended and presented at three of the workshops.  

The above outreach efforts are in addition to those performed by the KGA. A list of meetings during which GSP and SGMA were discussed is included in Appendix E of the MA Plan, which was updated to reflect additional recent meetings. This includes 39 public meetings of the AEWSD Board between 2/9/2016 and 11/12/2019 where opportunity was provided for public comment. The topic of stakeholder engagement was... |
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>also addressed in AEWSD’s email response (dated 11/7/2019; attached below) to questions from LCJA. <em>Additional information on the stakeholder engagement process was added to Section 5.5.2.</em></td>
</tr>
</tbody>
</table>

ACSD’s outreach efforts during the MA Plan development process included:

- April 3, 2017: ACSD Board Meeting
- April 17, 2017 ACSD Board Meeting
- May 1, 2017 ACSD Board Meeting
- November 6, 2017 ACSD Board Meeting
- December 18, 2017 ACSD Board Meeting
- January 3, 2018 ACSD Board Meeting
- April 2, 2018 ACSD Board Meeting
- May 7, 2018 ACSD Board Meeting
- May 21, 2018 ACSD Board Meeting
- September 24, 2018 ACSD Board Meeting
- November 5, 2018 ACD Board Meeting
- November 19, 2018 ACSD Board Meeting
- January 22, 2019 ACSD Board Meeting
- March 4, 2019 ACSD Board Meeting
- April 1, 2018 ACSD Board Meeting
- July 15, 2019 ACSD Board Meeting
- September 3, 2019 ACSD Board Meeting
- Since May 6, 2019 General Manager Updates Board of Directors every meeting on all Kern Basin GSA’s Manager’s Meetings or other meetings and items pertaining to SGMA.
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWS/AECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-7</td>
<td>The Arvin-Edison Water Storage District (&quot;Arvin-Edison WSD&quot;) states in its GSP (&quot;Arvin GSP&quot;) that it considered disadvantaged communities by engaging representatives of the Arvin CSD (&quot;Arvin CSD&quot;), which contains disadvantaged community residents; by creating a Stakeholder Communication and Engagement Plan; and by “welcom[ing] public participation” at stakeholder workshops, Arvin-Edison WSD board meetings, Arvin CSD board meetings, KGA GSA events and meetings, a stakeholder survey, letters to landowners, and small or one-on-one meetings with individual stakeholders. However, as a community-based organization working directly with residents in Arvin, we were not included in these conversations until August 15, 2019 when we attended the Arvin-Edison WSD Board meeting where they presented their GSP chapter to its board for approval. Residents we work with did not have any knowledge of the GSP development process in the Arvin-Edison Management Area. They had heard about SGMA, but had a minimal understanding of what it entailed and were not aware of their local GSP development.</td>
<td>ACSD is a co-author of the Arvin-Edison MA Plan and was directly involved in its preparation. Specific portions of the MA Plan that were prepared by and/or pertain to the ACSD area are listed in Section 4. ACSD also worked directly with other community organizations and groups regarding SGMA, including Committee for a Better Arvin (CBA) a subgroup of the Center for Race Poverty and the Environment. CBA sent a support letter on December 3, 2019 describing the active ways in which ACSD/AEWSD involved then in the SGMA process. Residents of the City of Arvin were sent flyers announcing informational meetings by direct mail and electronic mail (see Appendix E). Records of meeting attendance show that several attendees identified themselves as Arvin residents (see Appendix E).</td>
</tr>
<tr>
<td>Page Number in LCJA Letter</td>
<td>LCJA Comment</td>
<td>Response from AEWSD/ACSD</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------</td>
<td>--------------------------</td>
</tr>
</tbody>
</table>
| 7                         | Additionally, as mentioned above, **Arvin-Edison WSD** did not maintain a list of interested parties that the public could access; their website contains no sign-up, and no meeting notices or agendas about GSP development meetings were published in any publicly available fora. In addition to this violation of public engagement requirements under SGMA, the members agency did not follow the Brown Act by publishing public meeting notices and agendas before meetings, and does not have agendas or meeting minutes on its website so that such materials are available to the public. ¹⁹ | • Residents that work directly with LCJA are encouraged to request a meeting with AEWSD/ACSD for a GSP update or other district purposes. | • The SCEP Section 4 describes the process for stakeholder identification by AEWSD and the KGA. A list of interested parties was identified in the SCEP and continuously updated during the MA Plan development process.  
• AEWSD website does include an email address that would provide anyone to be included as an interested party  
• All AEWSD customers and interested parties are on the AEWSD list serv and thus receive announcements from AEWSD, including meeting announcements and agendas.  
• Engagement of ACSD customers was handled by ACSD, in coordination with SHE and other community organizations, including CBA.  
• AEWSD follows all applicable public noticing requirements. The topic of public noticing and Brown Act compliance was also addressed in AEWSD’s email response (dated 11/7/2019; attached below) to questions from LCJA.  
• References made to Kern River GSA appear to be an error however future stakeholder engagement will follow the SCEP as outlined in **Appendix E** |
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 8                          | The Kern Subbasin Undesirable Results Do Not Comply with Existing Law        | • The Undesirable Results definitions in the Arvin-Edison MA Plan were developed in accordance with existing law (SGMA).  
                               |                                                                              | • See KGA response to this comment for further information.                                                                                               |
| 11                         | The GSP’s Minimum Thresholds and Measurable Objectives Are Not Adequate      | • See comment response below.  
                               |                                                                              | • See KGA response to this comment for further information.                                                                                               |
| 12                         | The KGA GSA did not ensure that minimum thresholds created by member agencies considered the interests of all beneficial user groups, or prioritize the security of drinking water in the subbasin, in developing minimum thresholds.  
                               | The AEWS Management Area Draft GSP details how it calculated historical water lows and divided the Management Area into four sections based on historical low groundwater levels and agency jurisdiction, and how it adjusted the minimum thresholds to protect the canal that brings surface water to farmers.  
                               |                                                                              | • AEWSD did evaluate potential impacts of Minimum Thresholds on dewatering of wells, including an assessment of how many wells could potentially be dewatered (see Section 14.1.1 and Figures SMC-4 and SMC-5).  
                               |                                                                              | • Section 18.1.6 of the MA Plan includes discussion of development of an Impacted Well Mitigation Program (also referred to as a Well Dewatering Mitigation Program) to address potential impacts arising from low groundwater levels, and has been updated to include more information on the types of mitigation that may be included in the program.  
                               |                                                                              | • The topic of groundwater level SMCs and analysis of potential well impacts was also addressed in AEWS’s email response (dated 11/7/2019; attached below) to questions from LCJA.  
<pre><code>                           |                                                                              | • ACS worked in conjunction with AEWS in regard to minimum thresholds levels. ACS believes these thresholds would be sufficient with respect to adequate water quality based on our well completion report. |
</code></pre>
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 14-15                     | As in the case of groundwater levels, it is clear that the GSA has not considered the potential impact on drinking water users, in particular disadvantaged communities who are less able to afford solutions to treat contaminated drinking water. This has resulted in minimum thresholds and measurable objectives like those in the Arvin GSP, which will only be monitoring for compliance with sustainable management criteria in one well location, and has set the minimum threshold at the drinking water MCL for the contaminant, and the measurable objective at 75% of the MCL. The member agency is only monitoring for compliance with arsenic standards, despite the agency’s knowledge of the existence of “nitrate...total dissolved solids (TDS), boron, iron and manganese...within or near the Arvin-Edison Management Area above drinking water standards and/or agricultural water quality goals.” | • AEWSD did conduct an extensive analysis of water quality based on the available data (see Section 8.5 and Figures GWC-9 through GWC-13, and Appendix H) and in consultation with representatives of beneficial users of the water (e.g., ACSD).  
• Arsenic is the one constituent identified by ACSD as having the potential to be influenced by groundwater management activities, and was thus selected for use as a Sustainable Management Criterion (see Section 14.4.1).  
• As stated in a footnote in the MA Plan, “SGMA does not empower GSAs to develop or enforce water quality standards; that authority rests with the State Water Resources Control Board (SWRCB) Division of Drinking Water and the County. Because of the limited purview of GSAs with respect to water quality, and the rightful emphasis on those constituents that may be related to groundwater quantity management activities, the only constituent of concern applicable within the Arvin-Edison Management Area is arsenic in the vicinity of the City of Arvin and ACSD. Furthermore, drinking water quality regulations for public water systems apply at the point of delivery to customers, not in the raw water source, and ACSD blends water from its various well sources.”  
• All monitoring sites will be sampled for the constituents identified in the Groundwater Quality Concerns section (Section 8.5.1), as well as other relevant groundwater quality parameters (see Section 16.1.4). Collection of |
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>additional data during plan implementation will be used to refine SMC definitions, as discussed in <strong>Section 13.4</strong>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All ACSD wells are sampled regularly in accordance with their SWRCB permit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The Representative Monitoring Site (RMS) was selected by ACSD, based on the list of considerations described in detail in <strong>Section 16.1.4</strong>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The topic of groundwater quality SMCs and monitoring networks was also addressed in AEWSD’s email response (dated 11/7/2019; attached below) to questions from LCJA.</td>
</tr>
<tr>
<td>15</td>
<td>The lack of sufficient groundwater quality sustainable management criteria in areas like <strong>Arvin</strong> is likely to lead to critical drinking water impacts, and will be disproportionately felt by disadvantaged communities, who are less able to afford treatment solutions.</td>
<td>• The sustainable management criteria (SMCs) for degraded water quality were developed by AEWSD and ACSD with direct consideration of the drinking water beneficial use (see <strong>Section 14.4</strong>).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The water quality SMCs and monitoring in the MA Plan are in addition to the drinking water standards and monitoring requirements to which ACSD is held under its drinking water permit from the State Water Resources Control Board (SWRCB) Division of Drinking Water (see <strong>Section 14.4</strong>).</td>
</tr>
<tr>
<td>15</td>
<td>The GSA has also not specified what actions will be taken if water contamination approaches minimum thresholds, or how minimum thresholds will be triggered. Member agencies such as the <strong>Arvin-Edison WSD</strong> have not specified this in their plans.</td>
<td>• As a public water supplier, ACSD has the responsibility to provide safe drinking water, under regulatory oversight by the SWRCB Division of Drinking Water, which is separate from SGMA.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Under its water system permit from the SWRCB, ACSD provides for water treatment and monitoring of water quality, separate from SGMA.</td>
</tr>
<tr>
<td>Page Number in LCJA Letter</td>
<td>LCJA Comment</td>
<td>Response from AEWSD/ACSD</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 17                         | The Monitoring Network is Inadequate With Respect to Groundwater Levels and Groundwater Quality | - SGMA does not require that a GSP describe the process that will take place if water quality measurements approach Minimum Thresholds.  
- **Section 14.4.2** of the MA Plan specifies the Minimum Threshold for groundwater quality as the exceedance of Maximum Contaminant Levels (MCL) for arsenic at the Representative Monitoring Site (i.e., ACSD Well #14). This description of the MT therefore **does** include a description of "how minimum thresholds will be triggered" (i.e., by an exceedance of the MCL for arsenic over four consecutive bi-annual measurement).  
- ACSD operates its wells under permit from the SWRCB which has its own monitoring schedule and reporting requirements. |
| 18                         | The groundwater quality monitoring network does not adequately capture impacts on drinking water users. In the case of the Arvin GSP, the member agency will only monitor for compliance with its minimum threshold and measurable objective for Arsenic once a year in one well, ACSD Well #14, which is one of the wells that provide drinking water to the community of Arvin. | - See comment response below.  
- See KGA response to this comment for further information.  
- As described above, ACSD monitors its supply wells for a list of constituents described in and on a schedule set by its drinking water system permit from the SWRCB. The water quality monitoring in this MA Plan is in addition to the monitoring conducted by ACSD under its permit.  
- The topic of groundwater quality monitoring networks was also addressed in AEWSD’s email response (dated 11/7/2019; attached below) to questions from LCJA. |
<p>| 18                         | Second, only measuring for compliance with arsenic measurable objectives and minimum thresholds does not protect against increases | - Arsenic was chosen as the only constituent for defining SMCs because it is currently the only constituent |</p>
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWS/ACSD</th>
</tr>
</thead>
</table>
| 18                          | in other contaminants that exist in other parts of the management area (boron, nitrates, TDS, 123-TCP, iron and manganese). These contaminants could extend, move or increase due to groundwater management activities and pumping patterns. The Arvin GSP does plan to monitor for these contaminants in seven other wells outside of Arvin, but has not set minimum thresholds and measurable objectives for these wells, and does not have plans to do so. | determined to be related to water management activities (i.e., water levels) (see Section 13.4.2). Other constituents are either naturally occurring or regulated pursuant to different programs. Additional data collection and analysis, as described in the MA Plan, will be used to inform the consideration of water quality issues in the future.  
- The topic of groundwater quality SMCs was also addressed in AEWS’s email response (dated 11/7/2019; attached below) to questions from LCJA. |
| 18                          | Furthermore, Arvin is currently experiencing 123-TCP contamination that threatens the health of Arvin residents, so the GSP must monitor for compliance with 123-TCP standards in particular. |  
- ACSD has recently installed a treatment system for 1,2,3-TCP in one of its production wells to address this occurrence of contamination (see Section 17.2.3).  
- ACSD has also included in this MA Plan, and is currently implementing, a project to mitigate arsenic and 1,2,3-TCP in its raw water supply through well replacement (see Section 19.1.2).  
- ACSD has never been out of compliance with 1,2,3-TCP as SWRCB set the MCL to take effect January 1, 2018. Wells that contained 1,2,3-TCP were taken offline in January 2018 when the MCL for 1,2,3-TCP was implemented. Arvin CSD is in litigation with Dow Chemical and Shell Oil Co. to collect on damages to the wells that were affected. |
| 19                          | Third, the well that was chosen, ACSD Well #14, was chosen because it does not have contaminants that are known to exist in wells in the northern part of the management area, which are not currently in use by Arvin CSD, according to our conversation with Arvin-Edison WSD. |  
- ACSD Well #14 was chosen by ACSD as it is considered representative of wells in the ACSD area that constitute the majority of drinking water beneficial use in the MA Plan area (see Section 16.1.4). |
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
|                            | staff at the Kern Subbasin Open House on September 26th, 2019. However, avoiding monitoring contaminated areas defeats the purpose of groundwater quality monitoring under SGMA, which is to measure the concentration and spread of contaminant plumes to ensure that groundwater management activities and pumping do not aggravate existing contamination. The GSA should ensure that the member agency instead monitors for all existing contaminants at minimum throughout the area and especially in areas where contamination is known to exist, and sets minimum thresholds and measurable objectives that apply to all monitoring wells. | • AEWSD staff has never, at the 9/26/2019 Kern Subbasin Open house nor at any other time, ever contended that the reason for selection of the ACSD Well #14 was, as the comment states, “because it does not have contaminants that are known to exist in wells in the northern part of the management area.”  
• ACSD chose this well as it is the northern most active well in its water system. This well would serve as an early indicator that would allow detection of any early signs of water quality degradation. Well #14 does contain levels of Arsenic which are below the MCL, but would be a good indicator of groundwater conditions.                                                                 |
| 20                         | Current Projects and Management Actions are Inadequate                                                                                                                                                        | • See comment response below.  
• See KGA response to this comment for further information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
<p>| 20                         | The GSA has allowed member agencies like the Arvin-Edison WSD to use a “glidepath” approach that increases surface water and groundwater recharge before demand reduction measures are implemented.67                                                                 | • Supply augmentation projects and demand reduction management actions (as needed) are to be implemented in a balanced approach under the “glide path” laid out in the Arvin-Edison MA Plan (see Section ES.10; Section 9.4.5; Section 17.1.4; and Table PMA-2).                                                                                                                                                                                                                                                                                                                                                   |
| 20                         | The Arvin GSP contains two projects for treating water quality in Arvin, but these projects were already under way and fully funded so should not be included in the GSP. The GSP has no overall drinking water protection program to protect residents against dry wells and contaminated drinking water from its policies and groundwater management activities.                                                                 | • These two projects were identified by ACSD as projects to include in the MA Plan because they aim to address the water quality sustainability indicator and relevant beneficial uses (i.e., drinking water supply).                                                                                                                                                                                                                                                                                                                                 |
| 21                         | The GSA Must Clearly Commit to a Drinking Water Protection Program for the Kern                                                                                                                               | • See KGA response to this comment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |</p>
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Recharge In or Near Disadvantaged Communities and Domestic Well Clusters</td>
<td>• See KGA response to this comment.</td>
</tr>
<tr>
<td>22</td>
<td>Establish Pumping Buffer Zones That Protect Disadvantaged Communities and Clusters of Domestic Wells</td>
<td>• See KGA response to this comment.</td>
</tr>
<tr>
<td>22</td>
<td>Warning Against a Groundwater Market</td>
<td>• See KGA response to this comment.</td>
</tr>
<tr>
<td>22</td>
<td>Multi-benefit projects</td>
<td>• See KGA response to this comment.</td>
</tr>
<tr>
<td>22</td>
<td>Funding of Projects and Management Actions</td>
<td>• See comment response below.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• See KGA response to this comment for further information.</td>
</tr>
</tbody>
</table>

Furthermore, any proposed assessments that will pay for projects may not place a disproportionate financial burden on disadvantaged communities. Small disadvantaged communities like Arvin should not be required to pay fees for GSP implementation.

• **Section 17.11** of the MA Plan describes the various funding sources that may be used to pay for the planned P/MAs.
• **Section 18.2.2** and **Section 19.2.2** list the funding sources identified by AEWSD and ACSD, respectively, to support general GSP implementation.
• The topic of GSP funding was also addressed in AEWSD’s email response (dated 11/7/2019; attached below) to questions from LCJA.
• ACSD and AEWSD have created a Memorandum of Understanding with regards to SGMA. It shall be noted that ACSD was not asked to contribute financially, which for ACSD stands to be a substantial cost savings.
• ACSD does participate financially with the KGA, but the KGA is set up for participating agencies to pay based on
<table>
<thead>
<tr>
<th>Page Number in LCJA Letter</th>
<th>LCJA Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>acreage which made being a voting member readily accessible for DAC like Arvin and Shafter.</td>
<td>• See KGA response to this comment.</td>
</tr>
<tr>
<td>23</td>
<td>The Draft GSP Threatens to Infringe on Water Rights</td>
<td>• See KGA response to this comment.</td>
</tr>
<tr>
<td>23</td>
<td>The Draft GSP Conflicts with the Reasonable And Beneficial Use Doctrine</td>
<td>• See KGA response to this comment.</td>
</tr>
<tr>
<td>23</td>
<td>The Draft GSP Conflicts with the Public Trust Doctrine</td>
<td>• See KGA response to this comment.</td>
</tr>
</tbody>
</table>
## Summary of Comments in the Wonderful Orchards/Wonderful Citrus (WOWC) Comment Letter (11/27/2019) to KGA and Responses from AEWSD/ACSD

<table>
<thead>
<tr>
<th>Page Number in WOWC Letter</th>
<th>WOWC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 1                          | Quantification of Native Yield | • “Native yield”, as defined in the Coordinated Water Budget, is applied to all lands in the basin uniformly (see Section 9.1.3).  
• Section 9.1.3 was added to clarify the intended purpose of the water budget, and includes a statement that “the “water accounting” approach described in the Coordination Agreement and Appendices thereto does attempt to evaluate the water budget using certain management assumptions (e.g., a uniform “native yield component to all lands within the Basin). However, nothing in this water budget information results in or is intended to be a determination of water rights within the Arvin-Edison Management Area”.  
• Implementation of P/MAs, including actions to further refine issues related to water budgets, is described in Section 18.1.2.  
• See KGA response to this comment for further information. |
<p>| 2                          | Allocation of Native Yield | • Section 18.1.4 which describes Stakeholder Engagement as part of MA Plan implementation, has been modified to include a statement that any actions to establish landowner-level allocations of native yield |</p>
<table>
<thead>
<tr>
<th>Page Number in WOWC Letter</th>
<th>WOWC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
|                           | acre. It is our understanding that subsequent to the release of the draft GSP, all MAPs and other GSPs in the basin agreed to utilize the same number for their water budgets. If referencing native yield this way is necessary, the GSP should clarify that it is for initial water budget purposes ONLY, is non-precedent setting, and is not a determination of individual landowner allocations or groundwater rights. Alternatively, in the 2020 plans subbasin native yield could be described as a total volume of water and not associated with a given gross or net area. In addition, GSAs should initiate a stakeholder-driven process to develop a methodology for establishing landowner-level allocations of native yield that are coordinated across the subbasin. The allocation methodology should be consistent with various legal considerations drawn from applicable case law and be generally consistent with groundwater rights, recognizing that GSAs do not have statutory authority to make a final determination of water rights. An equal-per-gross acre approach to allocations is not likely to be consistent with established water rights doctrine, which must recognize many equitable considerations in addition to acreage owned, to determine a legally defensible allocation. Further information regarding allocation methodology can be found in Groundwater Pumping Allocations Under California’s Sustainable Groundwater Management Act – Environmental Defense Fund and New Current Water & Land, July 2018. | will be conducted through a robust stakeholder engagement process.  
- See KGA response to this comment for further information.  
- Also see response to comment above. |
| 2 | **Groundwater Markets**  
Markets are essential in facilitating the highest and best use of a limited resource and in giving landowners the most flexibility to minimize the economic impacts of pumping restrictions. To enable a market that works for all landowners in the subbasin, it is imperative that all pumpers know exactly how much marketable water they have available for use or transfer. Unless it is deemed necessary to prevent | • The MA Plan includes in its portfolio of P/MAs a management action to evaluate and potentially implement a groundwater marketing and trading system (see Section 17.2.2).  
• As described in Section 18.1.2, implementation of P/MAs, including the potential establishment of a |
<table>
<thead>
<tr>
<th>Page Number in WOWC Letter</th>
<th>WOWC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 2                           | Pumping Restrictions  
Wonderful understands that there are instances where it may be necessary to restrict pumping in order to achieve basin-wide sustainability. If this becomes a necessity, the GSAs or MAs should implement pumping restrictions when supported by the best available data and appropriate analytical tools. Furthermore, if possible, pumping should be ramped down gradually over the implementation period to avoid a sudden disruption in economic activity.  
As with native yield allocations, initial pumping allowances and ramp down schedules should be coordinated across the entire basin so that similarly situated pumpers in the basin are treated equitably regardless of their respective MA (some MAPs include a ramp down schedule for groundwater-only lands and others do not; this is a significant difference and should be reconciled). | • Demand reduction Management Actions are included in the MA Plan as one element in a portfolio of P/MAs (see Section 17).  
• The P/MA implementation timetable is based on a phased/incremental “glide path” approach (see Section 17.1.4).  
• P/MA implementation will entail, in many cases, performing studies and/or analysis to refine concepts into actionable projects or policies (see Section 18.1.2).  
  *Section 18.1.2 was modified to clarify that such studies will be based on using the best available data and science.*  
• See KGA response to this comment for further information. |
| 3                           | Groundwater Recharge and Banking  
GSAs must develop clear policies and conditions that protect existing investment in groundwater banking and banked inventory, and without interference with existing rules and regulations. GSAs must also find a way to incentivize additional investment, such as on-farm recharge, and allow flexibility for recharged or banked water to be freely transferable (subject to the rights and conditions of use associated with the source water and the avoidance of undesirable results). | • As described in Section 18.1.2, implementation of P/MAs, including projects to enhance recharge and projects to manage and/or capture floodwater, will include performance of any appropriate further studies and analysis, including engineering, economic/financial, and/or legal, as appropriate. |
<table>
<thead>
<tr>
<th>Page Number in WOWC Letter</th>
<th>WOWC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Where possible, GSPs should also identify management areas that may benefit from additional recharge and banking. We also recommend that GSAs work to develop incentives for public or private investment to expand recharge and banking capacity, as these facilities help to achieve multiple benefits (e.g., habitat, water quality, drinking water, etc.).</td>
<td>• See KGA response to this comment for further information.</td>
</tr>
</tbody>
</table>
| 3                         | **Measurement and Data Management**  
Finally, GSAs should develop a coordinated basin-wide data management system ("DMS") that is capable of tracking groundwater and surface water use at the landowner, field, or parcel level, and a coordinated methodology for measuring landowner-level use of groundwater. The DMS should also include, or be capable of interfacing with, a groundwater market platform that allows for individual users to conduct transactions.  
Markets will be most effective if there is confidence in the accuracy of the measurements taken, consistency in the data sources relied upon, and flexibility to allow for transactions across the basin. For instance, GSAs using remote sensing to calculate crop evapotranspiration ("ET") as a measurement of consumptive use of groundwater should develop methodologies and quality assurance elements to allow for grower provided information to be included into the ET calculation and calibration. Additionally, GSAs should establish criteria and procedures to address any apparent inaccuracies in the ET calculations (e.g., if calculated ET is greater than applied water and precipitation). | • The comment is noted.  
• **Section 8.1 has been added to the MA Plan to describe data sources used in MA Plan development and how this local DMS will be coordinated with the basin-wide DMS.**  
• **Appendix I has been added to the MA Plan to list additional water quality data sources that will be evaluated during MA Plan implementation.**  
• The Plan implementation section includes an action to refine the local DMS to comply with (coordinate with) the basin-wide DMS (see Sections 18.1.1 and 18.1.3).  
• See KGA response to this comment for further information. |
<table>
<thead>
<tr>
<th>Comment Number</th>
<th>FR Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Allocation of Groundwater Rights. Though not specifically addressed, we are concerned that the overlying right to extract groundwater will be allocated among all District landowners based on gross acreage. While this is a simple approach to what can be a complex issue, it ignores accepted principles of law intended to more fairly allocate this right among those who have historically used groundwater for irrigation purposes and made substantial investments based on that use. We wish to at least see identification of this issue in the Chapter and an acknowledgment that it will not be decided now. If the District determines that the issue is broader, then we leave it to the District to address it at the Uberta GSP level. Any implication that the District has decided to allocate the overlying groundwater rights based simply on gross acreage could invite some to pursue premature legal action to challenge the District's conclusion, which might not be necessary depending on the success of the proposed actions in the Chapter. While this issue certainly affects our interests, we are equally concerned about avoiding unnecessary legal challenges made by others and the instability that would bring to the sub-basin.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• “Native yield”, as defined in the Coordinated Water Budget, is applied to all lands in the basin uniformly (see Section 9.1.3).</td>
<td></td>
</tr>
</tbody>
</table>
|               | • Section 9.1.3 was added to clarify the intended purpose of the water budget, and includes a statement that “the “water accounting” approach described in the Coordination Agreement and Appendices thereto does attempt to evaluate the water budget using certain management assumptions (e.g., a uniform “native yield component to all lands within the Basin). Howev, nothing in this water budget information results in or is intended to be a determination of water rights within the Arvin-Edison Management Area”.
<p>|               | • Implementation of P/MAs, including actions to further refine issues related to water budgets, is described in Section 18.1.2. |
|               | • See KGA response to this comment for further information. |
| 2             | Native Yield. The Chapter identifies a coordinated estimated native yield of 0.15-0.30 acre feet per acre across the KGA. We understand and acknowledge that some number needed to be identified for Water Budget and planning purposes and support the use of these numbers for such purposes. However, these numbers should not be seen as establishing a precedent or used to establish some legal right. Therefore, a statement emphasizing the above points should be made - the planning purpose nature of these numbers and not establishing legal precedent. Additionally, in coordinating with other members of the KGA under the Uberta GSP, the District should push for a consistent native yield and related methodology across the sub-basin. We understand that this |
|               | • “Native yield”, as defined in the Coordinated Water Budget, is applied to all lands in the basin uniformly (see Section 9.1.3). |
|               | • Section 9.1.3 was added to clarify the intended purpose of the water budget, and includes a statement that the “native yield” is for planning purposes only and not a determination of actual legal ground water rights. |
|               | • Implementation of P/MAs, including actions to further refine issues related to allocations of groundwater, is described in Section 18.1.2. |
|               | • See KGA response to this comment for further information. |</p>
<table>
<thead>
<tr>
<th>Comment Number</th>
<th>FR Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 3              | Groundwater Market. This issue might be premature at this point. However, the Chapter could address the possibility of a market for the exchange or transfer of groundwater credits. If a market system were contemplated, we would encourage such a system to be as flexible as possible (within the requirements of SGMA, the Chapter and the Umbrella GSP) to facilitate the needs of farmers with lands in different areas of the sub-basin and those with the ability to store surface water underground. Again, this might be premature at this time, but a mention of the District’s position to support a flexible groundwater market could help move the discussion forward once the Umbrella GSP is submitted to the Department of Water Resources and agencies begin the implementation process. | • The MA Plan includes in its portfolio of P/MAs a management action to evaluate and potentially implement a groundwater marketing and trading system (see Section 17.2.2).  
• As described in Section 18.1.2, implementation of P/MAs, including the potential establishment of a market-based system, will include performance of any appropriate further studies and analysis, including engineering, economic/financial, and/or legal, as appropriate.  
• See KGA response to this comment for further information. |
<table>
<thead>
<tr>
<th>Page Number in HFS Letter</th>
<th>HFS Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 1 | **Allocation of Native Yield**  
The GSP references native yield in terms of acre-feet per gross acre for water budget purposes. If referencing it this way is necessary, the GSP should clarify that these calculations are for initial water budget purposes ONLY, are non-precedent setting, and not a determination of individual landowner allocations or groundwater rights. Alternatively, native yield could be described only as a total volume of water, for example xxx,xxx acre-feet and not associated with a given gross or net area.  
In the event that allocations of any sort are distilled to a landowner or property level, HFS encourages the GSAs in the basin to initiate a stakeholder-driven process to develop a methodology for establishing landowner-level allocations that are coordinated across the basin. The allocation methodology should be consistent with various legal considerations drawn from applicable case law and attempt to be consistent with groundwater rights, recognizing that GSAs do not have statutory authority to make a final determination of water rights. An equal-per-gross acre approach to allocations is not likely to be consistent with established water rights doctrine, which must recognize many equitable considerations, in addition to acreage owned, to determine a legally defensible allocation. Further information regarding allocation methodology can be found in Groundwater Pumping Allocations Under California’s Sustainable Groundwater Management Act – EDF and NCWL, dated July, 2018. | • “Native yield”, as defined in the Coordinated Water Budget, is applied to all lands in the basin uniformly (see Section 9.1.3).  
• **Section 9.1.3 was added to clarify the intended purpose of the water budget, and includes a statement that “the “water accounting” approach described in the Coordination Agreement and Appendices thereto does attempt to evaluate the water budget using certain management assumptions (e.g., a uniform “native yield component to all lands within the Basin). However, nothing in this water budget information results in or is intended to be a determination of water rights within the Arvin-Edison Management Area”**.  
• Implementation of P/MAs, including actions to further refine issues related to water budgets, is described in Section 18.1.2.  
• **Section 18.1.4 which describes Stakeholder Engagement as part of MA Plan implementation, has been modified to include a statement that any actions to establish landowner-level allocations of native yield will be conducted through a robust stakeholder engagement process.**  
• See KGA response to this comment for further information. |
| 1 | **Groundwater Recharge and Banking**  
GSAs and MAs must develop clear and understandable policies and conditions that protect existing groundwater banking and banked inventory and allow them to continue operating as they have been under their existing rules and regulations without interference. They | • As described in Section 18.1.2, implementation of P/MAs, including projects to enhance recharge and projects to manage and/or capture floodwater, will include performance of any appropriate further studies |
<table>
<thead>
<tr>
<th>Page Number in HFS Letter</th>
<th>HFS Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
|                           | must also incentivize additional investment, such as on-farm recharge by providing pumping credits and allow flexibility for recharged or banked water to be freely transferrable subject to the rights and conditions of use associated with the source water and the avoidance of undesirable results. They should develop incentives for public or private investment to expand recharge and banking capacity, as these facilities help to achieve multiple benefits (e.g., habitat, water quality, drinking water, etc.). | and analysis, including engineering, economic/financial, and/or legal, as appropriate.  
- See KGA response to this comment for further information. |
| 3                         | **Refinement and Validation of Consumptive Use Calculations Based on ET Measurement**  
HFS supports use of efficient and accurate systems to determine groundwater use. GSAs using remote sensing to calculate crop ET as a measurement of consumptive use of groundwater should develop methodologies and quality assurance elements to allow for grower-provided information to be included into the ET calculation and calibration. These methodologies should be developed in consultation with the vendor providing ET data to ensure it is applicable and useful in creating the best available data set. Additionally, GSAs and/or MAs should establish criteria and procedures to address apparent inaccuracies in the ET calculations. An obvious use of the procedure would be in instances where the grower can demonstrate that applied water, plus precipitation, is less than the calculated ET. In these instances, and subject to any requirements established by the GSA, the grower’s use of groundwater should be reduced to the applied water total as the ET calculation should not be greater than applied water. |  
- The comment is noted.  
- See KGA response to this comment for further information. |
<table>
<thead>
<tr>
<th>Page Number in WGIM Letter</th>
<th>Allocation of Native Yield</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The GSP references native yield in terms of acre-feet per gross acre for water budget purposes. If referencing it this way is necessary, the GSP should clarify that these calculations are for initial water budget purposes ONLY, are non-precedent setting, and not a determination of individual landowner allocations or groundwater rights. Alternatively, native yield could be described only as a total volume of water and not associated with a given gross or net area. In the event that allocations are to be made at a landowner or property level, WGIM encourages the KGA and other GSAs in the basin to initiate a stakeholder-driven process to develop a methodology for establishing landowner-level allocations that are coordinated across the basin. The allocation methodology should be consistent with various legal considerations drawn from applicable case law and attempt to be consistent with groundwater rights, recognizing that GSAs and Management Areas (MAs) do not have statutory authority to make a final determination of water rights. An equal-per-gross acre approach to allocations is not likely to be consistent with established water rights doctrine, which must recognize many equitable considerations, in addition to acreage owned, to determine a legally defensible allocation. Further information regarding allocation methodology can be found in Groundwater Pumping Allocations Under California’s Sustainable Groundwater Management Act – EDF and NCWL, dated July, 2018.</td>
<td>“Native yield”, as defined in the Coordinated Water Budget, is applied to all lands in the basin uniformly (see Section 9.1.3). Section 9.1.3 was added to clarify the intended purpose of the water budget, and includes a statement that the “the “water accounting” approach described in the Coordination Agreement and Appendices thereto does attempt to evaluate the water budget using certain management assumptions (e.g., a uniform “native yield component to all lands within the Basin). However, nothing in this water budget information results in or is intended to be a determination of water rights within the Arvin-Edison Management Area”. Implementation of P/MAs, including actions to further refine issues related to allocations of groundwater, is described in Section 18.1.2. Section 18.1.4 which describes Stakeholder Engagement as part of MA Plan implementation, has been modified to include a statement that any actions to establish landowner-level allocations of native yield will be conducted through a robust stakeholder engagement process. See KGA response to this comment for further information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demand reduction Management Actions are included in the MA Plan as one element in a portfolio of P/MAs (see Section 17).</td>
</tr>
</tbody>
</table>

1 | Pumping Restrictions | We understand that there are instances where it may be necessary to restrict pumping in order to achieve basin-wide sustainability. If this becomes a necessity, the GSAs and MAs should implement pumping |
<table>
<thead>
<tr>
<th>Page Number in WGIM Letter</th>
<th>WGIM Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 2                           | Restrictions when supported by the best available data and appropriate analytical tools. Furthermore, if possible without creating undesirable results, pumping should be ramped down gradually over the implementation period to avoid a sudden disruption in economic activity. As with native yield allocations, initial pumping allowances and ramp down schedules should be coordinated and consistent across the entire basin so that similarly situated pumpers in the basin are treated equitably regardless of their respective MA (some MAPs include a ramp down schedule for groundwater-only lands and others do not; this is a significant difference and should be reconciled). | • The P/MA implementation timetable is based on a phased/incremental “glide path” approach (see Section 17.1.4).  
• P/MA implementation will entail, in many cases, performing studies and/or analysis to refine concepts into actionable projects or policies (see Section 18.1.2).  
Section 18.1.2 was modified to clarify that such studies will be based on using the best available data and science.  
• See KGA response to this comment for further information. |
| 2                           | **Groundwater Recharge and Banking**  
GSAs and MAs must develop clear and understandable policies and conditions that protect existing groundwater banking and banked water inventory, and allow them to continue operating as they have been under their existing rules and regulations without interference. They must also incentivize additional investment, such as on-farm recharge by providing pumping credits and allow flexibility for recharged or banked water to be freely transferrable subject to the rights and conditions of use associated with the source water and the avoidance of undesirable results. They should develop incentives for public or private investment to expand recharge and banking capacity, as these facilities help to achieve multiple benefits (e.g., habitat, water quality, drinking water, etc.). | • As described in Section 18.1.2, implementation of P/MAs, including projects to enhance recharge and projects to manage and/or capture floodwater, will include performance of any appropriate further studies and analysis, including engineering, economic/financial, and/or legal, as appropriate. |
| 2                           | **Measurement and Data Management**  
GSAs should develop a coordinated basin-wide data management system (“DMS”) that is capable of tracking groundwater and surface water use at the landowner, field, or parcel level, and a coordinated methodology for measuring landowner-level use of groundwater. The DMS should also include, or be capable of interfacing with, a  
|                                                                                                                                                                                                 | • The comment is noted.  
• *Section 8.1 has been added to the MA Plan to describe data sources used in MA Plan development and how this local DMS will be coordinated with the basin-wide DMS.* |
<table>
<thead>
<tr>
<th>Page Number in WGIM Letter</th>
<th>WGIM Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
|                           | groundwater market platform that allows for individual users to conduct transactions. Markets will be most effective if there is confidence in the accuracy of the measurements taken, consistency in the data sources relied upon, and flexibility to allow for transactions across the basin. For instance, GSAs using remote sensing to calculate crop evapotranspiration ("ET") as a measurement of consumptive use of groundwater should develop methodologies and quality assurance elements to allow for grower provided information to be included into the ET calculation and calibration. Additionally, GSAs should establish criteria and procedures to address any apparent inaccuracies in the ET calculations (e.g., if calculated ET is greater than applied water and precipitation). | - Appendix I has been added to the MA Plan to list additional water quality data sources that will be evaluated during MA Plan implementation.  
- The Plan implementation section includes an action to refine the local DMS to comply with (coordinate with) the basin-wide DMS (see Sections 18.1.1 and 18.1.3).  
- See KGA response to this comment for further information. |
| 3                         | **Refinement and Validation of Consumptive Use Calculations Based on ET Measurement**  
WGIM supports use of efficient and accurate systems to determine groundwater use. GSAs using remote sensing to calculate crop ET as a measurement of consumptive use of groundwater should develop methodologies and quality assurance elements to allow for grower-provided information to be included into the ET calculation and calibration. These methodologies should be developed in consultation with the vendor providing ET data to ensure it is applicable and useful in creating the best available data set. Additionally, GSAs and/or MAs should establish criteria and procedures to address apparent inaccuracies in the ET calculations. An obvious use of the procedure would be in instances where the grower can demonstrate that applied water, plus precipitation, is less than the calculated ET. In these instances, and subject to any requirements established by the GSA, the grower’s use of groundwater should be reduced to the applied water total as the ET calculation should not be greater than applied water. | - The comment is noted.  
- See KGA response to this comment for further information. |
<table>
<thead>
<tr>
<th>CDFW Comment Number</th>
<th>CDFW Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 1                   | The Plan Area narrative does not identify Department-owned lands.            | • The Arvin-Edison MA Plan identifies lands owned by the California Department of Fish and Wildlife in **Section 5.1.3** and on **Figure PA-2**.  
  • See KGA response to this comment for further information. |
| 2                   | The GSP identifies an ‘environmental’ category of beneficial user but does not specify how impacts to environmental beneficial uses and users of groundwater were considered throughout the GSP. | • The process used to assess the potential occurrence of “environmental” uses/users of groundwater in the Management Area is based on depth to groundwater based on available data from wells in the principal aquifer, as described in **Section 8.2, 8.7** and **8.8**. This process was informed by the TNC (2019) guidance for evaluation of GDEs.  
  • See KGA response to this comment for further information. |
| 3                   | The GSP identifies the potential for interconnected surface waters but dismisses further evaluation of interconnectivity and abdicates oversight of shallow groundwater-surface water communication. | • The process used to assess the potential occurrence of interconnected surface water in the Management Area is based on depth to groundwater (similar to the process used for evaluation of GDEs, which was done consistent with TNC (2019) guidance; see below) based on available data from wells in the principal aquifer, as described in **Section 8.2 and 8.7**.  
  • See KGA response to this comment for further information. |
<p>| 4                   | The GDE identification section, pursuant to 23 CCR§ 354.16 (g), identifies ecosystems that may depend on groundwater. A report completed by the California Department of Water Resources (CDWR) | • The process used to assess the potential occurrence of GDEs in the Management Area is based on depth to groundwa |</p>
<table>
<thead>
<tr>
<th>CDFW Comment Number</th>
<th>CDFW Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| (1997) shows that a large area of Kern County has 0 to 10 feet to depth to free water below the surface (see CDWR Figures 2, 3 and 5). Based on the presence of shallow groundwater, the Department supports the further investigation of GDEs and recommends including additional references for a more robust GDE evaluation. The Department recognizes that Natural Communities Commonly Associated with Groundwater (NCCAG) (Klausmeyer et al. 2018) provided by CDWR is a good starting reference for GDEs. There are additional resources available for evaluating GDE locations and habitat types, as well as information for State and Federal listed species. These recommended references include, but not limited to the following tools and other resources: the California Department of Fish and Wildlife (CDFW) Vegetation Classification and Mapping Program (VegCAMP) (CDFW 2019A); the CDFW California Natural Diversity Database (CNDDDB) (2019B); the California Native Plant Society (CNPS) Manual of California Vegetation (CNPS 2019A); the CNPS California Protected Areas Database (CNPS 2019B); the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (2018); the USFWS online mapping tool for listed species critical habitat (2019); the United States Forest Service CALVEG ecological grouping classification and assessment system (2019); and other publications by Klausmeyer et al. (2019), Rohde et al. (2018), The Nature Conservancy (TNC) (2014, 2019), and Witham et al. (2014). | Based on available data from wells in the principal aquifer, as described in Section 8.2 and 8.8.  
- **Section 8.8 was modified to include mention the use of the TNC (2019) guidance and criteria therein.**  
- The criteria used to remove NCCAG from the list of potential GDEs is a depth to water greater than 30 feet, which is based on guidance from The Nature Conservancy (2019).  
- See KGA response to this comment for further information. |
| The identification of undesirable results and selection of minimum thresholds are based on an extended 10-year drought period and exclude Sustainable Management Criteria for surface water depletions. | • Because interconnected surface waters are determined to not occur within the MA Plan area, based on depth to groundwater data from the principal aquifer, sustainable management criteria for Depletion of Interconnected Surface Waters are deemed not applicable/necessary.  
• See KGA response to this comment for further information. |
<p>| Implementation of Future Project Actions Related to SGMA: Comments related to: | • Comments are noted. |</p>
<table>
<thead>
<tr>
<th>CDFW Comment Number</th>
<th>CDFW Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• The CDFW’s role as “Trustee Agency for fish and wildlife resources”, and • The CDFW’s role as a “Responsible Agency under CEQA” that “may need to exercise regulation authority as provided by the Fish and Game Code for implementation of projects related to the GSP that are also subject to CEQA”.</td>
<td>• Permitting requirements for each P/MA included in the MA Plan are discussed in Section 17.6 and in Table PMA-1. Work efforts related to P/MA implementation, including studies and environmental (CEQA) documentation, are discussed in Section 18.1.2. • See KGA response to this comment for further information.</td>
</tr>
<tr>
<td>Page Number in TNC Comment Letter</td>
<td>TNC Comment</td>
<td>Response from AEWS/ACSD</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------</td>
<td>-------------------------</td>
</tr>
</tbody>
</table>
| 9                                 | Notice and Communication | - The Arvin-Edison MA Plan identifies lands owned by the California Department of Fish and Wildlife in Section 5.1.3 and on Figure PA-2.  
• See KGA response to this comment for further information. |
| 10                                | Plan Area Setting | - Section 7.2.5 of the MA Plan was updated to include a statement that there are no in-stream flow requirements set for any creeks that flow into the Arvin-Edison Management Area, including Caliente Creek.  
• See KGA response to this comment for further information. |
| 10                                | Existing Plans in the Plan Area | - Section 5.3 of the MA Plan includes information about land use plans (i.e., General Plans), including a summary of goals, policies and implementation measures related to land and water use.  
• See KGA response to this comment for further information. |

Notice and Communication
Please describe the other beneficial uses and users of groundwater in the Subbasin identified by the Water Code including: GDEs; managed wetlands; Protected Lands, including preserves, wildlife refuges, conservation areas, recreational areas and other protected lands; and Public Trust Uses, including wildlife, aquatic habitat, fisheries, recreation and navigation.

Please identify any environmental uses and users of groundwater in the plan area, and take particular note of the species with protected status.

Plan Area Setting
Please provide a description of any current and planned instream flow requirements or regulatory requirements for protection of species of concern in the Kern River, Poso Creek and Caliente Creek. If there are no requirements in place or planned, then please state that in the GSP.

Existing Plans in the Plan Area
We suggest adding a discussion of General Plan goals and policies related to the protection and management of GDEs and aquatic resources that could be affected by groundwater withdrawals. Please include a description of any land use or environmental plans relevant to wetlands, aquatic resources and other GDEs and ISWs and their relationship to the GSP. Please include a discussion of how implementation of the GSP may affect and be coordinated with General Plan policies and procedures regarding the protection of
<table>
<thead>
<tr>
<th>Page Number in TNC Comment Letter</th>
<th>TNC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 10                               | **Existing and Ongoing Water Resource Programs**  
Please provide a description of resource management plans, monitoring activities and responsibilities by State, Federal and local agencies and jurisdictions related to aquatic resources and GDEs that could be affected by groundwater withdrawals, and list them in Table 2-1.  
Please review and discuss the potential groundwater reliance of critical species in the Subbasin. Please include a discussion regarding the management of critical habitat for these aquatic species and its relationship to the GSP.  
Please include a discussion of any monitoring programs related to GDEs and sensitive habitats. | • See KGA response to this comment for further information. |
| 11                               | **Well Permitting Process, Well Construction Policies**  
Please discuss that future well permitting and well construction must be coordinated with the GSP to assure achievement of the Plan’s sustainability goals.  
Please state how the well permitting process incorporates protection of GDEs and ISWs within the Subbasin.  
Please include a discussion of the need for well permitting programs to comply with this requirement. | • Sections 5.3.4 and 5.4 of the MA Plan includes discussion of the Kern County Well Permitting Process.  
• See KGA response to this comment for further information. |
<table>
<thead>
<tr>
<th>Page Number in TNC Comment Letter</th>
<th>TNC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
</table>
| 11                               | **Hydrogeologic Conceptual Model – Bottom of the Subbasin**  
Please characterize groundwater well extractions from the deepest wells in relation to defining the basin bottom.  
If the bottom boundary of the Subbasin has not been clearly defined in certain management areas, please identify this as a data gap and elaborate in the monitoring section how and where additional observations can be made to reconcile this data gap. | • **Section 7.1.3** of the MA Plan describes the definition of the bottom of the basin, which includes consideration of the deepest groundwater wells.  
• See KGA response to this comment for further information.                                                                                                                                                                                  |
| 12                               | **Hydrogeologic Conceptual Model – Principal Aquifers and Aquitards**  
Please provide additional description of the shallow aquifers within the Subbasin including characteristics of interconnections with surface water and GDEs, vertical groundwater gradients, connections with underlying production aquifers, and the resulting potential interaction of groundwater pumping with ISWs and GDEs. Please state whether localized perched aquifers are present in the Subbasin. Describe any data gaps. The function and significance of the Shallow Aquifers that provide groundwater to ISWs and GDEs should be summarized in Table 2-3.  
Please describe whether the existence of Aquifer Exemptions has any bearing or implications related to environmental beneficial uses of groundwater. | • **Section 7.1.4** of the MA Plan mentions the occurrence of the “A”-Clay which may result in localized perched groundwater in some areas.  
• **Section 7.3.2** of the MA Plan mentions that these perched zones are often poor quality and do not yield significant or economic amounts of water to wells, springs, or surface water systems, and are therefore not considered part of the principal aquifer.  
• See KGA response to this comment for further information.                                                                                                                                                                          |
| 12                               | **Hydrogeologic Conceptual Model – Data Gaps and Uncertainty**  
If data are not present to produce the information requested in the comment above, please clearly identify this as a data gap. Please elaborate in the monitoring section how and where additional observations are to be conducted in order to address this data gap. | • See KGA response to this comment for further information.                                                                                                                                                                                                                                         |
| 12                               | **Hydrogeologic Conceptual Model – Cross-Sections**  
Please include near-surface cross sections or insets that depict the conceptual understanding of shallow groundwater and ISW interactions at different locations, including perched and regional aquifers and GDEs. | • See KGA response to this comment for further information.                                                                                                                                                                                                                                         |
<table>
<thead>
<tr>
<th>Page Number in TNC Comment Letter</th>
<th>TNC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td><strong>Hydrogeologic Conceptual Model - Elevation and Flow Directions</strong> Please provide any available stratigraphic data, hydrograph data, pumping test data or other information to substantiate these claims. If the data are not available, please identify this as a data gap.</td>
<td>• See KGA response to this comment for further information.</td>
</tr>
</tbody>
</table>
| 14                               | **Interconnected Surface Water Systems** Please provide additional data or analysis to substantiate the nature of the hydrologic relationship between the shallow aquifer and production aquifers and ISWs. If data are not available to verify that such a connection does not exist, acknowledge where ISWs may exist and identify appropriate sustainable management criteria, monitoring networks and management actions for sustainable ISW management or to address data gaps. Data could include groundwater level data from shallow or nested monitoring wells, comparison of stream stages to groundwater levels, modeling information or additional gaging data. Please elaborate how and where additional observations (shallow monitoring wells, stream gauges, and nested / clustered wells) along surface water features can be used to address data gaps in the Monitoring Network section of the GSP to improve identification of ISWs rather than prematurely disregarding them in the GSP. | • The process used to assess the potential occurrence of interconnected surface water in the Management Area is based on depth to groundwater (similar to the process used for evaluation of GDEs, which was done consistent with TNC (2019) guidance; see below) based on available data from wells in the principal aquifer, as described in Section 8.2 and 8.7.  
• See KGA response to this comment for further information. |
| 14                               | **Groundwater-Dependent Ecosystems** Please identify any data gaps related to identifying and mapping GDEs. If there are data gaps, please describe in detail in the monitoring plan how the data gaps will be addressed. Please support this statement with specific groundwater level data that indicate a gap in the saturated zone between the production aquifers and shallow groundwater, and define the extent of the NCCAG dataset polygons that are excluded from consideration as GDEs on this basis. | • The process used to assess the potential occurrence of GDEs in the Management Area is based on depth to groundwater based on available data from wells in the principal aquifer, as described in Section 8.2 and 8.8.  
• **Section 8.8 was modified to include mention of the use of TNC (2019) guidance and criteria therein.**  
• The criteria used to remove NCCAG from the list of potential GDEs is a depth to water greater than 30 feet, which is based on guidance from The Nature Conservancy (2019).  
• See KGA response to this comment for further information. |
<table>
<thead>
<tr>
<th>Page Number in TNC Comment Letter</th>
<th>TNC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Please identify any data gaps related to identifying and mapping GDEs. If there are data gaps, please describe in detail in the monitoring plan how the data gap will be resolved.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Please revise the GDE analysis in the GSP by conducting more substantial, data-based evaluation focusing on GDE identification in the GSP, clearly identify which NCCAG polygons are excluded, which polygons are determined to be GDEs and which polygons are uncertain at this time and will be verified as data gaps are address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Confirmation of GDEs should be performed based on depth to groundwater in the shallow zone, and additional information provided as to whether the shallow zone may be affected by groundwater withdrawal from the production aquifers. Please refer to Appendix D of this letter for best practices for using groundwater data to verify a connection to groundwater.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Therefore, we recommend using depth to groundwater contour maps derived from subtracting groundwater levels from a DEM, as described above, to identify whether a potential connection to groundwater exists for the wetlands mapped in Attachment H of the GSP. Please refer to Attachments D and E of this letter for best practices for using local groundwater data to 1) verify whether polygons in the NC Dataset are supported by groundwater in an aquifer, and 2) verify whether ecosystem decline or recovery is correlated with groundwater levels.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>We recommend the inclusion of a discussion regarding the nature and characteristics of GDEs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Please provide information on the historical or current groundwater conditions near the GDEs or the ecological conditions present.</td>
<td></td>
</tr>
<tr>
<td>Page Number in TNC Comment Letter</td>
<td>TNC Comment</td>
<td>Response from AEWSD/ACSD</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 17                              | We recommend an ecological inventory (see Appendix III, Worksheet 2 of the GDE Guidance) for all potential GDEs that includes vegetation or habitat types and rank the GDEs as having a high, moderate or low value. Explain how each rank was characterized. Please identify whether any endangered or threatened freshwater species of animals and plants, or areas with critical habitat were found in or near any of the GDEs. Some organisms rely on uplands and wetlands during different stages of their lifecycle. | • ET information used in the water budget analysis is from the ITRC-METRIC study and includes all lands, including non-irrigated lands.  
• See KGA response to this comment for further information.   |
| 17                              | **Water Budget**  
Please provide a breakdown of ET for native and riparian vegetation (such as wetlands, riparian vegetation, phreatophytes and other communities). Please evaluate the spatial relationship of native vegetation ET to NCCAG polygons to determine the groundwater use by this beneficial user for inclusion in the water budget. Identify any data gaps and outline the actions needed to address them. |                                                                                                             |
| 17                              | **Sustainability Goal**  
Please clarify the sustainability goal and expand its description to ensure that all beneficial uses and users of groundwater are identified as being protected from undesirable results, and in particular, include GDEs, ISWs and related critical habitats.  
Since GDEs and ISWs may be present in the Subbasin (please see comments under Checklist Items 16-20) they should be recognized as beneficial users of groundwater and should be specifically included in the Sustainability Goal. In addition, a statement about any intention to address pre-SGMA impacts should be included.  
Please include ISWs in the Sustainability Goal until/unless sufficient data is available and provided to verify the status of ISWs. | • The sustainability goal for the MA Plan area is stated in Section 2 and Section 12, and does include mention of beneficial uses including environmental.  
• See KGA response to this comment for further information. |
<table>
<thead>
<tr>
<th>Page Number in TNC Comment Letter</th>
<th>TNC Comment</th>
<th>Response from AEWSD/ACSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Given that there are potential GDEs in the Subbasin and that they may be affected by water quality, they should be included in the Sustainability Goal and addressed in the Water Quality section.</td>
<td>• Because GDEs are determined to not occur within the MA Plan area, based on depth to groundwater data from the principal aquifer, sustainable management criteria for Depletion of Interconnected Surface Waters are deemed not applicable/necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• See KGA response to this comment for further information.</td>
</tr>
<tr>
<td>19</td>
<td><strong>Minimum Thresholds and Measurable Objectives</strong>&lt;br&gt;For each of these applicable sustainable management criteria, please include a discussion of GDEs (see comments under checklist items 16-20) and whether the minimum thresholds, measurable objectives and interim milestones will help achieve the sustainability goal as it pertains to the environment. Please modify Section 3.2.2 to specifically address impacts from degraded water quality to the plant and wildlife communities within GDEs.</td>
<td>• Because GDEs and ISW are determined to not occur within the MA Plan area, based on depth to groundwater data from the principal aquifer, sustainable management criteria for Depletion of Interconnected Surface Waters are deemed not applicable/necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• See KGA response to this comment for further information.</td>
</tr>
<tr>
<td>19</td>
<td><strong>Undesirable Results</strong>&lt;br&gt;Please add “possible adverse impacts to potential GDEs and ISWs” to the list of potential undesirable results. &lt;br&gt; Please review these spatial patterns and, where possible, correlate them with water level trends. Any indications of adverse trends and any data gaps should be identified. &lt;br&gt; For each identifiable GDE unit with supporting hydrological datasets, please include the following: &lt;br&gt; For identifiable GDE units without supporting hydrological datasets please describe data gaps and / or insufficiencies. &lt;br&gt; Compile and synthesize biological data for each GDE unit by: &lt;br&gt; Describe possible effects on potential ISWs, GDEs, land uses, and property interests, including:</td>
<td>• Because GDEs and ISW are determined to not occur within the MA Plan area, based on depth to groundwater data from the principal aquifer, sustainable management criteria for Depletion of Interconnected Surface Waters are deemed not applicable/necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• See KGA response to this comment for further information.</td>
</tr>
<tr>
<td>20</td>
<td><strong>Monitoring Network</strong></td>
<td>• See KGA response to this comment for further information.</td>
</tr>
<tr>
<td>Page Number in TNC Comment Letter</td>
<td>TNC Comment</td>
<td>Response from AEWSD/ACSD</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Please modify the description of the monitoring network to provide methodologies, data and other information to address the data gaps associated with GDEs and ISWs. This modification should include 1) locating new wells that are appropriately screened to detect changes in groundwater levels in the uppermost water table and the connectivity of GDEs and ISWs with the upper unconfined or shallow zone aquifer; and 2) identifying or installing additional stream gauges in areas where there is potential for ISWs and GDEs. Please expand on the discussion of how the new well and stream data will be used to improve ISW mapping and inform an adequate analysis, and how the data will be used to verify possible GDEs. Please address data gaps along the Kern River and tributary creeks identified earlier in the GSP in this section of the GSP to improve ISW mapping in companion or future GSPs (e.g., through shallow monitoring wells, stream gauges, and nested/clustered wells).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projects and Management Actions</td>
<td>For the projects already identified, please consider stating how ISWs and GDEs will benefit or be protected, or what other environmental benefits will accrue. Please consider additional management actions and projects targeted for protecting ISWs and GDEs. Please describe how the projects and management actions will be evaluated to assess whether adverse impacts to GDEs may occur and/or will be mitigated or prevented.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>• Because GDEs and ISW are determined to not occur within the MA Plan area, based on depth to groundwater data from the principal aquifer, P/MAs to benefit and protect GDEs and ISW are deemed not applicable/necessary. • See KGA response to this comment for further information.</td>
</tr>
</tbody>
</table>
From Amanda Monaco, Leadership Counsel for Justice and Accountability (10/8/2019 email to Jeevan)

Below, I have included our list of questions that we wanted to ask you, and filled in the answers to the questions that we got from you at the workshop; please review those as well to ensure that our impressions are accurate. If you could please respond to the unanswered questions, that would be great. We can also jump on the phone sometime next week if that would be easier.

1. **Groundwater Quality SMC**: Given that the GSP shows that there are many plumes of various contaminants (nitrates, TCP, boron, iron, etc) in the subbasin, why is the GSA only monitoring for Arsenic?
   - Arsenic is the only drinking water contaminant currently in the drinking water in Arvin [AE Response: The rationale for the water quality monitoring network is provided in Section 16.1.4. While one well has been designated as a Representative Monitoring Site (RMS) with Sustainable Management Criteria (SMCs) defined for Arsenic, the water quality monitoring network also includes seven other RMSs throughout the Management Area. All RMSs will be monitored for a suite of constituents as listed at the end of Section 16.1.4.]
   - This MT/MO does not take into account any new or increased drinking water contamination from other types of contaminants that may have been caused by the GSA’s groundwater management decisions and activities. [AE Response: There is no new or increased contamination from other types of contaminants that may have been caused by the GSA’s management decisions or activities, as those management activities have not begun yet. Whereas other regulatory programs regulate drinking water quality and groundwater quality, GSAs’ authorities generally involve management of water quantity and do not supersede or replace those other programs. There is insufficient information to draw a connection between water supply management and water quality in this area (see Section 13.4.2); however, such information will become available as monitoring under the GSP progresses and the potential relationship between GSA management activities and groundwater quality will be revisited.]

2. **Groundwater Quality Monitoring Network**: Will AEWD only monitor for an increase in Arsenic levels in one monitoring well in Arvin? Will that be adequate to detect impacts to all drinking water users in the area?
   - The monitoring network will test Arsenic concentrations at one site in Arvin. There will also be ag wells testing for Arsenic around the community. [AE Response: Yes, arsenic and a suite of other constituents will be tested regularly at a total of eight wells throughout the Management Area as part of the proposed water quality monitoring network (see Section 16.1.4).]
   - This will not detect increases in arsenic in other areas where Arvin CSD has drinking water wells [AE Response: The selection of the RMS within Arvin CSD was made by Arvin CSD and is considered representative of groundwater conditions in that area. As a Public Water System, Arvin CSD also regularly monitors its raw and treated water sources pursuant to SWRCB requirements and its public water system permit.]
   - This will not detect movement of arsenic plumes or movement of plumes of other contaminants [AE Response: As mentioned above, there are a total of eight RMSs in the proposed monitoring network, which will allow for assessment of changes/movement in groundwater quality conditions over time.]
   - Will the ag wells likely will not detect impacts to domestic well users around Arvin because they are likely not screened in the same zones as drinking water users. [AE Response: In the area around Arvin, the screened interval of domestic wells is similar to the screened interval of the Arvin CSD public supply well (see Figure SMC-4).]

3. **Groundwater Levels SMC**: 
   - The Minimum Thresholds will be detected at only one well, where the groundwater levels are likely to be the lowest. The MT is 70 feet below mean sea level, and the MO is at 30 feet below mean sea level. The MT is where groundwater levels were in the driest year, 2015. [AE Response: Groundwater Level Minimum Thresholds are defined at 16 wells throughout the Management Area (see Figure SMC-3). The Minimum Threshold in the ACSD Zone is at -70 ft msl and the Measurable Objective is at +30 ft msl. The process/rationale for setting the SMCs is described in Section 14.1 and includes
consideration of historical lows, groundwater level trends, well construction information, and proximity to critical infrastructure.

o AEWD did an analysis of where the domestic wells, community water system wells, and ag wells are, and found that only "some" wells will go dry. They used the state OSWCR database, and assumed that many wells that may go dry according to the analysis may not currently be in use. This analysis is not written explicitly in the GSP. [AE Response: The analysis is described in the latter portion of Section 14.1 and results are depicted on Figures SMC-4 and SMC-5.]

4. Mitigation program: Is there a mitigation program to help drill new wells, replace/deepen wells, treat wells, or connect folks to reliable and safe drinking water if impacts occur from the GSA’s decisions or actions?

o There is a potential mitigation plan included in the GSP, and it will be designed and begun to be implemented by the 5 year update. [AE Response: An “Impacted Well Mitigation Program” will be developed as part of plan implementation, as described in Section 18.1.6. AE plans to develop and implement this program within the first few years of GSP adoption.]

5. Public participation plan: Is there a stakeholder engagement plan for public engagement during plan implementation, and as new projects are being considered or the GSP is modified? [AE Response: AE has prepared and implemented a Stakeholder Communication and Engagement Plan (SCEP) as part of GSP/Management Area Plan development. The SCEP is included as Appendix D to the Management Area Plan. Continued stakeholder engagement after plan adoption is described in Section 18.1.4.]

6. White Areas: How will the white areas around AEWD be included? [AE Response: Selected land owners in undistricted areas around the AEWSD service area have signed agreements to be covered under the AE Management Area Plan and are included by way of a water supply inventory in Appendix L (see Section 5.1.5). Those landowners who have not signed an agreement are not included in the AE Management Area Plan and presumably will be subject to groundwater extraction reporting requirements under CWC § 5202(a)(2).]

7. Brown Act: Did the AEWD comply with the Brown Act? Since it was delegated authorities from the GSA, it now has the same transparency obligations as a legislatively created public agency, and as a GSA under SGMA. Did the AEWD maintain a list of interested parties? Did it notice its meetings 72 hours in advance, and post a meeting agenda?

o No, this did not occur. Meetings occur regularly, but interested parties have to call AEWD to find out meeting dates and times. There was no notice or agenda sent out. [AE Response: Your statement is not correct and appears to be a misunderstanding. AE complies with Brown Act, maintains a list of interested parties, and provides notice/posting of agendas as required.]

8. Financing GSP implementation: How will AEWD pay to implement their GSP?

o There will be a Prop 218 process to collect additional fees to pay for GSP implementation, but the district will try to get grants to minimize these costs to residents. [AE Response: Funding for GSP implementation is described in Section 18.2.2.]

o No collaboration or assistance with funding from other water districts in the GSA. [AE Response: Collaboration is occurring to the extent feasible, in fact we are pursuing Prop 68 funds now as a County wide group.]
Appendix G

SWRCB Concurrence Letters Re: Edison Oil Field
October 19, 2018

Kenneth A. Harris Jr., State Oil & Gas Supervisor
Department of Conservation
Division of Oil, Gas & Geothermal Resources
801 K Street, MS 18-05
Sacramento, CA 95814-3530
ken.harris@conservation.ca.gov

FINAL CONCURRENCE ON THE VOLUME I AQUIFER EXEMPTION PROPOSAL, EDISON OIL FIELD, KERN COUNTY

Dear Mr. Harris:

State Water Resources Control Board (State Water Board) staff, in consultation with Central Valley Regional Water Quality Control Board staff (collectively Water Boards staff), have reviewed the Volume I aquifer exemption proposal provided by the Division of Oil, Gas and Geothermal Resources (DOGGR) on September 22, 2016 for the Edison Oil Field. The proposal seeks to expand the aquifer exemption for the Vedder Formation and Pyramid Hills Sands of the Freeman Jewett Formation, Main Wicker Sands of the Fruitvale Formation, and the Transition/Santa Margarita Formation within the Edison Oil Field for Class II injection. Water Boards staff assessed whether the proposal meets the criteria set forth in California Public Resources Code (PRC) section (§) 3131 and § 146.4 of Title 40 of the Code of Federal Regulations (CFR) and considered comments received during the public comment process.

Public Comment Process

On March 7, 2018, State Water Board staff preliminarily concurred with the proposal to expand the aquifer exemption for the Vedder Formation and Pyramid Hills Sands of the Freeman Jewett Formation, Main Wicker Sands of the Fruitvale Formation, and the Transition/Santa Margarita Formation within the Edison Oil Field, pending the State’s public comment process. On July 2, 2018, DOGGR published notice of the exemption proposal and opened a public comment period. DOGGR and State Water Board staff held a joint public hearing to receive comments on the exemption proposal on August 2, 2018. The comment period closed on August 9, 2018. DOGGR and State Water Board staff have reviewed and responded in writing to the comments received during the comment period and public hearing.

Concurrence with Limitation on Underground Injection Control (UIC) Projects

State Water Board staff concur with the exemption proposal for the Vedder Formation, Pyramid Hills Sands, and Main Wicker Sands with no limitation and with the proposal for the...
Transition/Santa Margarita Formation with a limitation. To ensure the injection of fluids does not affect the quality of water that is, or may reasonably be, used for any beneficial use, fluids injected in the Transition/Santa Margarita Formation must be of similar or better quality than the existing groundwater in this area, as determined by Water Boards staff.

In conjunction with the evaluation of current and future UIC projects in the proposed exempted areas, DOGGR and Water Boards staff will consider incorporating conditions, described below, into project approvals.

**State and Federal Exemption Criteria**

As required by PRC § 3131(a)(1) and 40 CFR § 146.4(a), the proposed exempted areas do not currently serve as sources of drinking water. No drinking water supply wells were identified as being completed within the proposed exempted areas. Water supply wells identified in proximity to the proposed exempted areas are completed in the Kern River, Chanac, and Santa Margarita Formations. In the area of these supply wells, the Vedder Formation, Pyramid Hills Sands, and Main Wicker Sands are vertically separated from the deepest water supply well by more than 1,300 feet and multiple vertical confining layers.

Consistent with 40 CFR § 146.4(b)(1), the proposed exempted areas will not in the future serve as sources of drinking water because they are hydrocarbon producing. In addition, as per PRC § 3131(a)(2), the injected fluids are not expected to affect the quality of water that is, or may reasonably be, used for any beneficial use because (1) the groundwater contained in the proposed exempted areas of the Vedder Formation, Pyramid Hills Sands, and Main Wicker Sands is not expected to be put to beneficial use because it contains petroleum hydrocarbons and elevated levels of boron and there is high quality water available in shallower formations, (2) the fluids injected into the Transition/Santa Margarita Formation will be of similar or better quality than the existing groundwater in the area, and (3) the injected fluids are expected to remain in the proposed exempted areas of each formation.

The requirement of PRC § 3131(a)(3) is also satisfied because the injected fluids are expected to remain within the proposed exempted areas due to the following geologic and hydraulic conditions:

**Vedder Formation and Pyramid Hills Sands**

Vertical containment is provided by the overlying, 750 feet thick Freeman Jewett Silt that consists of lower permeability silts. Lateral containment is provided by an inward hydraulic gradient from current production and by sealing faults along the northwest and southeast proposed exemption boundaries.

**Main Wicker Sands**

Vertical containment is provided by the overlying, 80 to 200 feet thick Fruitvale Shale that consists of lower permeability marine claystone and mudstone. Lateral containment is provided by an inward hydraulic gradient from current production and fluid migration up-dip (to the north) where the Main Wicker Sands pinch out to impermeable mudstones and claystones of the Fruitvale Formation. Permeability of the reservoir also decreases to the east, further limiting fluid migration eastward.
Santa Margarita Transition

Vertical containment is provided by the overlying, 30 feet thick lower Chanac that consists of lower permeability siltstone and shale. Lateral containment is provided by an inward hydraulic gradient from current production and by a sand pinch-out to lower permeability siltstone and shale at the northern, southern, and western proposed exemption boundaries. A sealing fault provides horizontal confinement along the eastern proposed exemption boundary.

Conditions on Injection Projects

Approval of Class II UIC projects involves a joint review by DOGGR and Water Boards staff. DOGGR and Water Boards staff will consider incorporating conditions into approvals of Class II injection projects. Potential conditions include, but are not limited to, the following:

1. Monitoring to demonstrate an inward hydraulic gradient in the exempted areas; and

2. Groundwater monitoring to demonstrate that injected fluids remain in the exempted areas (e.g., sentinel well monitoring). If a monitoring requirement is incorporated in a UIC project approval, the operator must submit a work plan to the Central Valley Regional Water Quality Control Board for consideration.

If you have any questions regarding this matter, please contact Mr. John Borkovich at (916) 341-5779 or john.borkovich@waterboards.ca.gov.

Sincerely,

Jonathan Bishop
Chief Deputy Director

cc: Patrick Pulupa
Executive Officer
Central Valley Regional Water Quality Control Board
patrick.pulupa@waterboards.ca.gov

Cameron Campbell
Deputy, Inland District
Department of Conservation
Division of Oil, Gas & Geothermal Resources
cameron.campbell@conservation.ca.gov
February 4, 2019

Kenneth A. Harris Jr., State Oil & Gas Supervisor
Department of Conservation
Division of Oil, Gas & Geothermal Resources
801 K Street, MS 18-05
Sacramento, CA 95814-3530
ken.harris@conservation.ca.gov

FINAL CONCURRENCE ON THE VOLUME II AQUIFER EXEMPTION PROPOSAL,
CHANAC FORMATION, EDISON OIL FIELD, KERN COUNTY

Dear Mr. Harris:

State Water Resources Control Board staff, in consultation with Central Valley Regional Water Quality Control Board staff (collectively Water Boards staff), have reviewed the Volume II aquifer exemption proposal provided on December 6, 2016 by the Division of Oil, Gas and Geothermal Resources (DOGGR) to the expand the existing aquifer exemption for the Chanac Formation within the Edison Oil Field. Water Boards staff assessed whether the proposal meets the criteria set forth in California Public Resources Code (PRC) section (§) 3131 and § 146.4 of Title 40 of the Code of Federal Regulations (CFR) and considered comments received during the public comment process.

Public Comment Process

On July 3, 2018, State Water Board staff preliminarily concurred with the exemption proposal pending the State's public comment process. On September 14, 2018, DOGGR published notice of the exemption proposal and opened a public comment period. DOGGR and State Water Board staff held a joint public hearing to receive comments on the exemption proposal on October 18, 2018. The comment period closed on October 18, 2018. DOGGR and State Water Board staff have reviewed and responded in writing to the comments received during the comment period and public hearing.

Concurrence with Limitation on Underground Injection Control (UIC) Projects

State Water Board staff concur with the exemption proposal; however to ensure injected fluids do not affect the quality of water that is, or may reasonably be, used for any beneficial use, the following limitation shall be incorporated in UIC project approvals:

FELICIA MARCUS, CHAIR | EILEEN SOBECK, EXECUTIVE DIRECTOR

1001 I Street, Sacramento, CA 95814 | Mailing Address: P.O. Box 100, Sacramento, CA 95812-0100 | www.waterboards.ca.gov
• Injected fluids must be of similar or better quality than the existing groundwater in the proposed exempted area, as determined by Water Boards staff in collaboration with DOGGR.

In conjunction with the evaluation of current and future UIC projects in the proposed exempted area, DOGGR and Water Boards staff will consider incorporating conditions, described below, into project approvals.

**State and Federal Exemption Criteria**

As required by PRC § 3131(a)(1) and 40 CFR § 146.4(a), the proposed exempted area does not currently serve as a source of drinking water. One active drinking water well was identified in Section 26 as being completed within the Chanac Formation. A capture zone analysis was performed for the well, and the area within the capture zone was removed from the proposed exempted area (as shown on the enclosed map). Additional water wells were identified within the proposed exempted area but are completed in the shallower Kern River formation, which is geologically and hydraulically isolated from the deeper Chanac Formation. At least 25 feet of vertical separation exists between the bottom of the water supply wells and the confining layer at the top of the upper Chanac Formation oil sands.

Consistent with 40 CFR § 146.4(b)(1), the proposed exempted area will not in the future serve as a source of drinking water because it is hydrocarbon producing or contains hydrocarbons that are expected to be commercially producible. In addition, as per PRC § 3131(a)(2), the injected fluids are not expected to affect the quality of water that is, or may reasonably be, used for any beneficial use because (1) the injected fluids will be of similar or better quality than the existing groundwater in the proposed exempted area, and (2) the injected fluids are expected to remain in the proposed exempted area.

The requirement of PRC § 3131(a)(3) is also satisfied because the injected fluids are expected to remain within the proposed exempted area due to a combination of geologic conditions and operational controls. Vertical containment is provided by the overlying, 15 to 50 feet thick lower permeability shale above the Chanac oil sands and by the underlying, 10 to 80 feet thick lower permeability silt and shale of the lower Chanac and upper Santa Margarita Formations.

Lateral containment for the proposed exempted area is provided by faults along the east-northeastern and west-northwestern boundaries and by an inward hydraulic gradient from current production. The containing nature of the faults is demonstrated by the separation of areas of known commercial hydrocarbons, differences in the oil-water contact across the fault, and geophysical log interpretations. The inward hydraulic gradient is interpreted from material balance calculations that indicate the withdrawal of fluids is greater than the volume of fluids injected within productive areas of the Chanac Formation.

**Conditions on UIC Projects**

Approval of UIC projects involves a joint review by DOGGR and Water Boards staff. DOGGR and Water Boards staff may incorporate conditions into approval letters, as appropriate. Potential conditions include, but are not limited to, the following:

1. In cases where injection is proposed near the capture zone excluded from the proposed exempted area in Section 26, limiting injectate volumes and pressure, including
potentially limiting injection activities to cyclic steam, to assure injected fluids do not migrate into the non-exempt area;

2. In cases where injection is proposed into the expanded exempt area where production has not been established (such as the north side of expanded exempt area), verifying the presence of commercially producible hydrocarbons and demonstrating an inward hydraulic gradient; and

3. Requiring monitoring, which may include water quality testing, to confirm injected fluids remain in the proposed exempted area, including the area adjacent to the capture zone in Section 26. If a monitoring requirement is incorporated in a project approval, the operator must submit a plan to the Central Valley Regional Water Quality Control Board for consideration.

If you have any questions regarding this matter, please contact Mr. John Borkovich at (916) 341-5779 or john.borkovich@waterboards.ca.gov.

Sincerely,

Jonathan Bishop
Chief Deputy Director

cc: Patrick Pulupa
Executive Officer
Central Valley Regional Water Quality Control Board
patrick.pulupa@waterboards.ca.gov

Cameron Campbell
Deputy, Inland District
Department of Conservation
Division of Oil, Gas & Geothermal Resources
cameron.campbell@conservation.ca.gov
Enclosure

Study Area Location Map (Figure Ch 4.2-2), Division of Oil, Gas and Geothermal Resources Aquifer Exemption Study, Chanac Productive Interval, Kern County, California, November 2016, Revised June 2018.
Appendix H

Analysis of Temporal Characteristics of Available Groundwater Quality Data
Appendix H -1

Analysis of Temporal Characteristics of Available Groundwater Quality Data - Total Dissolved Solids vs. Groundwater Elevation
30S29E34A001M

Groundwater Elevation (ft msl)

[TDS] (mg/L)

31S29E01K001M

Groundwater Elevation (ft msl)
Analysis of Temporal Characteristics of Available Groundwater Quality Data - Nitrate (as NO3) vs. Groundwater Elevation
Appendix I

Potential Additional Water Quality Data Sources
# Summary of Water Quality Data Sources

## Table of Contents

1. California EPA – Information on Hazardous Waste in Groundwater ................................................................. 2  
   1.1. Regulated Site Portal ........................................................................................................................................... 2  
   1.2. Cortese List ..................................................................................................................................................... 5  
   1.3. Managing Hazardous Waste website ............................................................................................................. 6  
   1.4. GeoTracker ................................................................................................................................................... 7  
2. USEPA Superfund: National Priorities List (NPL) ........................................................................................................ 11  
3. California EPA – Information on Drinking Water Quality .......................................................................................... 13  
   3.1. Water Quality Analysis Database Files ........................................................................................................... 13  
   3.2. Drinking Water Watch ..................................................................................................................................... 16  
   3.3. GAMA-PBP Groundwater-Quality Results: Assessment and Trends ............................................................... 17  
4. Information on Pesticide Use pertaining to groundwater quality ................................................................................ 19  
   4.1. California Pesticide Information Portal (CalPIP) ............................................................................................... 19  
5. Information on Groundwater Quality in Areas of Oil and Gas Production ................................................................. 25  
   5.1. WellFinder .................................................................................................................................................... 25  
   5.2. CalStim'D – Well Stimulation Permits and Sites ............................................................................................ 27  
   5.3. Water Quality in Areas of Oil and Gas Production – Regional Groundwater Monitoring Program ..................... 31  
6. Information on Vulnerability Assessment Tools Pertaining to Groundwater .............................................................. 36  
   6.1. CalEnviroScreen 3.0 Maps ................................................................................................................................ 36
1. California EPA – Information on Hazardous Waste in Groundwater

1.1. Regulated Site Portal
https://siteportal.calepa.ca.gov/nsite

- Lists many environmentally regulated sites and facilities, including: hazardous waste and materials, hazardous waste facilities and sites, and storm water management sites.
- Data sources include California Occupational Safety and Health Administration (Cal/OSHA), California Environmental Reporting System (CERS), California Integrated Water Quality System (CIWQS), US EPA’s Emission Inventory System (EIS), the California Department of Toxic Substances Control’s (DTSC) EnviroStor site, the State Water Resources Control Board’s (SWRCB) GeoTracker site, the SWRCB’s Stormwater Multiple Application and Report Tracking System (SMARTS), the Solid Waste Information System (SWIS), and the federal Toxic Release Inventory (TRI) database.
- Contains downloadable data (e.g., quantity of chemical release), and other regulatory documents.
- No available spatial or temporal concentration data.

Screenshots of website and selected downloadable data:
### Regulatory Programs

#### Chemical Storage Facilities

**Environmental Interest Start Date**
07/10/2013

**Last Inspected**
03/16/2017

**Source System**
California Environmental Reporting System

**Source System ID**
10164700

### Site Contacts

#### Environmental Contact

**Name**
Environmental Compliance

**Address**
15505 Sand Canyon Avenue, MS D-104
Irvine, CA 92618

#### CUPA District

**Name**
Los Angeles County Fire

**Phone**
(233) 800-6045

**Address**

---

### Geopolitical

**County**
Los Angeles County

**CalEnviroScreen 3.0 Percentile Range**
31-49%

### Site Codes

**NAICS**

**8512** Radio/telephone communications

## Alternate IDs

**Phone & Broadstreet Number**
108725003

**Facilities Explorer ID**
168974
1.2. **Cortese List**  
[https://calepa.ca.gov/sitecleanup/corteselist/](https://calepa.ca.gov/sitecleanup/corteselist/)

- A list released by CalEPA annually, including hazardous waste and substance sites (DSTC), leaking USTs, solid waste disposal sites, “active” CDO and CAO sites.
- Data sources from DTSC, SWRCB, and local enforcement agencies.
- No available spatial or temporal concentration data.

**Screenshot of website:**

![Cortese List Data Resources](https://calepa.ca.gov/sitecleanup/corteselist/)
1.3. Managing Hazardous Waste website
https://dtsc.ca.gov/managing-hazardous-waste/

- Hazardous waste sites updates/status/current regulation.

Screenshot of website:
1.4. GeoTracker

https://geotracker.waterboards.ca.gov/map/?global_id=T10000006808

- Lists relevant information about the hazardous sites, including location, substance of spill, clean up timeline, monitoring reports, site investigation reports, regulatory correspondence, etc.
- Chemical data available for each county (as txt file, can be opened with Access or Excel). https://geotracker.waterboards.ca.gov/data_download_by_county
- Temporal and spatial chemical concentration data.

Screenshots of website and selected downloadable data:
| COUNTY  | GLOBAL_ID  | FIELD_PT | LOGCODE | LAPID | MATRIX | SAMPLD | TASTIQ  | PABCODE | LABCODE | LABNAME | LABLOC | ANNAME | LABLOC | GSEAS1 | PABLABEL | PABVAL | PABPSQ | PABEL | REPL  | UNITS | ANLOC | UNLOC | ORTAC | UNRT1 |
|---------|------------|----------|---------|-------|--------|--------|---------|---------|---------|---------|--------|--------|--------|--------|---------|---------|--------|--------|-------|-------|--------|-------|-------|-------|-------|
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
| Kern    | 4032000000381 | NO-2-02  | 12/1/2014 | 100 | 52 | 06 | 9650-2 | TAC  | 9464-2 | 59620 | 220703 | 1 | 0 | ND | 0.23 | 2 VIGL | 1 |
2. **USEPA Superfund: National Priorities List (NPL)**

[https://www.epa.gov/superfund/superfund-national-priorities-list-npl](https://www.epa.gov/superfund/superfund-national-priorities-list-npl)

- USEPA lists all current, proposed or deleted sites of national priority resulting from known or threatened releases of hazardous substances, pollutants or contaminants.
- No downloadable data.
- Graphical display and lists all current and proposed NPL sites, sortable by state, regions, etc.
- Site descriptions include summary reports.

*Screenshots of website:*

![Superfund: National Priorities List (NPL)](https://www.epa.gov/superfund/superfund-national-priorities-list-npl)
Superfund
National Priorities List (NPL) Sites - by State

Choose a state or territory from the map or list below.
California

This page provides information about sites on the NPL, including site name, city, site EPA ID, listing date, federal facility indicator, site narrative, site progress profile, and Federal Register Notice. Select a state from the map for a list of NPL sites in that state.

You may need a PDF reader to view some of the files on this page. See EPA’s About PDF page to learn more.

California (98 sites)

<table>
<thead>
<tr>
<th>Site Name</th>
<th>City</th>
<th>Site EPA ID</th>
<th>Listing Date</th>
<th>Site Score</th>
<th>Federal Facility Indicator</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Micro Devices, Inc.</td>
<td>Sunnyvale</td>
<td>CADOH61490359</td>
<td>06/10/1986</td>
<td>37.03</td>
<td>No</td>
<td>Site Listing Narrative, Site Progress Profile, Federal Register Notice (PDF) (14 pp, 899K) Site Location</td>
</tr>
</tbody>
</table>

Superfund Site:

ADVANCED MICRO DEVICES, INC.
SUNNYVALE, CA

Announcements and Key Topics
EPA continues indoor air sampling for TCE vapors in homes and school buildings near the site and is overseeing the installation of more than 20 mitigation systems in residences and classrooms affected by vapor intrusion.

Background
The former Advanced Micro Devices, Inc. 901/902 Thompson Place Superfund Site (Site) covers 6 acres in Sunnyvale, California. AMD designed and fabricated semiconductor devices at two adjoining low-rise buildings at ... Continue reading background »

Site Contacts
Community Involvement Coordinator
Alejandro Diaz
(415) 972-3242

Remedial Project Manager
Melanie McShane
(415) 972-3090

Site Location
Street Address:
901 THOMPSON PL
SUNNYVALE, CA 94086

Sign up for this Superfund site’s mailing list
3. California EPA – Information on Drinking Water Quality

3.1. Water Quality Analysis Database Files

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/EDTlibrary.html

- Electronic Data Transfer (EDT) Library, a link to Schedules for Upcoming Water Quality Monitoring, files for the Division of Drinking Water’s (DDW’s) water quality analyses database, and county small water system water quality data files.
- Statewide current and historical chemical data from water suppliers.
- Downloadable data, including temporal data.
- Chemical data from April 1947 to current; data format: dbf, can be opened in Access; supporting database files are needed to interpret the data.

Screenshots of website and downloadable data:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>SAMP_DATE</th>
<th>SAMP_TIME</th>
<th>LAB_NUM</th>
<th>ANADATE</th>
<th>INDATE</th>
<th>METHOD</th>
<th>INBY</th>
<th>SPECIAL</th>
<th>STORE_NUM</th>
<th>XMOD</th>
<th>FINDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001039-003</td>
<td>1/10/2007</td>
<td>1200</td>
<td>4470</td>
<td>1/31/2007</td>
<td>2/26/2007</td>
<td>A</td>
<td>S</td>
<td>01502</td>
<td>0.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1001039-004</td>
<td>12/5/2017</td>
<td>155</td>
<td>4796</td>
<td>12/12/2017</td>
<td>1/11/2018</td>
<td>#</td>
<td>S</td>
<td>A-031</td>
<td>&lt; 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1001039-005</td>
<td>1/29/2008</td>
<td>1140</td>
<td>1675</td>
<td>1/29/2008</td>
<td>2/7/2008</td>
<td>A</td>
<td>S</td>
<td>71850</td>
<td>&lt; 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRIM_STA_C</td>
<td>SAMP_DATE</td>
<td>SAMP_TIME</td>
<td>LAB_NUM</td>
<td>ANDATE</td>
<td>INDATE</td>
<td>METHOD</td>
<td>INBY</td>
<td>SPECIAL</td>
<td>STORE_NUM</td>
<td>XMOD</td>
<td>FINDING</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td>-----------</td>
<td>---------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>------</td>
<td>---------</td>
<td>-----------</td>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>0103069-004</td>
<td>11/22/2017 0648</td>
<td>4790</td>
<td>11/22/2017</td>
<td>11/30/2017</td>
<td>SM 232</td>
<td>#</td>
<td>5</td>
<td>0001</td>
<td>&lt;</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>0103069-004</td>
<td>11/22/2017 0648</td>
<td>4790</td>
<td>11/22/2017</td>
<td>11/30/2017</td>
<td>SM 235</td>
<td>#</td>
<td>5</td>
<td>0009</td>
<td>&lt;</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>0103069-004</td>
<td>11/22/2017 0648</td>
<td>4790</td>
<td>11/29/2017</td>
<td>11/30/2017</td>
<td>SM 235</td>
<td>#</td>
<td>5</td>
<td>0009</td>
<td>&lt;</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>0103069-004</td>
<td>11/22/2017 0648</td>
<td>4790</td>
<td>11/29/2017</td>
<td>11/30/2017</td>
<td>SM4500</td>
<td>#</td>
<td>5</td>
<td>0003</td>
<td>&lt;</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>0103069-004</td>
<td>11/22/2017 0648</td>
<td>4790</td>
<td>11/22/2017</td>
<td>11/30/2017</td>
<td>300.0</td>
<td>#</td>
<td>5</td>
<td>0003</td>
<td>&lt;</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/21/2013 442</td>
<td>1675</td>
<td>8/22/2013</td>
<td>9/9/2013</td>
<td>71820</td>
<td>A</td>
<td>5</td>
<td>71820</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>7/15/2015 1300</td>
<td>1675</td>
<td>7/15/2015</td>
<td>8/9/2015</td>
<td>71820</td>
<td>A</td>
<td>5</td>
<td>71820</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>7/15/2015 1307</td>
<td>1644</td>
<td>7/18/2015</td>
<td>7/27/2015</td>
<td>71820</td>
<td>A</td>
<td>5</td>
<td>71820</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>7/12/2016 1315</td>
<td>1675</td>
<td>7/12/2016</td>
<td>7/22/2016</td>
<td>72722</td>
<td>A</td>
<td>5</td>
<td>72722</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/15/2016 1325</td>
<td>2416</td>
<td>8/21/2016</td>
<td>9/2/2016</td>
<td>73288</td>
<td>A</td>
<td>5</td>
<td>73288</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/15/2016 1325</td>
<td>2416</td>
<td>8/21/2016</td>
<td>9/2/2016</td>
<td>73288</td>
<td>A</td>
<td>5</td>
<td>73288</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/15/2016 1325</td>
<td>2416</td>
<td>8/21/2016</td>
<td>9/2/2016</td>
<td>73288</td>
<td>A</td>
<td>5</td>
<td>73288</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/15/2016 1325</td>
<td>2416</td>
<td>8/21/2016</td>
<td>9/2/2016</td>
<td>73288</td>
<td>A</td>
<td>5</td>
<td>73288</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/15/2016 1325</td>
<td>2416</td>
<td>8/21/2016</td>
<td>9/2/2016</td>
<td>73288</td>
<td>A</td>
<td>5</td>
<td>73288</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/15/2016 1325</td>
<td>2416</td>
<td>8/21/2016</td>
<td>9/2/2016</td>
<td>73288</td>
<td>A</td>
<td>5</td>
<td>73288</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0103040-007</td>
<td>8/15/2016 1325</td>
<td>2416</td>
<td>8/21/2016</td>
<td>9/2/2016</td>
<td>73288</td>
<td>A</td>
<td>5</td>
<td>73288</td>
<td>&lt;</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

**Announcements:** Important EDT Data Reporting Changes and Reminders

**Store Code 00618 (Nitrate as N):** Reported findings are required to be in units of milligrams per liter (mg/L). California’s drinking water regulations require the nitrate MCL to be expressed as “10 mg/L (as nitrogen, N)” instead of “45 mg/L (as nitrate, NO₃).” The MCL has not become more stringent. **Effective January 1, 2016,** all nitrate data submitted to the EDT Portal must be submitted under Store Code 00618 (Nitrate as N) otherwise the data will not be accepted. For more information, see the detailed announcement for laboratories accredited by the Environmental Laboratory Accreditation Program.

**Store Code 00620 (Nitrate as N):** Effective January 1, 2016, all data submitted to the EDT Portal must be reported in units of mg/L.

**Laboratory Reporting Errors**
Effective immediately, laboratory reporting errors will not be changed in the database. Instead, (1) The laboratory will inform the district office of the error. (2) District office will approve deletion of erroneous data from database, and (3) The laboratory will resubmit data electronically.

**EDT Data Submittals**
EDT data submissions via email are no longer accepted. Data are submitted via the EDT Portal webpage at: [http://drinc.ca.gov/WQM/](http://drinc.ca.gov/WQM/). For more information, see DDW’s Announcement Regarding No Procedures for EDT (11-16-2015) and EDT Portal Upload Instructions (09-10-2015).
EDT Data Submittals via email are no longer accepted. Data are submitted via the EDT Portal webpage at: http://dtwq.ca.gov/EDT/. For more, see DTW’s Announcement Regarding No Procedures for EDT (08.26.2015) and EDT Portal Upload Instructions (09.10.2015).

EDT Library

These executable self-extracting files* support the submittal of drinking water analytical results. More information is available at the Drinking Water Program’s EDT webpage.


This zip file contains WQSetup.exe, 4.5 MB, the setup file for Write-On for Windows 95/98/2000/XP Water Quality Input System (Version 2.0r). The file can be installed directly into an existing Write-On folder, and the changes will be made automatically. The entire installed Write-On for Windows 95/98/2000/XP software will require ~14.5 MB of disk space with the Library's installation.

NOTE: USE THIS FILE TO INSTALL WRITE-ON ONLY. THE SOURCE AND SYSTEM LIBRARIES ARE NO LONGER INCLUDED WITH THIS INSTALLATION PACKAGE. THE LIBRARIES ARE REQUIRED FOR WRITE-ON TO OPERATE. FOR THE CURRENT LIBRARIES, DOWNLOAD THE FILE BELOW, "Water System and Source Libraries."

Updated Software Files for Write-On (Zip) — Last Update: September 30, 2016

This zip file contains 3 files and will expand to ~70 KB. These updates contains a revised form, and a revised file that contains updated store information. These files are designed to be used with the Write-On software, and should be unzipped and placed in the \WQWIN folder.

Water System and Source Libraries (Zip file, expands to 4MB) — Last Update: May 12, 2019

This zip file contains 47 files and will expand to ~4 MB. This system and source files are designed to be used with the Write-On software, and should be unzipped and installed in the \WQWIN folder. It includes both large and small water system sources, and an updated laboratory data file.

List of Water Quality Chemicals and Parameters (Excel) — Last Update: May 6, 2019.

This is an MS Excel file (~70 KB) that lists chemicals in Write-On, and includes US EPA STORET numbers or other identifiers, maximum contaminant levels, detection levels for purposes of reporting, and reporting units.

Hardcopy Reporting Forms (Zip) — Last Update: January 22, 2018.

This file, FORMS.ZIP, 67 KB, is self-extracting (expanding to 577 KB) and includes the following forms in MS Word: (1) Base Neutral and Acids, (2) Organic Chemical Analysis, (3) Radioactivity Analysis, and (4) General Mineral, Physical & Inorganic Chemical Analyses. **NOTE:** These forms are for hardcopy submission of water quality data only (prior to the requirement for EDT submittal) and not for the required submittal of data by EDT.

Write-On Library Mover (Zip) — Last Update: March 25, 2003

This zip file contains the Write-On Library Mover (LIBMOVE.EXE) is a utility that assists you in moving updated system and source libraries to your hard disk drive. It is ~15 KB in size. This file saves you the task of having to reenter the sources and systems you created to the new libraries with Library Maintenance. This file was formerly included with the Water System and Source Libraries (ALL_LIB.EXE). Included is a library Mover.doc 02/25/2003.

* Obtain a copy of these files by clicking on the highlighted text to download a self-extracting version of these files. After successful download, simply double click on the file in your File Manager and the extraction process will be performed.
3.2. **Drinking Water Watch**

[https://sdwis.waterboards.ca.gov/PDWW/](https://sdwis.waterboards.ca.gov/PDWW/)

- This website provides a variety of chemical data (including many uncommon chemicals) for wells and distribution systems. Includes historical data (at least dated back in the 1980s).
- Data are available in the pdf form (convertible to Excel).
- With well locations and temporal changes in chemical concentrations, a trendline analysis is feasible.

_Screenshots of website and downloadable data:_
3.3. GAMA-PBP Groundwater-Quality Results: Assessment and Trends

https://ca.water.usgs.gov/projects/gama/water-quality-results/

- From USGS California Water Science Center, Groundwater Ambient Monitoring and Assessment (GAMA) Priority Basin Project (PBP)
- Map viewer showing concentrations and trends of many constituents, such as metal ions, nutrients, TDS, pesticides, VOCs, age-dating tracers, radioactivity, etc.
- Concentrations are provided and categorized as different ranges, with color code. No date is associated with the measurements.
- No downloadable data.

Screenshots of website:
4. Information on Pesticide Use pertaining to groundwater quality

4.1. California Pesticide Information Portal (CalPIP)
https://calpip.cdpr.ca.gov/main.cfm

- From Department of Pesticide Regulation (DPR).
- Pesticide use reporting (PUR) data, and Groundwater Protection Areas (GWPAs).
- Downloadable data in text files, shapefiles, maps, and KML files.
- Data can be sorted by locations, chemicals, years, counties.
- Trendline analysis can be done on usage of pesticides, but not on groundwater elevation or chemical concentrations.
- Data archives are available for download.
  ftp://transfer.cdpr.ca.gov/pub/outgoing/pur_archives/
  - List the locations and quantities of pesticide uses for that year.
- Pesticide use reporting (PUR) https://www.cdpr.ca.gov/docs/pur/purmain.htm
  - Choose location of interests and generate a report.

Screenshots of website and selected downloadable data:
Pesticide Use Reporting - 2016 Summary Data

Back to Pesticide Use Reporting Menu

Text files for all 2016 Annual Report tables and figures are available for download.

- Pounds of active ingredient by county, PDF (42 kb)

Top Five Lists

- The top five sites by pounds, PDF (331 kb) in total pesticide use in each county in 2016 and the top five pesticides used on each of these sites.
- The top five pesticides by pounds, PDF (335 kb) used in each county in 2016 and the top five sites of use for each of these pesticides.
- The top five sites by acres treated, PDF (478 kb) in each county in 2016. This table lists the top five sites and corresponding top five pesticides ranked by cumulative acres treated.
- The top five pesticides by acres treated, PDF (337 kb) in each county in 2016. This table lists the top five pesticides and corresponding top five sites ranked by cumulative acres treated.

Top 100 Lists

- The top 100 sites by pounds, PDF (161 kb) in total statewide pesticide use in 2016.
- The top 100 pesticides by pounds, PDF (260 kb) used statewide (all sites combined) in 2016.
- The top 100 sites by acres treated, PDF (244 kb) in 2016. This table ranks the top 100 sites and corresponding statewide pesticide use by cumulative acres treated.
- The top 100 pesticides by acres treated, PDF (162 kb) in 2016. This table ranks the top 100 pesticides by cumulative acres treated.

2016 Statewide Report

- Summary of Pesticide Use Report Data
- Indexed by commodity, PDF (9.2 mb)
- Indexed by chemical, PDF (9 mb)

2016 County Summary Reports:

Indexed by Commodity
- Click arrow to select a county report.

Indexed by Chemical
- Kern

Please send your questions and comments to PUR.inquiry@cdpr.ca.gov.
<table>
<thead>
<tr>
<th>Chemical Commodity</th>
<th>Pounds Applied</th>
<th>Agricultural Applications</th>
<th>Amount Treated</th>
<th>Unit Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almond</td>
<td>2,492.30</td>
<td>1,416</td>
<td>137,693.08</td>
<td>A</td>
</tr>
<tr>
<td>Apple</td>
<td>&lt; 0.01</td>
<td>1</td>
<td>1.90</td>
<td>A</td>
</tr>
<tr>
<td>Beans, Dry</td>
<td>5.05</td>
<td>7</td>
<td>483.78</td>
<td>A</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>1.74</td>
<td>3</td>
<td>157.50</td>
<td>A</td>
</tr>
<tr>
<td>Cherry</td>
<td>64.40</td>
<td>75</td>
<td>2,872.13</td>
<td>A</td>
</tr>
<tr>
<td>Cotton</td>
<td>77.33</td>
<td>118</td>
<td>7,731.22</td>
<td>A</td>
</tr>
<tr>
<td>Eggplant</td>
<td>0.21</td>
<td>1</td>
<td>12.00</td>
<td>A</td>
</tr>
<tr>
<td>Garlic</td>
<td>0.69</td>
<td>1</td>
<td>34.50</td>
<td>A</td>
</tr>
<tr>
<td>Grape</td>
<td>106.36</td>
<td>188</td>
<td>7,881.72</td>
<td>A</td>
</tr>
<tr>
<td>Grape, Wine</td>
<td>35.00</td>
<td>28</td>
<td>1,836.19</td>
<td>A</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>5.39</td>
<td>21</td>
<td>341.20</td>
<td>A</td>
</tr>
<tr>
<td>Lemon</td>
<td>44.83</td>
<td>52</td>
<td>2,014.82</td>
<td>A</td>
</tr>
<tr>
<td>Lettuce, Leaf</td>
<td>2.28</td>
<td>5</td>
<td>110.50</td>
<td>A</td>
</tr>
<tr>
<td>Melon</td>
<td>0.69</td>
<td>2</td>
<td>101.00</td>
<td>A</td>
</tr>
<tr>
<td>N-Grohs Plants In Containers</td>
<td>0.11</td>
<td></td>
<td>61.25</td>
<td>A</td>
</tr>
<tr>
<td>N-Outdr Plants In Containers</td>
<td>1.09</td>
<td></td>
<td>96.00</td>
<td>A</td>
</tr>
<tr>
<td>Onion, Dry</td>
<td>20.93</td>
<td>26</td>
<td>1,116.00</td>
<td>A</td>
</tr>
<tr>
<td>Orange</td>
<td>770.45</td>
<td>501</td>
<td>20,775.57</td>
<td>A</td>
</tr>
<tr>
<td>Pepper, Fruiting</td>
<td>19.52</td>
<td>35</td>
<td>1,594.50</td>
<td>A</td>
</tr>
<tr>
<td>Pepper, Spice</td>
<td>46.28</td>
<td>22</td>
<td>2,106.00</td>
<td>A</td>
</tr>
<tr>
<td>Pistachio</td>
<td>3.32</td>
<td>6</td>
<td>451.63</td>
<td>A</td>
</tr>
<tr>
<td>Structural Pest Control</td>
<td>0.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tangelo</td>
<td>2.23</td>
<td>5</td>
<td>94.40</td>
<td>A</td>
</tr>
<tr>
<td>Tangerine</td>
<td>335.10</td>
<td>294</td>
<td>17,506.75</td>
<td>A</td>
</tr>
<tr>
<td>Tomato, Processing</td>
<td>8.66</td>
<td>3</td>
<td>450.00</td>
<td>A</td>
</tr>
<tr>
<td>Uncultivated Ag</td>
<td>0.30</td>
<td>1</td>
<td>20.00</td>
<td>A</td>
</tr>
<tr>
<td>Walnut</td>
<td>10.49</td>
<td>16</td>
<td>541.94</td>
<td>A</td>
</tr>
<tr>
<td>Watermelon</td>
<td>15.68</td>
<td>30</td>
<td>1,435.05</td>
<td>A</td>
</tr>
<tr>
<td>Chemical Total</td>
<td>4,062.29</td>
<td>2,869</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.1.1. Locations of Ground Water Protection Areas (GWPA)
https://www.cdpr.ca.gov/docs/emon/grndwtr/gwpa_locations.htm

- GWPA maps and county lists.
- Downloadable maps, shapefiles, KML files.
- Contains locations of regulated sites, but no data.
- Choose a township and check whether it contains GW Protection Areas.
  https://calpip.cdpr.ca.gov/county.cfm?ds=GWPA
- Ground Water Protection Area Lists
  https://www.cdpr.ca.gov/docs/emon/grndwtr/gwpa_lists.htm
Choose a Township (COMTR) or townships under the county(s) specified and click Select. Then choose a Section (COMTRS) or sections under the township(s) specified and click Select. Then go to Submit.

Available COMTR
Township and Range under selected county(s) (257):
15 M24S18E
15 M24S34E
15 M24S36E
15 M25S17E
15 M25S18E

Available COMTRS
Sections within selected Township-Range (1):
15 M24S34E 31

Please click on the SUBMIT button to receive GWPA information about the township and section you selected in the county(s) chosen, or click the RESET button to clear your selection.

Reset  Start Over  Submit

Version 2013.04 (2018 PUR Data Update)

Back to Ground Water Protection Area Lists

Kern County Ground Water Protection Areas
Effective May 27, 2004
County_Meridian_Township_Range_Section (COMTRS)  Condition
15M25S24E01  Runoff
15M25S24E11  Runoff
15M25S24E12  Runoff
15M25S25E02  Leaching
15M25S25E03  Leaching
15M25S25E05  Runoff
15M25S25E06  Runoff
15M25S25E07  Runoff
15M25S25E08  Runoff
15M25S25E17  Runoff
15M28S23E24  Runoff
15M28S23E25  Runoff
15M28S24E30  Runoff
15M28S24E31  Runoff
15M28S25E14  Leaching
15M31S27E16  Leaching
5. Information on Groundwater Quality in Areas of Oil and Gas Production

5.1. WellFinder
https://maps.conservation.ca.gov/doggr/wellfinder/#openModal/-118.94276/37.11133/6

- From California Division of Oil, Gas, and Geothermal Resources (DOGGR).
- Oil and gas well locations, information and records; Information about other oil and gas facilities.
- Data from DOGGR through third party reporting.
- Well locations as Excel; well data and reports as pdf or tif files.

Screenshots of website and selected downloadable data:
5.2. **CalStim’D – Well Stimulation Permits and Sites**

https://maps.conservation.ca.gov/doggr/calstimd/#close

- Data from DOGGR.
- Map viewer of well stimulation sites.
- No downloadable data.
- Searched by permits or American Petroleum Institute (API) number.
- Well Stimulation Treatment (WST) Disclosure; includes WST disclosures from Jan. 1, 2014 to present.

*Screenshots of website:*
### Basic Stage Information

<table>
<thead>
<tr>
<th>Stage No.</th>
<th>Stage Top MD (ft)</th>
<th>Stage Bottom MD (ft)</th>
<th>Stage Top TVD (ft)</th>
<th>Stage Bottom TVD (ft)</th>
<th>Fracture Length (ft)</th>
<th>Fracture Height (ft)</th>
<th>Fracture Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9518</td>
<td>9725</td>
<td>9518</td>
<td>9725</td>
<td>250</td>
<td>207</td>
<td>N20E</td>
</tr>
</tbody>
</table>

### WST Fluid Information

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Purpose</th>
<th>Supplier</th>
<th>CAS Number</th>
<th>Chemical Constituent</th>
<th>Alt CAS Number</th>
<th>Additive Concentration</th>
<th>Chemical Constituent Concentration (% mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Carrier</td>
<td>Baker Hughes</td>
<td>7732-16-5</td>
<td>Water</td>
<td></td>
<td>Additive Concentration in HF Fluid (% by mass) is 81.155946</td>
<td>81.155946</td>
</tr>
<tr>
<td>BC-3 [SB-4]</td>
<td>Breaker</td>
<td>Baker Hughes</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>0.001765%</td>
<td>0.000000</td>
</tr>
<tr>
<td>BF-7L [SB-4]</td>
<td>Buffer</td>
<td>Baker Hughes</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>0.864969%</td>
<td>0.000000</td>
</tr>
<tr>
<td>Enzyme G-1 [SB-4]</td>
<td>Breaker</td>
<td>Baker Hughes</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>0.089597%</td>
<td>0.000000</td>
</tr>
</tbody>
</table>
5.2.1. Well Stimulation Treatment Disclosure Search

https://secure.conservation.ca.gov/WSTDisclosure/?BeginDate=&EndDate=01%2F01%2F2014&Chemical=&ChemCASNumber=&CASNumber=&TradeName=&DataBaseSource=Both&wellInfoDataTableID_length=10

- Well stimulation sites and permits can be searched by date or chemical constituent.
- No downloadable data.
<table>
<thead>
<tr>
<th>Chemical Constituent (use text boxes below to search list)</th>
<th>CAS Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3 - Propanol</td>
<td>56-61-5</td>
</tr>
<tr>
<td>1,2,3-Trimethylbenzene</td>
<td>526-73-8</td>
</tr>
<tr>
<td>1,2,4 Trimethylbenzene (impurity)</td>
<td>95-63-6</td>
</tr>
<tr>
<td>1,2,4,5-Tetrabromobenzene</td>
<td>636-28-2</td>
</tr>
<tr>
<td>1,2,4-Trimethylbenzene</td>
<td>95-63-6</td>
</tr>
<tr>
<td>1,2-benzisothiazolin-3-one</td>
<td>2634-33-5</td>
</tr>
<tr>
<td>1,2-Diiodobenzene</td>
<td>615-42-9</td>
</tr>
<tr>
<td>1,3,5-Tribromobenzene</td>
<td>626-39-1</td>
</tr>
<tr>
<td>1,3,5-Trimethylbenzene</td>
<td>108-67-8</td>
</tr>
<tr>
<td>1,4-Dibromobenzene</td>
<td>106-37-6</td>
</tr>
<tr>
<td>1-bromo-3,5-dichlorobenzene</td>
<td>19752-55-7</td>
</tr>
<tr>
<td>1-Bromo-4-iodobenzene</td>
<td>589-87-7</td>
</tr>
<tr>
<td>1-Butoxy-2-Propanol</td>
<td>5131-66-8</td>
</tr>
<tr>
<td>1-Chloro-4-Iodobenzene</td>
<td>637-87-6</td>
</tr>
<tr>
<td>1-Eicosene</td>
<td>3452-07-1</td>
</tr>
<tr>
<td>1-Hexadecene</td>
<td>629-73-2</td>
</tr>
<tr>
<td>1-Iodonaphthalene</td>
<td>90-14-2</td>
</tr>
<tr>
<td>1-Methoxy-2-Propanol</td>
<td>107-98-2</td>
</tr>
</tbody>
</table>
5.3. Water Quality in Areas of Oil and Gas Production – Regional Groundwater Monitoring Program

https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/regional_monitoring/index.html#overview

- Salinity mapping.
- Produced water characterization.
- Groundwater potential risk zone analysis.
- Data from USGS, DOGGR, and other state and regional boards.
- Chemical data are available to download. Trendline analysis is feasible.
- Data releases:
  https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/regional_monitoring/index.html#datareleases

Screenshots of website and selected downloadable data:
Reports

The data collected during the exploratory sampling is summarized in the following report: "USGS Open-File Report 2016-1381: Data from Exploratory Sampling of Groundwater in Selected Oil and Gas Areas of Coastal Los Angeles County and Kern and Kings Counties in Southern San Joaquin Valley, 2014-15: California Oil, Gas, and Groundwater Project."

The U.S. Geological Survey sampled water wells in the Los Angeles Basin and southern San Joaquin Valley, California, and oil wells in the San Joaquin Valley for analysis of multiple chemical, isotopic, and groundwater-age tracers. This report summarizes that work to evaluate the utility of using tracers for assessing oil and gas production activities on groundwater quality in California. The report is available at the following: "Preliminary results from exploratory sampling of wells for the California oil, gas, and groundwater program, 2014–15. Open-File Report 2016-1106."

The U.S. Geological Survey compiled data that characterizes the intensity of petroleum resource development and proximity to groundwater resources. This report is available at the following: "Prioritization of oil and gas fields for regional groundwater monitoring based on a preliminary assessment of petroleum resource development and proximity to California's groundwater resources, Scientific Investigations Report 2018-5065."

The U.S. Geological Survey compiled a report to document the preliminary groundwater salinity mapping of 31 oil fields and adjacent aquifers. The data is summarized into 8 sub-regions across major oil-producing areas of central and southern California. This report is available at the following: "Preliminary groundwater salinity mapping near selected oil fields using historical water-sample data, central and southern California. Scientific Investigations Report 2018-5082."

Data Releases

Data collected from collected produced water samples from four petroleum wells in the southern San Joaquin Valley. This dataset contains the site information, analyzing laboratories and methods, and water chemistry and quality control results for these samples. The report is available at the following: Produced water chemistry data for samples from four petroleum wells, Southern San Joaquin Valley, California (2014).

Supporting data for the "Produced water chemistry data for samples from four petroleum wells, Southern San Joaquin Valley, California, 2014" (9/9/2016)

Data from the Fruitvale produced water ponds is available at the following: "Historical produced water chemistry data compiled for the Fruitvale Oilfield, Kern County, California, (2/20/2018).

Supporting data for the "Produced water chemistry data for the Lost Hills, Fruitvale, and North and South Belridge study areas, Southern San Joaquin Valley, California" (6/7/2018)

Data Analyzed for the Preliminary Prioritization of California Oil and Gas Fields for Regional Groundwater Monitoring (7/23/2018)

Supporting data for the "Water and petroleum well data used for preliminary regional groundwater salinity mapping near selected oil fields in central and southern California" (7/24/2018)

Groundwater and surface water chemistry results for samples collected near the Lost Hills and North and South Belridge oil fields, Kern County, California (9/17/2018)

"Geochemical and geophysical data for wells in the Fruitvale and Rosedale Ranch oil and gas fields, Kern County, California, USA" (0/27/2018)

"Water chemistry data for samples collected at groundwater sites near the Fruitvale oilfield, September 2016-February 2017, Kern County, California" (9/20/2018)

"Geochemical, geologic, and geophysical data for wells in the Poso Creek oil and gas field, Kern County, California" (12/13/2018)

"Geochemical and geophysical data for salinity mapping in the Midway-Sunset oilfield area" (12/19/2018)

"Historical produced water chemistry data compiled for the Lost Hills and North and South Belridge Oilfields, Kern County, California" (1/23/2019)

NEW - "Geochemical and geophysical data for selected wells in and surrounding the South Cuyama oil and gas field" (4/9/2019)

Water chemistry data for samples collected at ground water wells

An investigation was done by the U.S. Geological Survey, in cooperation with the California State Water Resources Control Board’s Program of Regional Groundwater Monitoring of Water Quality in Areas of Oil and Gas Production. To assess the effects of oil and gas production activities on nearby groundwater resources. During November 2016–September 2017, 30 samples were collected at groundwater wells and 1 sample was collected at a surface-water site. This dataset contains site information and water chemistry results for samples collected near the Lost Hills and North and South Belridge oil fields, Kern County, California. Samples were analyzed for water-quality indicators, major and minor ions, nutrients, trace elements, volatile organic compounds, naturally occurring radioactive material, geochemical and age-dating tracers, dissolved organic carbon, low molecular weight organic acids, dissolved standard and non-standard gases, and dissolved noble and atmospheric gases. Quality-control samples including replicates, source-solution, equipment, and field blanks; laboratory spikes, and split samples for interlaboratory comparisons were collected and summarized in this data release.

Contacts

Point of Contact: Tracy Davis
Originator: Tracy Davis, Jessica A. Teunes, Anthony J. Mccarroll, Neil O. Seltz, Joshua C. Johnson
Metadata Contact: Tracy Davis
Publisher: U.S. Geological Survey
Distributor: U.S. Geological Survey - ScienceBase
SDC Data Owner: California Water Science Center
USGS Mission Area: Water Resources

Attached Files

Click on title to download individual files attached to this tool or download all files listed below as a compressed file.

- LOST_BELS_sampled_sites.xlsx 16.29 KB
- LOST_BELS_samples.xlsx 427.91 KB
- LOST_BELS_ENV_results.xlsx 513.21 KB
- LOST_BELS_QC_results.xlsx 42.3 KB
- COGO_Data Dictionary.xlsx 34.99 KB
- CSV_LOST_BELS.zip 27.34 KB
- LOST_BELS_metadata.xml 48.18 KB
- Original F&GDC Metadata
- Supplemental metadata.txt 20.3 KB
- LOST_BELS_map.png 125.44 KB

Spatial Services

ScienceBase WMS:
https://www.sciencebase.gov/catalyst/

Communities

- California Oil, Gas, and Groundwater
- USGS California Water Science Center
- USGS Data Release Products

Associated Items

- copied into Water chemistry data for samples collected at groundwater and surface-water sites near the Lost Hills and Belridge oil fields, November 2016–September 2017 (ver. 2.0, May 2019), Kern County, California (CCPY)

Tags

- View Associated Items
Table 1. Identification, sampling, and construction information for wells included in exploratory sampling of groundwater in coastal Los Angeles County and Kern and Kings Counties of the southern San Joaquin Valley, September 2014 to January 2015. California Oil, Gas, and Groundwater Project.

<table>
<thead>
<tr>
<th>Local Identifier</th>
<th>USGS site identification number</th>
<th>State identification number</th>
<th>Depth sampled (m)</th>
<th>Date sampled (mm/dd/yyyy)</th>
<th>Latitude of LID (ft above NAVD 88)</th>
<th>Well Type</th>
<th>Use of Well</th>
<th>Well depth (ft below LID)</th>
<th>Screen intervals (ft below LID)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A-1</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>44</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-2</td>
<td>32320511032461</td>
<td>05001319123805</td>
<td>44</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-3</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-4</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>28</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-5</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-6</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-7</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-8</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-9</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-10</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-11</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-12</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-13</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-14</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-15</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-16</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-17</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-18</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-19</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-20</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-21</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-22</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-23</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-24</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-25</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-26</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>3A-27</td>
<td>32320511032461</td>
<td>04401119123805</td>
<td>20</td>
<td>09/18/14</td>
<td>-128.00</td>
<td>Groundwater</td>
<td>water supply</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>
6. Information on Vulnerability Assessment Tools Pertaining to Groundwater

6.1. CalEnviroScreen 3.0 Maps
https://oehha.ca.gov/calenviroscreen/maps-data

- Scores for pollution burden, including groundwater threats, drinking water contamination, clean ups, pesticides, and other indicators of pollution burden, and population characteristics by census tract.
- From various sources.
- Downloadable data in various formats (no chemical concentration measurements or groundwater elevations).
- Screening tool to help identify communities burdened by or susceptible to multiple sources of pollution.
- Maps – Cal EnviroScreen, Pesticides, Pollution Map, Disadvantaged Communities, etc.
  https://oehha.ca.gov/library/maps
    - Most results are expressed as scores; applicable for regulatory purposes.
- Chemicals databases – toxicity reports https://oehha.ca.gov/node/11208

Screenshots of website:
**Synonym(s)**
Arsenic, inorganic; Arsenic black; Arsenic 75; Colloidal arsenic; Gray arsenic; Inorganic arsenic compounds; Metallic arsenic

**Occurrence(Use)**
Wood preservative, herbicide, nonferrous alloys, medicine (leukemia treatment); component of tobacco smoke. Formerly used in optical glass.

More Information about Arsenic

**California Public Health Goals Data**

<table>
<thead>
<tr>
<th>Health Risk Category</th>
<th>Carcinogenicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Health Goal (mg/L):</td>
<td>0.000004</td>
</tr>
<tr>
<td>Downloads:</td>
<td>Response to comments on PHG for arsenic, Fact Sheet: Public Health Goal for Arsenic</td>
</tr>
<tr>
<td>Cancer Risk at PHG:</td>
<td>0.000001</td>
</tr>
<tr>
<td>MCL value (mg/L):</td>
<td>0.01</td>
</tr>
<tr>
<td>Cancer Risk at MCL:</td>
<td>0.0025</td>
</tr>
<tr>
<td>Last PHG Revision:</td>
<td>2004</td>
</tr>
<tr>
<td>California PHG Comments:</td>
<td>Solubility of arsenic compounds vary.</td>
</tr>
<tr>
<td>Update Date:</td>
<td>04/03/2004</td>
</tr>
</tbody>
</table>

**Maps**

**Indicator Maps (CalEnviroScreen)**
View maps on pollution burden, ozone, PM2.5, Diesel PM, Drinking Water, Pesticides, Toxic Releases, Traffic, Cleanups, Groundwater, Hazardous Waste, Impaired Waters and Solid Waste

**Pesticides (CalEnviroScreen)**
Map information about agricultural use of Pesticides in your region.

**Pollution Map (CalEnviroScreen)**
This map shows Pollution concentrations.

**Fish Advisory Map**
Searchable map by waterways to find safe fish to eat

**Disadvantaged Communities (CalEnviroScreen)**
This map shows the disadvantaged communities designated by CalEPA for the purpose of SB 535.

**Medical Supervisor Registration**
California’s Medical Supervision Program is a biomonitoring program that measures cholinesterase activity in blood samples collected from agricultural workers who regularly handle category I and II organophosphate and carbamate pesticides.
Appendix J

Methods and Data Used in the Water Budget Spreadsheet Model Approach
Appendix J-1

Water Budget Model Overview
APPENDIX J-1
WATER BUDGET MODEL OVERVIEW

A water budget is an accounting of all water inflows to and outflows from a given spatial domain, and enforces the principle of mass balance through use of a change in water storage term. A water budget is expressed by the following simple equation:

\[
\text{Inflows} - \text{Outflows} = \text{Change in Storage}
\]

The above fundamental equation holds true for any defined domain (e.g., parcel, watershed, basin, etc.) and length of time (e.g., day, month, year, etc.) and, when properly constructed using process- and/or physics-based components, serves as a powerful tool for understanding water flow through a system.

Figure J-1-1: DWR Water Budget Schematic (Fig. 7 from DWR’s SGMA BMP #4, pg. 30)

Description of Water Budget Framework

A water budget “framework” has been developed to inform the development of a water budget model for the District’s service area that is consistent with the requirements of the Sustainable Groundwater Management Act (SGMA) and aligns with the historical, current, and future water budget periods as specified by the Kern Groundwater Authority GSA (KGA GSA) and further described below. The conceptual water budget model is depicted on Figures WB-1 and WB-2 of AEWSD’s Management Area Plan for the Kern Subbasin, and is further described below.

Water Budget Subdomains

The water budget is divided into six internal subdomains, each influenced by a number of flow components and within which mass-balance is enforced (i.e., the sum of inflow components is balanced by the sum of outflow components and/or a change in storage component). Figure WB-1 shows the water budget domain, and the following internal subdomains:
a. Artificial channels  
b. Spreading grounds  
c. Agricultural lands  
d. Urban lands  
e. Natural channels, and  
f. Groundwater system

In addition to the six internal subdomains, several external subdomains are incorporated into the spreadsheet model. These include the watersheds that contribute streamflow to streams entering the District, and the atmosphere which is a source of precipitation and sink for evapotranspiration. The spreadsheet model does not explicitly account for the vadose (unsaturated) zone between the land surface and the (saturated) groundwater system, but instead incorporates temporal lag factors to account for the movement of water through this zone. An implicit assumption in this approach, therefore, is that the vadose zone does not experience any change in storage over time.

**Water Budget Flow Components**

Within and between each subdomain are 36 water budget flow components that route water through the Arvin-Edison Water Storage District. [Figure WB-2](#) shows a conceptual diagram of the individual water budget flow components between subdomains as well as flow components that are external to the overall water budget domain (i.e., serve only as an inflow or outflow to the entire system, rather than a flow between subdomains). The 36 conceptual water budget flow components are listed in [Table J-1-1](#), along with an overview of their estimation methods. The general relationship between water budget subdomains, associated flow components, and mass balance relationships is further depicted in [Table J-1-2](#).

Certain components are based on “raw” data which are directly measured and based on historical records. These “raw” components are considered to have a relatively high degree of certainty. Other components are estimated using a variety of analytical methods (e.g., Darcy’s Law to calculate subsurface flows across the domain’s external boundaries) and are thus subject to greater uncertainty based on the parameters used in their estimation. Some components (i.e., groundwater pumping for agricultural use) constitute major proportions of the overall water budget and have thus been given significant attention. Others are relatively minor in magnitude (e.g., seepage from artificial channels) and are, to some degree, less significant to the overall water budget and less well defined.

While the various subdomains and linkages shown on Figures WB-1 and WB-2 and in Table J-1-1 and Table J-1-2 indicate a highly complex system, the use of such a component-based bottom-up approach allows each component to be considered separately which can benefit model development and application. For example, if new data or methods become available for a certain component, they can be easily plugged into the appropriate component without disturbing the rest of the model.

**Water Budget Time Periods**

As mentioned above, the water budget spreadsheet model was developed to estimate the magnitude of water budget flow components and the resulting change in groundwater storage to the local aquifer system underlying AEWSD for three distinct time-periods as defined by the KGA GSA:

- **Historical** – DWR Water Years 1995 – 2014 (i.e., October 1994 – September 2014);  
- **Current** – DWR Water Year 2015 (i.e., October 2014 – September 2015); and
• **Future** – 50-year projection of DWR Water Years 2016 – 2065 (see Appendix J-6).

**Water Budget Spreadsheet Model Functionality**

The water budget spreadsheet model was developed using Microsoft Excel. The complete model consists of one Excel (.xlsx) workbook with several individual spreadsheet tabs which can generally be grouped into four categories:

- “Master” Models
- “User Input Parameters” and Model Calibration
- Presentation and Reporting
- “Backend” Data and Calculations

**“Master” Models**

The final calculations for all historical and current (1994 - 2015) water budget components occur within the following three “master” tabs of the spreadsheet:

- “Kern_monthly_WB”
- “WWB_monthly_WB”
- “Combined_monthly_WB”

These tabs contain the fully populated monthly historical and current water budgets for (1) the District’s SGMA management area within the Kern Subbasin\(^1\), (2) the District’s SGMA management area within the White Wolf Subbasin, and (3) District’s entire SGMA management area, respectively.

Results of the historical and current water budget efforts for the Kern Subbasin were subsequently used to inform the development of three projected (i.e. future) water budget scenarios for the AEWSD Kern Subbasin Management Area, which are described in greater detail in Appendix J-6. The projected water budget “master” spreadsheet models include:

- “Kern_PROJECTED_baseline”
- “Kern_PROJECTED_2030”
- “Kern_PROJECTED_2070”

All master spreadsheets are denoted in green within the Excel workbook. Each column of the master spreadsheets represents an individual water budget flow component or associated calculation. Flow components are grouped by Water Budget Domain/Subdomain, and main flow components are listed by number (1 through 36) near the top of each master tab. Each row of the master spreadsheets (apart from the header rows) represents a single month in the model period, as defined in columns E-F. All values are listed in acre-feet (AF). Monthly values are subsequently summarized by water year at the bottom of each master spreadsheet. The master spreadsheets have been fully populated with data via linkages with the “backend” data and calculation spreadsheets (described in further detail below) and/or through calculations made directly within the master spreadsheet, and in all cases should not be directly edited.

---

\(^1\) This area does not include the District’s overlap lands with East Niles CSD, which falls under the SGMA jurisdiction of the Kern River GSA (KRGSA).
unless intending to override the existing data with updated inputs. Raw data inputs are denoted in blue shaded cells, whereas unshaded cells are calculated inputs.

“User Input Parameters” and Model Calibration

As further described in Appendix J-5, various “User Input Parameters” are included to assist in calibration of the historical and current water budgets. These are listed above the header rows of the master tabs, including:

- Irrigation Efficiency Coefficients (for micro-drip, micro-sprinkler, sprinkler, and gravity-based irrigation types; see Appendix J-4)
- Deep Percolation Lag Period (i.e., approximate time delay for deep percolation to reach groundwater table; see Appendix J-4)
- Spreading Basin Lag Period (i.e., approximate time delay for banked water to reach the groundwater table from the District’s spreading facilities; see Appendix J-4)
- Hydraulic Conductivity & Aquifer Thickness along the northwestern AEWSD-Kern Delta Water District (KDWD) Boundary (to estimate transmissivity along northwestern District boundary; see Appendix J-3)
- Hydraulic Conductivity & Aquifer Thickness along the southwestern AEWSD-KDWD Boundary (to estimate transmissivity along northwestern District boundary; see Appendix J-3)
- White Wolf Fault Hydraulic Conductivity and Thickness (to estimate transmissivity along the fault; see Appendix J-3)
- Leachate Water Electrical Conductivity (to estimate leaching demands; see Appendix J-4)
- Additional Operational Demands (to estimate additional applied water demands [in terms of AFY/irrigated acre] from cultural practices and other operation requirements, e.g. dust abatement, frost control, etc.; see Appendix J-4)
- Ineffective Precipitation Deep Percolation Coefficient (to estimate deep percolation from ineffective precipitation; see Appendix J-4)
- Kern & White Wolf Watershed Consumptive Use Fractions (to estimate residual streamflows into the District; see Appendix J-2)
- Kern & White Wolf Watershed Precipitation Thresholds for Runoff (to estimate residual streamflows into the District, see Appendix J-2)
- Municipal & Industrial Consumptive Use Fraction
- Artificial Canals Seepage Rate
- Natural Channels Seepage Fraction (see Appendix J-2)

Many of these “User Input Parameters” have been adjusted within the model to reflect best available information and/or calibrated to optimize model response, but can be adjusted manually to reflect updated information or to test model response. Adjustments to the User Input Parameters are made
within the “Calibration” tab of the model, and the listed values within the master tabs will update automatically.

As further described in Appendix J-5, The “Calibration” tab is the active module used to qualitatively calibrate the water budget by aligning the historical change in storage calculated in the master model tabs to change in storage values estimated via historical water level records collected within the model domain. This is principally done via adjustment of select “User Input Parameters” specified above, and subsequent assessment of the resulting fit of the model-calculated change in storage to analogous estimates made from water level records collected at two “bookend” periods in time within the model period. The water level-calculated change in storage estimates used for this analysis are listed in the “WL_storage_change” spreadsheet of the Excel workbook. All calibration-related spreadsheets are denoted in yellow.

Presentation and Reporting

Live tables and figures that have been developed for inclusion in the Kern Management Area Plan, as well as several associated presentation & reporting related tabs, can be found in the blue shaded tabs within the water budget Excel workbook. These include:

- Exhibits used in the Kern Management Area Plan, including:
  - “Table WB-1_Kern” – Annual Surface Water Inflows and Outflows by Source Type
  - “Table WB-2_Kern” – Annual Inflows to and Outflows from the Groundwater System, and Change in Storage
  - “Table WB-3_Kern” – Annual and Cumulative Change in Groundwater Storage between Seasonal Highs
  - “Table WB-4_Kern” – Annual Change in Groundwater Storage vs. DWR Water Year Type
  - “Table WB-5_Kern” – Annual Total Inflows, Outflows, and Change in Groundwater Storage
  - “Table WB-6_Kern” – Summary of Projected Water Budget Results (with/without) Project & Management Action Implementation
  - “Table J-1_1 WB_Components” – Summary of Analytical Water Budget Components
  - “WB_graphs_Kern” – includes all graphs used to develop Figures WB-1 through WB-20 of Kern Management Area Plan
  - “Fig WB-21” – Figure WB-21 of Kern Management Area Plan
  - “Fig J-4-2” – Agricultural Subdomain Water Budget Schematic

- Spreadsheets supporting development of Management Area Plan exhibits, including:
  - “horiz_bar_chart” – used to summarize water budget components for reporting in Tables WB-1 through WB-5
  - “horiz_bar_chart_proj” – used to summarize projected water budget components for reporting in Table WB-6
  - “change_storage_figs” – used to develop Figures WB-10 through WB-14, GWC-8
  - “FK_import_vs_contract” – used to develop Figure WB-17
  - “IMPSOURCE” – used to help develop Figure WB-4
  - “charts_for_mxd_recent” – used to help develop Figure WB-21
  - “conversion_to_WL” – used to help develop Figure WB-21

“Backend” Data and Calculations
All other tabs within the Excel workbook contain various input data and calculations used to support water budget calculations in the master water balance tabs and should not be edited. Uncolored tabs correspond to various raw input data that are directly linked to the historical and current master model tabs. These include:

- **“Monthly_operations_AE”** – main AEWSD “operations” tab, including monthly surface water deliveries, spreading operations, and District pumping
- **“Deliveries_to_WW_AE”** – monthly AEWSD deliveries to parcels in White Wolf Subbasin portion of service area
- **“WMWSD_Overlap_Deliveries_AE”** – monthly WMWSD deliveries to AEWSD/WMWSD overlap lands in Kern and White Wolf Subbasins
- **“Arvin_CSD_Operations”** – monthly groundwater pumping rates and deliveries from ACSD well network
- **“Monthly_precip_AE”** – monthly precip rates [in] at Arvin and NOAA climate stations
- **“C2VSim_FG_Boundary_Params”** – average transmissivity and depths of C2VSim-FG Layers 1 and 2 extracted along AEWSD boundary lines, for use in approximating groundwater flux (see Appendix J-3)
- **“MWD_MONTHLY”** – monthly operations summary for AEWSD’s groundwater storage and recovery project with Metropolitan Water District (MWD)
- **“MWD_ANNUAL”** – annual operations summary for AEWSD’s MWD project

Raw input data inputs to the water budget model also include spreadsheets imported directly from the R processing software, which was used predominantly to process land use and ITRC-METRIC data for integration into the Agricultural Lands subdomain (see **Appendix J-4**). These are denoted as **light grey** tabs in the Excel workbook, and include:

- **“MONTHLY_ITRC_00_15_R”** – AEWSD monthly ITRC data by irrigation type, 2000 - 2015
- **“MONTHLY_ITRC_by_Facilities_R”** – monthly ITRC data at AEWSD facilities, 1993 - 2015
- **“MONTHLY_ITRC_by_Canals_R”** – monthly ITRC data along AEWSD canals, 1993 - 2015
- **“MONTHLY_ITRC_by_Basin_R”** – AEWSD monthly ITRC data by groundwater subbasin, 1993 - 2015
- **“CROPS_94_16_R”** – AEWSD acreage by crop and irrigation type (seasonal), 1994 - 2016

**Dark grey** tabs represent spreadsheets involving a calculation or series of calculations for incorporation into the historical & current master model tabs. These include:

- **“climate_parser_master_AE”** – used to estimate precipitation on District lands and within surrounding watersheds (see **Appendix J-2**)
- **“GW_Fluxes”** – used to estimate subsurface fluxes across District boundaries (see **Appendix J-3**)
- **“GW_Fluxes_gradient_scaling”** – used to estimate subsurface fluxes across northwestern and southwestern District boundaries (see **Appendix J-3**)
- Various tabs used to calculate components within the Agricultural Lands subdomain (see **Appendix J-4**), including:
  - **“Monthly__ET_by_zone”** – parses monthly ITRC data into different land use subdomains
  - **“Monthly_acreages”** – parses seasonal crop data into different land use subdomains
  - **“Monthly_irr_eff”** – calculates monthly irrigation efficiency coefficients based on seasonal irrigation types
“leaching_master” – calculates monthly leaching volumes based on seasonal crop types
“operational demands” – calculates monthly operational demands based on irrigated acreage
“effective_precip” – calculates monthly effective precipitation using raw precipitation, ET data
“2012_AgDomain” – estimates monthly ET for calendar year 2012, where ITRC-METRIC data was unavailable
“Crops_pre2k_estimators” – parses 1994 - 1996 cropping data by land use, irrigation type
“native yield” – used for KGA “native yield” discussions (no impact on water budget functionality)

Finally, brown shaded tabs correspond to raw data inputs and calculations used to inform development of three projected model scenarios (see Appendix J-6). These include:

- Projected AEWSD “operations” tabs (including projected surface water deliveries, spreading operations, and District pumping), including:
  - “Monthly_operations_AE_analog” – projected operations for 50-yr analog period (no adjustments to supplies, climate assumptions)
  - “Monthly_operations_AE_baseline” – projected operations under “baseline” scenario surface water supply, climate assumptions
  - “Monthly_operations_AE_2030” – projected operations under “2030 Climate Change” scenario surface water supply, climate assumptions
  - “Monthly_operations_AE_2070” – projected operations under “2070 Climate Change” scenario surface water supply, climate assumptions

- KGA climate change factors and surface water delivery assumptions for projected water budget scenarios, including:
  - “SWP Baseline” – Projected State Water Project supply change factors under “baseline” scenario
  - “SWP 2030” – Projected State Water Project supply change factors under “2030 Climate Change” scenario
  - “SWP 2070” – Projected State Water Project supply change factors under “2070 Climate Change” scenario
  - “Friant 2015 Deliveries” – Projected Friant-Kern Canal deliveries under “baseline” scenario
  - “Friant 2030 Deliveries” – Projected Friant-Kern Canal deliveries under “2030 Climate Change” scenario
  - “Friant 2070 Deliveries” – Projected Friant-Kern Canal deliveries under “2070 Climate Change” scenario
  - “Kern River 2030” – Projected Kern River supply change factors under “2030 Climate Change” scenario
  - “Kern River 2070” – Projected Kern River supply change factors under “2070 Climate Change” scenario
  - “Precipitation 2030 SR 21” – Projected precipitation change factors under “2030 Climate Change” scenario
- **“Precipitation 2070 SR 21”** – Projected precipitation change factors under “2070 Climate Change” scenario
- **“ET 2030 SR 21”** – Projected evapotranspiration change factors under “2030 Climate Change” scenario
- **“ET 2070 SR 21”** – Projected precipitation change factors under “2070 Climate Change” scenario

- **“Kern_PROJECTED_analog”** – Kern master water budget under 50-yr analog period (no adjustments to supplies, climate assumptions) – *not* used as a unique projected scenario, only to assist in calculations for baseline/2030/2070 projected scenarios
- **“P&MA_scenarios”** – used to input P&MA supply augmentation and demand reduction targets for 2030 and 2070 climate change scenarios to assess impacts on projected change in storage under full SGMA implementation
Water Budget Domains and Subdomains

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01

Figure WB-1
Conceptual Water Budget Components and Linkages

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure WB-2
<table>
<thead>
<tr>
<th>#</th>
<th>Water Balance Component</th>
<th>Component's Role in Overall Water Budget Domain</th>
<th>Component's Role in Analytical Water Budget Model</th>
<th>Likely Negligible</th>
<th>Likely Negligible Component</th>
<th>Water Budget Subdomain</th>
<th>Component Estimation Method in Analytical Water Budget Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>District Water Rights</td>
<td>External</td>
<td><img src="image" alt="In Flow" /></td>
<td><img src="image" alt="Yes" /></td>
<td><img src="image" alt="In" /></td>
<td><img src="image" alt="Not currently quantified in water budget (contribution reflected in total imports)" /></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Out-of-District Water Banks</td>
<td>External</td>
<td><img src="image" alt="In/Out" /></td>
<td><img src="image" alt="Yes" /></td>
<td><img src="image" alt="In/Out" /></td>
<td><img src="image" alt="Not currently quantified in water budget (contribution reflected in total imports)" /></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Out-of-District Transfers/Exchanges</td>
<td>External</td>
<td><img src="image" alt="In/Out" /></td>
<td><img src="image" alt="Yes" /></td>
<td><img src="image" alt="In/Out" /></td>
<td><img src="image" alt="Not currently quantified in water budget (contribution reflected in total imports)" /></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Total Surface Water Imports</td>
<td><img src="image" alt="In Flow" /></td>
<td><img src="image" alt="In" /></td>
<td></td>
<td><img src="image" alt="In" /></td>
<td>From AEWSD historical operations data</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Rainfall onto Artificial Channels</td>
<td><img src="image" alt="In Flow" /></td>
<td><img src="image" alt="In" /></td>
<td></td>
<td><img src="image" alt="In" /></td>
<td>Precip Rate * Canals area</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>District Recovery Groundwater Pumping Inputs to Artificial Channels</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td><img src="image" alt="Yes" /></td>
<td><img src="image" alt="Out" /></td>
<td>From AEWSD historical operations data</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Private User Groundwater Pumping Inputs to Artificial Channels</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td><img src="image" alt="Yes" /></td>
<td><img src="image" alt="Out" /></td>
<td>From AEWSD historical operations data</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Deliveries to Spreading Grounds</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td><img src="image" alt="Out" /></td>
<td>From AEWSD historical operations data</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Evaporation from Artificial Channels</td>
<td><img src="image" alt="Outflow" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Observed ITRC-METRIC ET along canals * estimated canal area</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>District Deliveries to Agricultural Lands</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td><img src="image" alt="Yes" /></td>
<td><img src="image" alt="Out" /></td>
<td>From AEWSD historical operations data</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Surface Water Exports / Unused Water</td>
<td><img src="image" alt="Outflow" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>From AEWSD historical operations data</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Rainfall on Spreading Grounds</td>
<td><img src="image" alt="In Flow" /></td>
<td><img src="image" alt="In" /></td>
<td></td>
<td></td>
<td>Precip Rate * Spreading Grounds area</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Evaporation from Spreading Grounds</td>
<td><img src="image" alt="Outflow" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Observed ITRC-METRIC ET on Spreading Grounds</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Percolation of Spread Water</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Spreading Deliveries [8] + Precip [13] + Evap. [14]</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Rainfall on Agricultural Lands</td>
<td><img src="image" alt="In Flow" /></td>
<td><img src="image" alt="In" /></td>
<td></td>
<td></td>
<td>Precip Rate * Ag. Lands area</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Private Agricultural Groundwater Pumping</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Calculated as the residual of the Ag. Lands subdomain (see Appendix J-4)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Total Evapotranspiration from Agricultural Lands</td>
<td><img src="image" alt="Outflow" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Observed ITRC-METRIC ET on Ag. Lands + Evap of Ineffective Precip (see Appendix J-4)</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Infiltration from Agricultural Lands</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Total Applied Water - Total ET on Ag. Lands [18] + Deep Perc. of Ineffective Precip (see Appendix J-4)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Rainfall onto Surrounding Watersheds</td>
<td><img src="image" alt="External" /></td>
<td><img src="image" alt="In" /></td>
<td></td>
<td></td>
<td>Rainfall onto Surrounding Watersheds [20] * CU Fraction (see Appendix J-3)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Consumptive Use from Surrounding Watersheds</td>
<td><img src="image" alt="External" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Rainfall onto Surrounding Watersheds [20] - CU from Surrounding Watersheds [21]</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Streamflow into District</td>
<td><img src="image" alt="In Flow" /></td>
<td><img src="image" alt="In" /></td>
<td></td>
<td></td>
<td>Rainfall on Natural Channels [23] + Evap from Natural Channels [24]</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Rainfall on Natural Channels</td>
<td><img src="image" alt="In Flow" /></td>
<td><img src="image" alt="In" /></td>
<td></td>
<td></td>
<td>Assumed negligible due to small stream area, and included in estimate of Rainfall on Ag. Lands [16]</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Evaporation from Natural Channels</td>
<td><img src="image" alt="Outflow" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Assumed negligible due to small stream area, and included in estimate of Evap. from Ag. Lands [18]</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Seepage from Natural Channels</td>
<td><img src="image" alt="Internal Linkage" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Streamflow into District [22] * Natural Channels Seepage Fraction</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Streamflow Out of District</td>
<td><img src="image" alt="Outflow" /></td>
<td><img src="image" alt="Out" /></td>
<td></td>
<td></td>
<td>Streamflow into District [22] - Seepage [25] + Atmospheric Exchange [23 - 24]</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Water Balance Component</td>
<td>Component's Role in Overall Water Budget Domain</td>
<td>&quot;Raw&quot; Component</td>
<td>Likely Negligible</td>
<td>Water Budget Subdomain</td>
<td>Component Estimation Method in Analytical Water Budget Model</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>-------------------------------</td>
<td>-------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Municipal and Industrial Pumping</td>
<td>Internal Linkage</td>
<td>Yes</td>
<td></td>
<td>In</td>
<td>From ACSD pumping / delivery data</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Evapotranspiration &amp; Consumptive Use from Urban Areas</td>
<td>Inflow</td>
<td>Yes</td>
<td></td>
<td>Out</td>
<td>ET = Observed [TRC-METRIC ET on Urban areas (see Appendix J-4); CU = M&amp;I Deliveries * M&amp;I CU Fraction]</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>District Deliveries to Municipal and Industrial Customers</td>
<td>Internal Linkage</td>
<td>Yes</td>
<td>Yes</td>
<td>Out</td>
<td>Not currently estimated (M&amp;I Delivery data not provided); assumed negligible</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Subsurface Groundwater Inflows</td>
<td>Inflow</td>
<td></td>
<td></td>
<td>Out</td>
<td>Estimated by applying Darcy's Law to groundwater head gradients derived from interpolated groundwater elevation maps (see Appendix J-3)</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Kern Basin Reduction in Groundwater Storage</td>
<td>Accumulation Term</td>
<td></td>
<td></td>
<td>In/Out</td>
<td>Calculated as Residual of Groundwater Basin subdomain within the Kern monthly budget</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Kern/White Wolf Groundwater Exchange</td>
<td>Internal Linkage</td>
<td></td>
<td></td>
<td>In/Out</td>
<td>Estimated by applying Darcy's Law to groundwater head gradients derived from interpolated groundwater elevation maps (see Appendix J-3)</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>White Wolf Basin Reduction in Groundwater Storage</td>
<td>Accumulation Term</td>
<td></td>
<td></td>
<td>In/Out</td>
<td>Calculated as Residual of Groundwater Basin subdomain within the White Wolf monthly budget</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Subsurface Groundwater Outflows</td>
<td>Outflow</td>
<td></td>
<td></td>
<td>Out</td>
<td>Estimated by applying Darcy's Law to groundwater head gradients derived from interpolated groundwater elevation maps (see Appendix J-3)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations:
ACSD = Arvin Community Services District
AEWSD = Arvin-Edison Water Storage District
Ag. = agricultural
AFY = acre-feet per year
CU = consumptive use
ET = evapotranspiration
Evap. = evaporation
GW = groundwater
M&I = municipal and industrial
Precip. = precipitation
WB = water budget

Notes:
1. Water budget subdomains outlined in dashed line are considered part of the overall water budget domain.
2. "Raw" components are those that generally are best quantified based on actual data.
3. The Artificial Channels Subdomain includes the District canals and delivery pipeline network.
4. "Evapotranspiration" includes all estimated crop and vegetative evapotranspirative demands as well as evaporation of excess rainfall and from open water bodies within the District.
<table>
<thead>
<tr>
<th>External Domains</th>
<th>Major Land Use Subdomains</th>
<th>Anchor Land Use Subdomains</th>
<th>Subsurface Subdomains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outside of Water Budget Domain</strong></td>
<td><strong>Atmosphere</strong></td>
<td><strong>Urban Lands (GW only)</strong></td>
<td><strong>Groundwater Bank &quot;Account&quot;</strong></td>
</tr>
<tr>
<td><strong>Components</strong></td>
<td><strong>Irrigated Ag Lands (SW and GW)</strong></td>
<td><strong>Irrigated Ag Lands (GW only)</strong></td>
<td><strong>Non-Irrigated Ag Lands (dry farming)</strong></td>
</tr>
<tr>
<td><strong>Mass Storage Area</strong></td>
<td><strong>Applied Water ET; Eff. Precip ET; Evap. of Ineff. Precip.</strong></td>
<td><strong>Applied Water ET; Eff. Precip ET; Evap. of Ineff. Precip.</strong></td>
<td><strong>Eff. Precip ET; Evap. of Ineff. Precip.</strong></td>
</tr>
<tr>
<td><strong>Exterior</strong></td>
<td></td>
<td><strong>Applied Water ET; Eff. Precip ET; Evap. of Ineff. Precip.</strong></td>
<td><strong>Applied Water ET; Eff. Precip ET; Evap. of Ineff. Precip.</strong></td>
</tr>
<tr>
<td><strong>Non-Irrigated Ag Lands</strong></td>
<td><strong>Precipitation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Urban Lands</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spreading Basins</strong></td>
<td><strong>Precipitation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Artificial Channels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deep (Production) Aquifer</strong></td>
<td><strong>GW Inflows from Adjacent Areas</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subsurface</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Groundwater Bank &quot;Account&quot;</strong></td>
<td><strong>GW Inflows from Adjacent Areas</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Mass Balance Equations**

**Subdomains that Must "Balance" (i.e., **Inflows = Outflows**):** external fluxes shown in blue (inflow) or pink (outflow) text; internal fluxes shown in black text

- **Irrigated Ag Lands (SW and GW)**
- **Non-Irrigated Ag Lands (dry farming)**
- **Urban Lands (GW only)**
- **Spreading Basins**
  - **Inflows** (Precipitation + [District] Spreading Deliveries) + **Outflows** (Evaporation + Perc. of Spreading Water)
- **Natural Channels**
  - **Inflows** (Precipitation + Streamflow from Adjacent Uplands) + **Outflows** (Evaporation + Perc. of Streamflow + Ag Diversions + M&I Diversions + Streamflow to Adjacent Lands)
- **Artificial Channels**
  - **Inflows** (Precipitation + [District] Imports) + **Outflows** (Evaporation + Expert + [District] Ag Deliveries)

**Subdomains that are not required to "Balance" (i.e., can have a change in storage):** external fluxes shown in blue (inflow) or pink (outflow) text; internal fluxes shown in black text

- **Irrigated Ag Lands (SW and GW)**
  - **Outflows** (GW Outflows to Adjacent Areas + Applied Water Perc. + Perc. Of Spreading Water + Streamflow Perc. + Artificial Channel Seepage Losses + Banking "Leave Behind")
- **Non-Irrigated Ag Lands (dry farming)**
  - **Outflows** (GW Outflows to Adjacent Areas + GW Pumping for Ag Use + GW Pumping for M&I Use + Seepage to Native Lands (GDE) + Seepage to Channels (GDE)) + GW Pumping to Artificial Channels ("Pump-in") + **GW Bank "Deposits"** = Change in Storage
- **Urban Lands (GW only)**
  - **Outflows** (GW Outflows to Adjacent Areas + GW Pumping for M&I Use + Seepage to Native Lands (GDE) + Seepage to Channels (GDE) + GW Pumping to Artificial Channels ("Pump-in") + **GW Bank "Deposits"** = Change in Storage
- **Spreading Basins**
  - **Outflows** (Banking "Deposit")
- **Artificial Channels**
  - **Outflows** (Banking "Leave Behind") + Recovery Pumping ("Withdraw") + Change in Storage ("Bank Balance")
- **Outside of Water Budget Domain**
  - **Outflows** (Banking "Deposit")
- **Atmosphere**
  - **Outflows** (Banking "Leave Behind") + Recovery Pumping ("Withdraw") + Change in Storage ("Bank Balance")

**Terms in Italic are natural; these could be considered to make up the "native yield" supplies**

**Inflows** = precipitation (total) + streamflows from adjacent uplands + GW inflows from adjacent areas + imports

**Outflows** = ET (consumptive use) + streamflows to adjacent lands + GW outflows to adjacent areas + exports

**Inflows** = precipitation (total) + streamflows from adjacent uplands + GW inflows from adjacent areas + imports

**Outflows** = ET (consumptive use) + streamflows to adjacent lands + GW outflows to adjacent areas + exports

**ARTIFICAL FLUXES**

**Domains that can have a non-zero balance**

**December 2010**

**Arvin-Edison Water Storage District**

**Kern Subbasin Management Area Plan**
Appendix J-2

Description of Precipitation and Contributing Streamflow Estimates
APPENDIX J-2
DESCRIPTION OF PRECIPITATION AND CONTRIBUTING STREAMFLOW ESTIMATES

This appendix documents the processes used to derive estimates of precipitation on Arvin-Edison Water Storage District (AEWSD or District) lands and the surrounding watersheds contributing to streamflow within the District.

Selection of Climate Stations

Precipitation on District lands is estimated from the California Irrigation Management Information System (CIMIS) “Arvin-Edison (Station 125)” regional climate station and informed by three local climate stations maintained by and located within the District. CIMIS Station 125 reports monthly precipitation data (in inches per month; [in/mo]), along with several other atmospheric parameters for the period March 1995 – present. The three local climate stations maintained by the District include:

- District Headquarters (i.e. “Office”) (July 1974 – present)
- Sycamore Station (July 1967 – present)
- Tejon Station (July 1969 – present)

Precipitation on surrounding watersheds is estimated using the Arvin-Edison CIMIS Station 125 along with five regional climate stations maintained by the National Oceanic and Atmospheric Administration (NOAA). The NOAA stations employed for this analysis are located outside of the District but within the surrounding watershed area (see Figure J-2-1). Each of these stations report measurements of monthly precipitation (in/mo) during the historical/current water budget period of interest (WY1 1995 – 2015), although data availability varies by station and includes sporadic missing monthly values which were filled with estimated values, as described below. The selected NOAA stations include:

- Loraine 5 NNE, CA [NOAA Coop. ID #45100] (January 2011 – June 2018)²
- Tehachapi, CA [NOAA Coop. ID #48826] (January 1893 – May 1997)³
- Tehachapi 4 SE, CA [NOAA Coop. ID #48829] (August 1997 – December 2017)⁴
- Tejon Rancho, CA [NOAA Coop. ID #48839] (January 1895 – December 2017)⁵
- Lebec, CA [NOAA Coop. ID #44863] (July 1948 – December 2017)⁶

---

1 A Water Year (WY), as defined by the California Department of Water Resources (DWR), extends from October of the prior year through September of the year in question.
2 Data retrieved from NOAA’s National Climatic Data Center (NCDC) online portal (https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00045100/detail)
3 Data retrieved from NOAA’s National Climatic Data Center (NCDC) online portal (https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00048826/detail)
4 Data retrieved from NOAA’s National Climatic Data Center (NCDC) online portal (https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00048829/detail)
5 Data retrieved from NOAA’s National Climatic Data Center (NCDC) online portal (https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00048839/detail)
6 Data retrieved from NOAA’s National Climatic Data Center (NCDC) online portal (https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00044863/detail)
NOAA stations were incorporated into this analysis because there is significant topographic difference (i.e., nearly 8,000-foot elevation difference) between the District lands and the peaks of the surrounding watersheds in the Southern Sierra Nevada and Tehachapi mountains to the northeast and southeast, respectively, that contribute to streamflow within the District. This elevation difference results in an orographic effect whereby precipitation in the surrounding watersheds is significantly greater than precipitation measured at the local climate stations within or proximate to the District. Therefore, data from the four additional NOAA climate stations were used to account for this precipitation difference. NOAA climate stations were selected based on the following criteria:

1) Data availability and continuity within the time-period of interest (WY 1995 – 2015);
2) Location within the District’s surrounding watersheds; and
3) Ground surface elevation (relative to the elevation range within surrounding watersheds).

*Interpolation of Missing Monthly Precipitation Data*

**CIMIS Station 125**

As mentioned previously, the Arvin-Edison CIMIS Station 125 became operational on March 1995, nearly fourteen months after the start of the water budget analysis period (January 1994 – December 2015). For these early missing months, precipitation at CIMIS Station 125 was estimated based on a linear regression model developed with a District-operated climate station. The District-operated climate station that most directly aligned with CIMIS Station 125 was the District’s Sycamore Station. As shown on Figure J-2-2 below, over the entire period of record (i.e., March 1995 – December 2015), monthly precipitation records collected from CIMIS Station 125 showed a **93% correlation** ($R^2 = 0.86$) with data collected from the Sycamore Station. As such, monthly precipitation values at CIMIS Station 125 were estimated for January 1994 – February 1995 using a linear regression model developed in relation to the Sycamore Station.
Figure J-2-2. Long-term Correlation between AEWSD Climate Stations & CIMIS Station 125

Figure J-2-3 below shows the resulting monthly precipitation estimates for Arvin-Edison CIMIS Station 125 for WY 1995 – 2015, compared to the District Headquarters, Sycamore Station, and Tejon Station.

Figure J-2-3. Monthly Precipitation at AEWSD Climate Stations vs. CIMIS Station 125

NOAA Climate Stations

NOAA stations employed in this analysis contained several missing monthly values within the period of interest. For these months, precipitation was estimated based on a linear regression model developed with a nearby NOAA or District-operated climate station at a similar elevation. The following correlations were used to estimate precipitation at each of the NOAA stations included in this analysis:

- $y = 1.1049x$  
  $R^2 = 0.8231$

- $y = 0.9402x$  
  $R^2 = 0.8584$

- $y = 0.988x$  
  $R^2 = 0.8627$
• Missing monthly values for the Tejon Rancho and Lebec NOAA stations were estimated using a linear regression model with Wheeler Ridge-Maricopa Water Storage District’s (WRMWSD) “Spillway Basin” climate station located in the southern White Wolf Subbasin\(^7\) (Tejon Rancho slope = 1.07, \(R^2 = 0.72\); Lebec slope = 1.25, \(R^2 = 0.52\)).

• Missing monthly values for the Tehachapi and Tehachapi 4 SE NOAA stations\(^8\) were estimated using a linear regression model with the Tejon Rancho NOAA station (slope = 1.02, \(R^2 = 0.64\)).

• Missing monthly values for the Loraine NOAA station were estimated using a linear regression model with the Tehachapi NOAA station (slope = 0.86, \(R^2 = 0.76\)).

In all cases, the linear regression model’s y-intercept was set to zero to ensure that months with zero measured precipitation at a given climate station were reflected in estimates of precipitation at correlative climate stations with missing data for that month. **Figure J-2-4** below shows the resulting monthly precipitation estimates from each of the NOAA climate stations for 1994 – 2015, relative to the CIMIS Station 125.

**Figure J-2-4. Monthly Precipitation at NOAA Climate Stations vs. CIMIS Station 125**

![Monthly Precipitation at NOAA Climate Stations vs. CIMIS Station 125](image)

**Spatial Representation of Precipitation Data**

Precipitation is a spatially-variable phenomenon and can usually only be directly observed at discrete points within a domain (i.e., at climate station locations). Additionally, precipitation is affected by surrounding topography, and the orographic effect must be considered when deriving rainfall estimates over watershed areas with significant elevation range. As mentioned previously, the nearly 8,000-ft difference in elevation between District lands and the peaks of the surrounding watersheds in the Southern Sierra Nevada and Tehachapi mountains results in an orographic effect. As such, it is practical

---

\(^7\) Data obtained from WRMWSD on 12 December 2017.

\(^8\) Tehachapi & Tehachapi 4 SE station data were merged for the purposes of this analysis due to their close proximity and based on the understanding that Tehachapi 4 SE was installed as a replacement to the older Tehachapi station in mid-1997.
to employ precipitation data from higher-elevation climate stations to estimate precipitation within these surrounding watersheds contributing to streamflow into the District.

Table J-2-1 presents the approximate elevation (in feet above mean sea level; [ft msl]) of each climate station used in this analysis, as derived from the U.S. Geological Survey National Elevation Dataset (NED):

<table>
<thead>
<tr>
<th>Climate Station</th>
<th>Operator</th>
<th>Ground Surface Elevation (ft msl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arvin-Edison CIMIS Station 125</td>
<td>DWR</td>
<td>500</td>
</tr>
<tr>
<td>Tejon Rancho</td>
<td>NOAA</td>
<td>1,425</td>
</tr>
<tr>
<td>Lebec</td>
<td>NOAA</td>
<td>3,590</td>
</tr>
<tr>
<td>Tehachapi</td>
<td>NOAA</td>
<td>4,020</td>
</tr>
<tr>
<td>Tehachapi 4 SE</td>
<td>NOAA</td>
<td>4,220</td>
</tr>
<tr>
<td>Lorraine</td>
<td>NOAA</td>
<td>4,235</td>
</tr>
</tbody>
</table>

Based on the distribution of locations and elevations from the five climate stations employed for this analysis, a two-part approach was employed to represent precipitation on District lands and from surrounding watersheds:

1) **Arvin-Edison CIMIS Station 125** was used exclusively to represent precipitation on District lands.

2) **Elevation cutoffs** were used to delineate the representative area for the higher-elevation NOAA climate stations within surrounding watersheds to the Kern Subbasin and White Wolf Subbasin portions of AEWSD.

This analysis is based on the following assumptions:

- **CIMIS Station 125** is located within the town of Arvin at the floor of the Central Valley; given the elevation range of approximately 330 – 1,100 ft msl and average elevation of approximately 500 ft. msl within the District boundaries, this station is therefore likely the most representative of District climate conditions as a whole.

- The five NOAA climate stations are located within surrounding watersheds to the east and south/southwest of the District, and at significantly higher elevations than Arvin CIMIS Station 125 (see Table J-2-1 above); thus, precipitation on the surrounding watersheds is best represented by the NOAA climate station at the nearest elevation to each point within the surrounding watershed areas for both the Kern and White Wolf Subbasins.

---

9 Precipitation at the CIMIS Station 125 for January 1994 – March 1995 was estimated using the procedure outlined in the previous subsection of this document.
Figure J-2-1 (attached) shows the location and coverage area represented by each climate station within the District and its surrounding watersheds. The following elevation cutoffs were used to determine which NOAA station (if any) would be employed in surrounding watersheds to the District:

For watersheds contributing to the Kern Subbasin portion of the District:

- Elevations less than 960 ft msl are represented by CIMIS Station 125 (i.e., the “in-District” climate station);
- Elevations between 960 ft msl and 2,770 ft msl are represented by the Tejon Rancho climate station; and
- Elevations greater than or equal to 2,770 ft msl are represented by an average of the Tejon Rancho and Loraine stations. An average of the two stations was used for the “high-elevation” estimate of precipitation in this case (1) because the Tehachapi and Loraine stations represent approximately equal elevations and (2) to account for the anticipated variability in climate conditions within this “high-elevation” watershed area as it stretches from the Southern Sierra Nevada northeast of the District down south into the Tehachapi mountains southeast of the District.

For watersheds contributing to the White Wolf Subbasin portion of the District:

- Elevations less than 2,480 ft msl are represented by the Tejon Rancho climate station; and
- Elevations greater than or equal to 2,480 ft msl are represented by the Lebec climate station.

Calculation of Rainfall and Contributing Streamflow

Following the spatial delineation process described above, total areas represented by each climate station were calculated for in-District lands, as well as for the surrounding watershed area.

The volume of monthly rainfall (acre-feet per month; [AF/mo]) on the District and on surrounding watersheds was then estimated as follows:

$$Rainfall = \sum_{i=1}^{12} \frac{P_{station}}{12} * A_{station}$$

(1)

where $p_{station}$ = monthly precipitation [in/mo] and $A_{station}$ = total area represented by the station [acres].

Contributing streamflow into the District was then calculated from the Rainfall on Watersheds using a linear equation with two parameters: a “Precipitation Threshold for Runoff Initiation” and a “Watershed Consumptive Use Fraction”. These parameters are defined as “User Input Parameters” in the water budget spreadsheet model (see Appendix J-1). Contributing streamflow into the District is calculated as:

$$Streamflow\ into\ District = max\left(0, Rainfall\ on\ Watersheds - \frac{P_{threshold}}{12} * A_{watershed}\right) * (1 - CU_{watershed})$$

(2)

where $p_{threshold}$ = Precipitation Threshold for Runoff Initiation [in], $CU_{watershed}$ = Watershed Consumptive Use Fraction [dimensionless], and $A_{watershed}$ = total area of surrounding watersheds [acres].
Ultimately, based on water budget calibration, Watershed Consumptive Use Fractions of 98% and 95% and Precipitation Thresholds of 0.75 inches and 0.5 inches were used to estimate contributing streamflow into the Kern Subbasin and White Wolf Subbasin portions of the District, respectively. This resulted in contributing streamflow estimates of 6,330 AFY and 8,416 AFY for the Kern and White Wolf portions of the District, respectively, over the historical water budget period (DWR WY 1995 – 2014). These estimates align very closely with the United States Geological Survey’s Basin Characterization Model10 (USGS-BCM) estimates for the same contributing watersheds (6,277 AFY and 9,730 AFY for the Kern and White Wolf areas) over 1981 – 2010. See Appendix J-5 for further details regarding the water budget calibration process.

**Adjustments to Contributing Streamflow in the White Wolf Subbasin**

It is understood that all streams entering the District boundary from surrounding watersheds are considered ephemeral in nature, and that most streamflow entering the District will percolate into the subsurface before leaving District boundaries11. For the Kern Subbasin, due to AEWSD’s proximity to the eastern basin boundary, it is reasonable to assume that streamflow runoff will enter the District boundaries as surface flow and/or baseflow within the creek bed before percolating into the groundwater subdomain. For the White Wolf Subbasin, AEWSD is located much further from the southern boundary where contributing streamflow enters the Basin, and the location where surface water flows become baseflow and/or percolate into the underlying aquifer is difficult to pin-point without additional stream flow and stage data. Furthermore, it becomes complicated apportioning contributing streamflow to the various water districts within the White Wolf Subbasin (AEWSD, Wheeler Ridge-Maricopa Water Storage District, Tejon-Castac Water District, and unincorporated “white lands” areas) because these entities have overlapping boundaries within the White Wolf Subbasin and the volume of stream flow entering and leaving each entity’s jurisdiction cannot be accurately estimated from the available historical data.

As further described in Appendix J-3 – Description of Subsurface Cross-Boundary Flow Estimates, for the purposes of this analytical water budget, we have estimated the contribution of streamflow to the White Wolf Subbasin portion of the District by:

1) Calculating the volume of contributing streamflow to the entire White Wolf Subbasin based on the watershed area depicted in Figure J-2-1 (8,416 AFY, as mentioned above);

2) Re-routing the contributing streamflow as a groundwater inflow to the White Wolf Subbasin, under the assumption that nearly all streamflow will percolate into the White Wolf Subbasin before crossing the White Wolf Fault (into the Kern Subbasin); and

3) Multiplying this value by the *relative percentage of total area* occupied by AEWSD within the White Wolf Subbasin (~17%, or 23,366 acres).

This methodology provides for an estimation of contributing streamflow to AEWSD’s surface area within the White Wolf Subbasin that (1) better reflects the District’s spatial coverage within the Basin; (2) avoids “double counting” precipitation falling within the White Wolf Subbasin; and (3) avoids having to

---


11 It has been historically observed that during very wet years streamflow from Caliente Creek reaches the City of Lamont, located directly to the west of the AEWSD/Kern Delta Water District boundary. However, more information is needed to quantify the volume of surface water leaving the District during these relatively infrequent and intermittent runoff events.
approximate volumetric stream flows across complicated jurisdictional boundaries for each of the individual creeks contributing to the Subbasin. After adjusting the contributing streamflow estimate to the White Wolf Subbasin by the AEWSD acreage within the Basin, the final estimate of groundwater inflows to the White Wolf portion of AEWSD amounted to 1,434 AFY on average over the historical water budget period.
Figure J-2-1

Arvin-Edison Water Storage District

Climate Station Locations and Representative Areas

Legend
- Arvin-Edison Water Storage District
- Stream/River
- Climate Station

Groundwater Subbasin
- Kern County (DWR 5-022.14)
- White Wolf (DWR 5-022.18)

Representative Climate Station
- Arvin-Edison (CIMIS Station #125)
- "High Elevation"
- Tejon Rancho
- Lebec

Abbreviations
- CIMIS = California Irrigation Management Information System
- DWR = California Department of Water Resources
- NHD = National Hydrography Dataset
- NOAA = National Centers for Environmental Information

Notes
1. All locations are approximate.
2. "High Elevation" area is represented by the merged records of the Tehachapi and Tehachapi 4SE stations, averaged with Loraine 5 NNE station's record.
3. Labels are shown for named surface water streams entering the Arvin-Edison Management Area.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. Surface water features and watersheds from NHD website: (https://viewer.nationalmap.gov/basic/)
3. NOAA climate stations information from NOAA website: (https://www.ncdc.noaa.gov/ncdc-web/)
4. CIMIS Station 125 information from CIMIS website: (https://cimis.water.ca.gov/)
Appendix J-3

Description of Subsurface Cross Boundary Flow Estimates
APPENDIX J-3
DESCRIPTION OF SUBSURFACE CROSS-BOUNDARY FLOW ESTIMATES

This appendix documents the process used to estimate subsurface cross-boundary flows (fluxes) as a means of quantifying groundwater inflows and outflows to the aquifer system underlying Arvin-Edison Water Storage District (AEWSD or District) lands. Monthly groundwater flux across District boundaries was calculated using Darcy’s Law, which states that:

\[ Q = T \times i \times L \]  \hspace{1cm} (1)

where \( Q \) = volumetric groundwater flow rate [feet cubed per day; ft\(^3\)/d], \( T \) = aquifer transmissivity [feet squared per day; ft\(^2\)/d], \( i \) = hydraulic gradient [dimensionless], and \( L \) = plan-view length of the boundary across which groundwater flux is estimated [feet; ft].

As shown in Figure J-3-1, cross-boundary groundwater fluxes were calculated for three segments along the District perimeter:

- **Western District Boundary (Northern Portion)** – to represent groundwater exchange between AEWSD and Kern Delta Water District (KDWD) lands along the northern portion of AEWSD’s western boundary.

- **Western District Boundary (Southern Portion)** – to represent groundwater exchange between AEWSD and KDWD lands along the southern portion of AEWSD’s western boundary.

- **White Wolf Fault Boundary** – to represent groundwater flow within AEWSD lands across the White Wolf Fault.

Methods used to derive values for \( T \), \( i \), and \( L \) along each boundary segment are discussed below.

*Estimation of Aquifer Transmissivity*

Aquifer transmissivity \( (T) \) is calculated as the product of aquifer hydraulic conductivity \( (K) \) [feet per day; ft/d] and saturated aquifer thickness \( (b) \) [ft]:

\[ T = K \times b \]  \hspace{1cm} (2)

There is significant uncertainty associated with each of these parameters across the District boundary segments described above. As such, we chose initial estimates for each parameter based on associated values reported in historical hydrogeological studies, numerical models, and water budgets conducted within the region, including:


Final hydraulic conductivity and saturated thickness values for the three boundary segments were subsequently determined through water budget calibration. See Table J-3-1 below for initial and final (calibrated) estimates of $K$ and $b$ along the Kern Northern Boundary and White Wolf Fault.

**Table J-3-1. Aquifer Hydraulic Conductivity and Saturated Thickness Estimates**

<table>
<thead>
<tr>
<th>Boundary Segment</th>
<th>Initial $K$ [ft/d]</th>
<th>Calibrated $K$ [ft/d]</th>
<th>Initial $b$ [ft]</th>
<th>Calibrated $b$ [ft]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwestern Boundary</td>
<td>15</td>
<td>5</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Southwestern Boundary</td>
<td>15</td>
<td>5</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>White Wolf Fault</td>
<td>1</td>
<td>3</td>
<td>1,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>

**Estimation of Hydraulic Gradients and Perimeter Length**

As mentioned previously, cross-boundary groundwater fluxes were estimated for three segments along the District perimeter:

- Western District Boundary (Northern Portion)
- Western District Boundary (Southern Portion)
- White Wolf Fault Boundary

To calculate boundary lengths ($L$) and hydraulic gradients ($i$), we employed a Geographical Information System (GIS)-based methodology using interpolated groundwater elevation rasters, polylines representing the District boundaries, and the “Zonal Statistics” toolbox to estimate average hydraulic heads across each of the three boundaries.
As part of a separate work effort for AEWSD, EKI developed regional groundwater elevation contour maps for the “South of Kern River” area for Spring and Fall 2015. Groundwater elevation rasters were generated through kriging interpolation of water level data compiled from AEWSD, Wheeler Ridge-Maricopa Water Storage District (WRMWSD), and KDWD. A simplified set of polylines were then drawn in GIS that generally traced both sides of the three boundary segments described above (six polylines in total, see Figure J-3-1). The distance between polylines in each of the three pairs was 10,000 feet, and lengths were set consistently for each polyline in a pair to deduce the approximate boundary length (L) for each of the three boundary segments listed above.

Subsequently, for both Spring and Fall 2015, an average groundwater elevation (in feet above mean sea level [ft msl]) was deduced for each polyline using the Zonal Statistics raster processing toolbox. Finally, the dimensionless hydraulic gradient (i) across the boundary segment for each season and year was calculated as follows:

\[ i = \frac{GWE_2 - GWE_1}{10,000 \text{ ft}} \]  

where GWE\(_1\) and GWE\(_2\) are the average groundwater elevations along the two polylines for each boundary segment.

**Estimation of Monthly Groundwater Flux in the Water Budget Model**

After deducing aquifer transmissivity (T), boundary length (L) and hydraulic gradient (i) parameters for Spring and Fall 2015, groundwater flux for these two seasons was calculated using Darcy’s Law (see Equation 1). Fluxes were converted from ft\(^3\)/d to acre-feet per month [AF/mo] to provide a representative “monthly” flux estimate associated with both Spring and Fall 2015. This raster-based gradient and flux calculation was then used as the basis for estimating monthly cross-boundary groundwater fluxes for the entire water budget analysis period (i.e., January 1994 – December 2015) using the methodologies described below.

**Western Boundary (Northern & Southern Portions)**

Estimation of gradients along AEWSD’s western boundary for earlier years during the water budget period of interest (i.e., prior to 2015) was accomplished by correlating the raster-based gradient estimates for 2015 to a selection of indicator wells on both sides of the shared AEWSD-KDWD boundary and extrapolating backwards in time using a scaling factor derived from correlative well pairings.

As shown in Figure J-3-2, three sets of “paired” wells located in reasonably close proximity to either side of the AEWSD-KDWD boundary were selected for use in this analysis. These well pairs were selected based on the following criteria:

1) Proximity to the AEWSD-KDWD boundary, and to each other;

---


2 WRMWSD’s water level database also includes data from DWR’s CASGEM & Water Data Library Portals, the United States Geological Survey, and other publicly available data sources.

3 KDWD water level data was provided to EKI via email from Jana Marquez (KDWD) on 9 March 2018.
2) Water level data density and reliability; and

3) A corresponding directional gradient between “paired” wells that is roughly perpendicular to the AEWSD-KDWD boundary.

After selecting the three well pairings, historical water level data were compiled from DWR’s CASGEM database (for the KDWD wells) and AEWSD’s own records (for the AEWSD wells). Water level data were then linearly interpolated between measurement dates to produce a representative “monthly” water level for the entire 1994 – 2015 period at all six wells. From here, a water level difference was calculated between each well pairing for every month, as follows:

\[ \Delta GWE_k = GWE_{KWD,k} - GWE_{AEWSD,k} \]  

(4)

where \( \Delta GWE_k \) = water level difference between paired wells at month “\( k \)”, \( GWE_{KWD} \) = groundwater elevation from KDWD well at month “\( k \)”, and \( GWE_{AEWSD} \) = groundwater elevation from AEWSD well at month “\( k \)”. From here, a monthly “scaling factor” was developed for each well pairing that compared their monthly water level differences to their water level difference calculated for Spring and Fall 2015:\n
\[ SF_{Spring2015,k} = \frac{\Delta GWE_k}{\Delta GWE_{March2015}} \]  

(5)

\[ SF_{Fall2015,k} = \frac{\Delta GWE_k}{\Delta GWE_{October2015}} \]  

(6)

where \( SF_{Spring2015,k} \) = monthly scaling factor to Spring 2015 conditions, and \( SF_{Fall2015,k} \) = monthly scaling factor to Fall 2015 conditions.

These scaling factors were subsequently averaged to produce a final monthly “scaling factor” to 2015 conditions:

\[ SF_{2015} = mean(SF_{Spring2015} , SF_{Fall2015}) \]  

(7)

Upon further inspection of the well pairing locations (see Figure J-3-2) and scaling factors relative to the “South of Kern River” Spring and Fall 2015 groundwater elevation rasters, it was determined that Pairs 1 & 2 were generally most representative of water level conditions along the northern portion of the AEWSD-KDWD boundary, and Pairs 2 & 3 were generally most representative of water level conditions along the southern portion of the AEWSD-KDWD boundary. As such, a final “monthly scaling factor” was developed for the northwestern and southwestern boundaries as follows:

\[ SF_{NW\, boundary} = mean(SF_{Pair\,1} , SF_{Pair\,2} ) \]  

(8)

\[ SF_{SW\, boundary} = mean(SF_{Pair\,2} , SF_{Pair\,3} ) \]  

(9)

---

4 March 2015 and October 2015 were selected as the representative dates for Spring 2015 and Fall 2015 conditions, respectively.
Figure J-3-3 and Figure J-3-4 show the final monthly scaling factors derived for the northwestern and southwestern AEWSD-KDWD boundaries, respectively.

Figure J-3-3. Monthly Scaling Factor for the Northwestern AEWSD-KDWD Boundary

Figure J-3-4. Monthly Scaling Factor for the Southwestern AEWSD-KDWD Boundary
To populate the water budget model with a monthly groundwater flux for the entire period of interest, the scaling factor associated with each boundary was then multiplied by the associated average 2015 groundwater gradient extracted along the corresponding boundary lines from the “South of Kern River” groundwater elevation rasters:

\[
Q_{NW\text{ boundary },k} = SF_{NW\text{ boundary },k} \times \text{mean}(Q_{NW\text{ Spring }2015},Q_{NW\text{ Fall }2015})
\]

\[
Q_{SW\text{ boundary },k} = SF_{SW\text{ boundary },k} \times \text{mean}(i_{SW\text{ Spring }2015},i_{SW\text{ Fall }2015})
\]

where \(Q_{NW\text{ boundary },k}\) and \(Q_{SW\text{ boundary },k}\) are the estimated groundwater fluxes for month “\(k\)” at the northwestern and southwestern boundaries, respectively.

**White Wolf Fault**

The White Wolf Fault is known to act as hydrogeologic barrier to groundwater flow, and a relatively continuous historical groundwater gradient has been demonstrated across the fault\(^5\). Therefore, it is assumed that groundwater flux across this boundary is not significantly affected by seasonal or annual variability in groundwater conditions in the vicinity of the fault line because flow is largely constrained by the low-conductivity fault zone.

As such, a simplifying assumption was used that the average monthly groundwater flux derived from the Spring and Fall 2015 “South of Kern River” groundwater elevation maps is reasonably representative of the monthly flux across the White Wolf Fault for the entire water budget period.

**Estimating Groundwater Inflows to the White Wolf Portion of AEWSD**

AEWSD’s service area within the White Wolf Subbasin is unique in that it is surrounded by neighboring water districts (including WRMWSD and the Tejon-Castac Water District [TCWD]) and, in certain parts, is overlapped by the WRMWSD service area. In addition, the AEWSD service area is located within the northern-central portion of the White Wolf Subbasin, and thus does not generally directly receive contributing streamflow from surrounding watersheds to the White Wolf Subbasin. Furthermore, the limited availability of water level data surrounding the District boundary within the White Wolf Basin makes it challenging to accurately estimate groundwater gradients across boundary lines within this area.

The White Wolf Subbasin is surrounded by mostly granitic and metamorphic bedrock formations of the Tehachapi Mountains to the south and east and San Emigdio Mountains to the west, and the White Wolf Fault to the north. Given the low bulk permeability and porosity of these bedrock materials, the White Wolf Subbasin likely does not receive significant subsurface inflows and is thus predominantly recharged via deep percolation of (1) contributing streamflow from surrounding watersheds, (2) direct precipitation, and (3) imported surface water. Furthermore, it is understood that most natural surface water features within the subbasin are ephemeral creeks, whereby nearly all surface water entering the subbasin will evaporate or percolate into the subsurface before crossing over the White Wolf Fault into the Kern Subbasin.

---

Therefore, a simplifying assumption to represent inflows into the White Wolf Subbasin is to quantify the contributing streamflow it receives from surrounding watersheds and assume that this streamflow fully percolates into the subsurface within the subbasin boundaries (i.e., zero natural surface water outflows). This contributing streamflow can thus be categorized as a "groundwater inflow" to the subbasin, and parsed by entity within the subbasin based on the relative percentage of acreage within the Basin (including overlap lands) occupied by each entity. Such an assumption allows for a more simplified calculation to estimate groundwater exchanges between entities within the subbasin, one that does not rely on sparse water level data to quantify groundwater gradients across complicated and sometimes overlapping jurisdictional boundaries.

**Estimating Contributing Streamflow**

Contributing streamflow to the White Wolf Subbasin is estimated in the same manner as described in Appendix J-2 – Description of Precipitation and Contributing Streamflow Estimates. Namely, contributing watershed areas are derived from the National Hydrography Dataset, precipitation onto these watersheds is estimated from a nearby climate station at similar elevation, and a consumptive use fraction is applied to estimate resulting streamflow into the basin. The NOAA climate stations employed for this analysis included:

- **Tejon Rancho, CA [NOAA Coop. ID #48839]** *(January 1895 – December 2017)*
- **Lebec, CA [NOAA Coop. ID #44863]** *(July 1948 – December 2017)*

For months with missing data, precipitation at these stations was estimated based on a linear regression model developed with WRMWSD’s “Spillway Basin” climate station located in the southern White Wolf Subbasin. Monthly precipitation records collected from the Spillway Basin station (elevation ~840 ft msl) showed an 85% correlation ($R^2 = 0.72$) with data collected from the Tejon Rancho station (elevation ~1,370 ft msl), and a 72% correlation ($R^2 = 0.52$) with data collected from the Lebec station (elevation ~3,600 ft msl).

**Figure J-2-1** depicts the contributing watershed areas and corresponding climate station locations employed for the calculation of contributing streamflow to the White Wolf Subbasin. Ultimately, a Watershed Consumptive Use Fraction of 95% and Precipitation Threshold of 0.75 inches were employed to estimate resultant contributing streamflow into the subbasin.

**Parsing Inflows by Entity**

As mentioned above, groundwater inflows from contributing streamflow are subsequently parsed by entity within the White Wolf Subbasin according to their proportional spatial acreage within the subbasin. Therefore, overlapping acreage within each District must be accounted for individually so as to accurately represent each district’s “representative proportional area” within the subbasin.

---

6 Data retrieved from NOAA’s National Climatic Data Center (NCDC) online portal (https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00048839/detail)

7 Data retrieved from NOAA’s National Climatic Data Center (NCDC) online portal (https://www.ncdc.noaa.gov/cdo-web/datasets/GSOM/stations/GHCND:USC00044863/detail)

8 Data obtained from WRMWSD on 12 December 2017. Correlations to Spillway Basin station were developed as part of a similar WRMWSD water budgeting effort and were subsequently employed for this analysis.
Table J-3-2 below reports the total acreage occupied by the various water agencies within the White Wolf Subbasin. Note that this table provides “exclusive” and “overlap” acreage, and calculates the total acreage within the subbasin both including the overlap areas from each entity (“TOTAL”), and only counting overlap areas once (“TOTAL UNIQUE”).

Table J-3-2. Total White Wolf Subbasin Acreage by Entity

<table>
<thead>
<tr>
<th>Entity</th>
<th>Exclusive Acreage</th>
<th>Overlap Acreage</th>
<th>Total Acreage</th>
<th>% Total Acreage</th>
<th>Overlap Entities</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEWSD</td>
<td>8,703</td>
<td>14,663</td>
<td>23,366</td>
<td>17%</td>
<td>WRMWSD</td>
</tr>
<tr>
<td>WRMWSD</td>
<td>28,016</td>
<td>29,546</td>
<td>57,562</td>
<td>42%</td>
<td>AEWSD, TCWD</td>
</tr>
<tr>
<td>TCWD</td>
<td>5,901</td>
<td>14,883</td>
<td>20,784</td>
<td>15%</td>
<td>WRMWSD</td>
</tr>
<tr>
<td>Kern County (i.e., “White Lands”)</td>
<td>35,380</td>
<td>0</td>
<td>35,380</td>
<td>26%</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>78,000</strong></td>
<td><strong>59,092</strong></td>
<td><strong>137,092</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL UNIQUE</strong></td>
<td><strong>78,000</strong></td>
<td><strong>29,546</strong></td>
<td><strong>107,546</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As indicated by the Table J-3-2 above, AEWSD has 23,366 acres of jurisdictional area within the White Wolf Subbasin, representing approximately 17% of the total acreage (including overlap areas) represented by the various entities within the subbasin. As such, monthly groundwater inflows to AEWSD’s lands in the White Wolf Subbasin are estimated at approximately 17% of the total estimated contributing streamflow to the White Wolf Subbasin for each month within the water budget period.
Abbreviations

DWR = California Department of Water Resources
ft msl = feet above mean sea level
GWE = groundwater elevation
WW = White Wolf

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. Water level data provided by Arvin-Edison Water Storage District, Kern Delta Water District, and Wheeler Ridge-Maricopa Water Storage District.
Paired Well Locations

Abbreviations
AEWSD = Arvin-Edison Water Storage District
DWR = California Department of Water Resources
KDWD = Kern Delta Water District
SGMA = Sustainability Groundwater Management Act

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2019.
2. Out-of-District wells obtained from SGMA Data Viewer:
   (https://sgma.water.ca.gov/webgis/?appid=SGMADataviewer)
Appendix J-4

Description of the Agricultural Lands Water Budget Subdomain
APPENDIX J-4
DESCRIPTION OF THE AGRICULTURAL LANDS WATER BUDGET SUBDOMAIN

This appendix describes the process for calculating water budget components within the Agricultural Lands subdomain of the Arvin-Edison Water Storage District (AEWSD or “District”) analytical water budget. This analysis was based on the following data sources:

- **Satellite Evapotranspiration (ET) Data** from the Irrigation Training & Research Center (ITRC)\(^1\)
  “Mapping Evapotranspiration at High Resolution with Internalized Calibration” (ITRC-METRIC) Study, funded by the Kern Groundwater Authority (KGA)\(^2\)
  - Monthly resolution, January 1993 – December 2015 \(^3\)

- **AEWSD Land Use Surveys** of various formats, including:
  - “1999 Overlap Landuse.xls” – by TRS, seasonal (spring & fall), 1999
  - “AECropSurvey_00to03.shp” – by Parcel, seasonal (spring & fall), 2000 – 2003\(^4\)
  - “AECropSurvey_04.shp” – by Parcel, seasonal (spring & fall), 2004
  - “AE_LandUse_05to08” – by Parcel, seasonal (spring & fall), 2005 – 2008

- **AEWSD District Operations Records** (surface water imports, spreading, deliveries, and groundwater extractions) compiled from various spreadsheets provided by the District, including:

- **Wheeler Ridge-Maricopa Water Storage District (WRMWSD) Delivery Records to AEWSD Overlap Lands**, provided by WRMWSD:
  - “WLEDGER” (from “WRM_DataMDB.mdb”) – by WRMWSD Turnout, monthly, 1999 - 2005

---

\(^1\) The Irrigation Training & Research Center is part of the California Polytechnic State University, San Luis Obispo.
\(^2\) Howes, D., 2018, 1993-2016 ITRC-METRIC Etc for Kern County, prepared for the Kern Groundwater Authority on behalf of the Cal Poly Irrigation Training & Research Center. (see Attachment J-4-1)
\(^3\) There is no ITRC satellite ET data for calendar year 2012, as the Landsat satellite system employed in the METRIC analysis was out of order during this period. See Attachment J-4-1 for further details.
\(^4\) Does not include Fall land use information for 2000, 2001, 2003
• **Precipitation Records** from the three local climate stations maintained by and located within the District, and five additional climate stations located outside of the District maintained by the National Oceanic and Atmospheric Administration (NOAA)⁵
  - “RAINFALL2015” — monthly, 1969 – 2016 (data availability varies by station)

**Description of ITRC-METRIC ET Dataset**

The ITRC-METRIC ET Dataset uses satellite-based remote sensing of radiant energy and the METRIC energy balance theory to quantify actual water flux to the atmosphere from the land surface (including ET and evaporation from wetted bare soil and open water). This approach differs from other commonly-used methods that estimate ET based on land use (i.e., cropping) patterns and reference ET data and/or crop water use coefficients. There are several advantages of the ITRC-METRIC approach over conventional crop coefficient methods:

- ITRC-METRIC provides the ability to measure actual ET over large areas without any previous knowledge of land use or climate variables, whereas crop coefficients will estimate ET based on known cropping acreages and assumed crop water use properties.
- ITRC-METRIC provides rasterized ET data at a high spatial resolution (satellite image pixel size of 30 x 30 meters) for an area of study, whereas crop coefficient-based ET estimates are limited to the resolution of the land use dataset being employed.
- ITRC-METRIC allows for ET measurement at a relatively frequent temporal resolution (e.g., approximately every 16 days)⁶, whereas crop coefficient methods are typically only available on a seasonal, or at best monthly, basis.

Due to these advantages, ET data developed using the ITRC-METRIC method will intrinsically reflect spatial and temporal variabilities in ET due to factors that cannot be fully accounted for using conventional crop coefficient methods. For example, the ITRC-METRIC ET rasters (image files) will reflect impacts on ET due to crop stresses from drought conditions, ET for crops at various stages of growth, ET for land parcels with multiple growing seasons (i.e., double cropping) and/or interbedded crops, and evaporation from surface water features (such as canals, reservoirs, spreading basins, etc.).

However, the ITRC-METRIC dataset has a significant limitation for water-budgeting purposes in that it does not provide an estimate of total applied water, only actual (observed) ET. Total applied water is a term used by water resource engineers to estimate how much water is actually being applied to the land. This differs from ET in that it includes not only water applied to satisfy crop water demand, but also unintentional over-irrigation due to irrigation inefficiency and water intentionally applied for other operational requirements or cultural practices (e.g., leaching, dust abatement, field preparation, frost control). During the main growing season from spring through fall, when precipitation is minimal and ET is greatest, total applied water is nearly always greater than evapotranspiration for any irrigated land, as

---

⁵ See Appendix J-2 for a detailed description of how climate stations are used to estimate precipitation on District lands and surrounding watersheds.

⁶ The ITRC-METRIC study did not use satellite imagery data from all available times during the period of interest, but rather used selected dates (between 9 and 13 each year) and used interpolation methods to fill in between.
no irrigation method is 100 percent efficient. Calculation of total applied water must also consider water added to the land surface via precipitation, as this will reduce the irrigation demand for a given area. **Figure J-4-1** illustrates the difference between actual (crop) ET ($ET_c$) and total applied water.

**Figure J-4-1.** Crop Evapotranspiration (ET or $ET_c$) vs. Total Applied Water

*Land Surface Processes within the Water Budget*

From a holistic water budgeting perspective, total applied water that does not go towards satisfying crop ET will be subject to four main processes once it is applied to the land surface:

1) Evaporation to the atmosphere  
2) Land surface runoff  
3) Infiltration and accumulation in the root zone  
4) Deep percolation below the root zone to the groundwater table (i.e., return flows)

---

7 Irrigation efficiency is defined as the fraction of total applied water that is used by the crop to satisfy its vegetative water demand.
Although this water budget model allows for temporary carry-over storage of excess effective precipitation in the root zone for subsequent uptake by crops (see below), it is assumed that there is no net long-term accumulation of water within the root zone. Accurate simulation of soil moisture changes would require detailed spatial information on soil properties and root zone depth, as well as data for precipitation, irrigation, and ET on the timescale of hours to days. As the current water budget is designed to reflect monthly changes on a District scale, this level of detail is beyond the current scope of the effort. Furthermore, assuming quasi-steady state conditions within the root zone mimics the approach of the MODFLOW Farm Process package, which has proven that “simulated inflows into the root zone converged to outflows after time intervals of several days”\(^8\). Therefore, the assumption of steady-state soil moisture within the root zone is justified.

Similarly, as this water budget was developed on a District scale, and given the generally low topographic slope and lack of significant permanent streams along District boundaries, we have assumed that land surface runoff of applied water is negligible for the purposes of this water budget. Though runoff may occur between parcels within the District service area, there is no continuous receiving water body (i.e., “Natural Channels” such as streams) that could transport surface water runoff outside of the District in any significant volume. Therefore, we have assumed that all land surface runoff occurring between parcels within the District will either (1) evaporate or (2) infiltrate into the subsurface before leaving District boundaries.

Under the above assumptions, excess water applied to the ground surface on District lands will predominantly either (1) evaporate from the wetted bare soil or (2) percolate below the root zone into the deeper subsurface (eventually recharging groundwater) before leaving District boundaries. Considering that landowners within AEWSD generally employ highly efficient irrigation techniques (such as micro-drip irrigation) and follow irrigation schedules designed to minimize evaporation of excess irrigation water, it is further assumed that evaporation of excess irrigation water is considered to be a negligible flux component of the ITRC-METRIC ET signal, and thus all “inefficient irrigation” of these lands will infiltrate through the root zone and eventually make its way down into the underlying principal aquifer.

**Building the Agricultural Lands Subdomain Water Budget**

**Land Use Data Availability by Year**

As described earlier, historical land use information was available for this water budget analysis for District Water Years\(^9\) 1994 – 2015 in multiple data formats and at varying spatial and temporal resolutions. Land use files therefore required individual processing for integration into the water budget depending on the level of detail provided within each file. **Table J-4-1** below summarizes data format and availability by year as provided in the District’s historical land use records.

---


\(^9\) AEWSD defines a water year (referred to herein as the “District Water Year”) as extending from March through February of the following year.
<table>
<thead>
<tr>
<th>District Water Year (Mar - Feb)</th>
<th>Data Format</th>
<th>Spatial Resolution</th>
<th>Temporal Resolution</th>
<th>Includes Irrigation Type?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>Excel</td>
<td>District-wide</td>
<td>Annual</td>
<td>No</td>
</tr>
<tr>
<td>1995</td>
<td>Excel</td>
<td>District-wide</td>
<td>Annual</td>
<td>No</td>
</tr>
<tr>
<td>1996</td>
<td>Excel</td>
<td>District-wide</td>
<td>Annual</td>
<td>No</td>
</tr>
<tr>
<td>1997</td>
<td>Excel</td>
<td>TRS</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>1998</td>
<td>Excel</td>
<td>TRS</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>1999</td>
<td>Excel</td>
<td>TRS</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2000</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Annual</td>
<td>Yes</td>
</tr>
<tr>
<td>2001</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Annual</td>
<td>Yes</td>
</tr>
<tr>
<td>2002</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2003</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Annual</td>
<td>Yes</td>
</tr>
<tr>
<td>2004</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2005</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2006</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2007</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2008</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2009</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2010</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2011</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2012</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>Year</td>
<td>Format</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Available</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>--------</td>
<td>------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>2013</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2014</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
<tr>
<td>2015</td>
<td>Shapefile</td>
<td>Parcel</td>
<td>Seasonal (Spring/Fall)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: TRS = township-range-section

The following subsections of this appendix are organized by year (or groups of years) based on the associated level of detail required within each land use processing step, given the annual land use data availability constraints outlined above.

**Determining Irrigated vs. Non-Irrigated and Urban Lands**

As mentioned above, deep percolation is the only major component of total applied water not measured by the ITRC-METRIC dataset within the agricultural lands subdomain. Deep percolation can result from any or all of three main applications of excess water to the ground surface:

1. Intentional operational and/or cultural processes, such as soil leaching and dust abatement
2. (Unintentional) irrigation inefficiencies
3. Excess (i.e. “ineffective”) precipitation

Excess water from operational processes and irrigation inefficiencies are only relevant to the irrigated portion of the District, whereas precipitation in excess of vegetative water demands must be considered across the entire District area. Therefore, for purposes of this water budget, we have separated the irrigated portion of the District from the non-irrigated portion of the District (i.e., including agricultural and native vegetation lands as well as urban lands) before estimating deep percolation and total applied water.

**District Water Years 1994 – 1996**

For District Water Years 1994 – 1996, land use data was in the format of a summary table outlining the major crop / land use types and their associated acreages by year. Major land use types were categorized within the spreadsheet as “Irrigated” or “Non-Irrigated”, and within the “Non-Irrigated” category was a subset devoted to “Urban” lands. These categories were subsequently employed within the water budget model.

**District Water Years 1997 – 2015**

For District Water Years 1997 – 2015, all annual/seasonal land use data included specific columns devoted to both Crop Type as well as Irrigation Type. Irrigation types listed in these records included:

- “S” – Sprinkler
- “C” – Center Pivot Sprinkler

---

10 Crop & irrigation codes were derived from DWR’s “Standard Land Use Legend”, accessible online at <http://www.cd.water.ca.gov/land_wateruse/ludata.cfm>
The “Irrigation Type” codes were used to decipher irrigated lands (i.e., TRS areas for 1997 – 1999 and parcels for 2000 – 2015) within the 1997 – 2015 land use datasets, by assuming that all entries marked as “N” were Non-Irrigated, and all other irrigation codes were considered to be Irrigated. From here, the “Crop Type” codes were used to further categorize certain lands as Urban Lands:

- “U” – Urban
- “UC” – Commercial
- “UC6” – Commercial (Schools)
- “UF” – Urban (unknown?)
- “UI” – Urban (Industrial)
- “UL” – Urban (Landscape)
- “UN” – Urban (Unknown?)
- “UR” – Urban (Residential)
- “UV” – Urban (Vacant)
- “UV-K” – Urban (Vacant – Freeways)

In addition, all parcels (or TRS areas) clearly marked as Highways were considered to be Urban Lands within this water budget. Associated codes included:

- “HWY 16”
- “HWY 166”
- “HWY 5”
- “HWY 58”
- “HWY 99”
- “HWY ED”
- “HWY 5”

Finally, Open Water Features were categorized separately from Urban Lands and Non-Irrigated Lands, though evaporation was ultimately estimated independently for the Artificial Channels and Spreading Basins subdomains within the water budget spreadsheet model. This allowed for a more accurate estimation of ET on non-irrigated lands that does not include evaporation from open water features. Open water features that were not associated with the Artificial Channels and Spreading Basins subdomains
were ultimately included in the Urban Lands subdomain of the budget, as these features generally corresponded to local storage ponds and/or recreational water bodies.

All of the data processing steps mentioned above were performed in R software to facilitate data processing and reproducibility of results.

**Determining Irrigation Methods and Irrigation Efficiency Coefficients**

As mentioned above, the contribution of “unintentional overwatering” resulting from irrigation inefficiency must be accounted for in estimating total applied water and deep percolation within the agricultural lands subdomain. As such, a representative irrigation efficiency coefficient must be associated with each irrigation type listed in the land use records.

**District Water Years 1994 – 1996**

As mentioned previously, for District Water Years 1994 – 1996 the land use records only provided detail on the total acreages of “irrigated” vs. “non-irrigated” lands within the District. Therefore, for the irrigated portion of the District, a uniform irrigation efficiency coefficient was applied for District Water Years 1994 – 1996 that reflected the average, area-weighted irrigation efficiency coefficient across the District (by groundwater subbasin), based off the 1997 – 1999 “Irrigation Type” records, as this was the closest period to 1994 – 1996 with available “Irrigation Type” information.

Based on this methodology, the irrigation efficiency coefficient employed for 1994 – 1996 was **77.9% for the Kern County Subbasin portion of the District, and 78.7% for the White Wolf Subbasin portion of the District.** See below for more information on how irrigation efficiency coefficients were defined for each “Irrigation Type” listed within this dataset.

**District Water Years 1997 – 2015**

For District Water Years 1997 – 2015, the “Irrigation Type” data included in the land use records was used to inform irrigation efficiency across the District. Irrigation types were first re-classified as follows:

- **Sprinkler**
  - “S” – Sprinkler
  - “C” – Center Pivot Sprinkler
  - “L” – Linear Move Sprinkler
  - “R” – Side Roll Sprinkler
  - “H” – Hand Move Sprinkler
  - “P” – Permanent Sprinkler
- **Micro-Sprinkler**
  - “M” – Micro-sprinkler
- **Micro-Drip**
  - “D” – Surface Drip Irrigation
  - “A” – Buried Drip Irrigation
- **Gravity**
  - “F” – Furrow Irrigation
  - “G” – Gravity (Furrow)
  - “B” – Border Strip Irrigation
This analysis was performed in R software to facilitate data processing and reproducibility of results.

From here, an area-weighted average irrigation efficiency coefficient was calculated for each season in the record within each subbasin, which was then later incorporated into the calculation of irrigation demands and residual deep percolation on irrigated lands. Irrigation efficiencies were initially estimated for each irrigation method based on representative values reported by the Food and Agricultural Organization of the United Nations (FAO)^11 and other commonly used resources, as follows:

- Micro-Drip (MD) – 85%
- Micro-Sprinkler (MS) – 80%
- Sprinkler (S) – 75%
- Gravity (G) – 65%

These values were included as “User Input Parameters” in the budget to facilitate easy adjustment, but were ultimately left unchanged during the calibration process. The resulting irrigation efficiency coefficient \( e_{IRR}^i \) for agricultural lands in any month \( i \) in the water budget period is then calculated as:

\[
e_{IRR}^i = \frac{\sum (0.85 \cdot \text{Acreage}_{MD}^i + 0.80 \cdot \text{Acreage}_{MS}^i + 0.75 \cdot \text{Acreage}_{S}^i + 0.65 \cdot \text{Acreage}_{G}^i)}{\text{Acreage}_{Irrigated Lands}^i}
\]

where \( \text{Acreage}_{x}^i \) = acreage of irrigated lands supplied by \( x \) irrigation type for month \( i \), and where \( x \) = micro-drip (MD), micro-sprinkler (MS), sprinkler (S), or gravity (G) irrigation types.

**Linking Reclassified Land Use Information to ITRC-METRIC ET Data**

Monthly ITRC-METRIC data was processed using a GIS model (i.e., automated procedure) that sums observed ET values (in raster format) by a specified set of overlying polygon features (e.g., by GSA boundaries, land use parcels, etc.). The GIS model employs a Spatial Analyst tool known as “Zonal Statistics” to sum the ET values from each 30 x 30 meter raster pixel within a specified boundary to determine the total ET value (in inches per month; [in/mo]) within the feature. This is then multiplied by the raster resolution (900 m\(^2\)) and converted into acre-feet per month (AF/mo) to provide a volumetric estimate of ET (in AF/mo) within each boundary on a given month. For this analysis, the selection of overlying boundary features for which to summarize ET within was determined by the data format and spatial resolution of the land use records provided by the District, and thus varied by year.

**District Water Years 1994 – 1996**

For District Water Years 1994 – 1996, land use data was provided on a District-wide level in the form of an Excel spreadsheet. As such, ET values from the ITRC-METRIC dataset for January 1994 – February 1997 (i.e., the end of Water Year 1996) were summarized monthly using the overlying GSA boundaries within the District. These included the boundary of the Kern Groundwater Authority GSA (KGA GSA) within the

---

Kern Subbasin portion of the District, and the White Wolf GSA (WWGSA) boundary within the White Wolf Subbasin portion of the District.12

After summarizing monthly ET by GSA (and, de facto, by subbasin), the total irrigated, non-irrigated, and urban acreages as defined by the 1994 – 1996 land use files were subsequently parsed by subbasin under the assumption that the 1997 – 1999 land use records were generally representative of the subbasin-based distribution of land use within the District during District Water Years 1994 – 1996. Total monthly ET values by subbasin (as derived from the GIS model) were subsequently parsed into the “Irrigated Lands”, “Non-Irrigated Lands”, and “Urban Lands” subdomains based on the estimated proportion of acreages within each subdomain, by subbasin, derived from the 1997 – 1999 land use records. An example of this process is as follows:

\[
ET_{\text{March,1994}}^{\text{Irrigated Lands,Kern}} = \text{Total } ET_{\text{March,1994}}^{\text{KGA GSA}} \times \frac{\text{Acreage}_{\text{1994 Irrigated Lands}}}{\text{Acreage}_{\text{1994 Total}}} \times \% \text{ Irrigated Lands}_{\text{Kern,1997–1999}} \tag{2}
\]

whereby

\[
\% \text{ Irrigated Lands}_{\text{Kern,1997–1999}} = \frac{\text{mean(} \text{Acreage}_{\text{Irrigated Lands,Kern,1997–1999}} \text{)} \text{}}{\text{mean(} \text{Acreage}_{\text{Irrigated Lands,Total}} \text{)}} \tag{3}
\]

This process was iterated for the set of monthly ITRC-METRIC ET rasters spanning January 1994 – February 1997 (i.e., the representative period of the 1994 – 1996 land use records) to produce an aggregated monthly estimate of ET on each subdomain, by basin, within this timeframe.

**District Water Years 1997 – 1999**

For District Water Years 1997 – 1999, land use data was provided by TRS unit in the form of an Excel spreadsheet. As such, the same approach was employed as for the 1994 – 1996 datasets, whereby monthly ET was summarized by overlying GSA boundaries and subsequently parsed into the Irrigated Lands, Non-Irrigated Lands, and Urban Lands subdomains by subbasin. The only difference here is that, for District Water Years 1997 – 1999, the TRS unit information allows for estimation of the percentage of Irrigated Lands, Non-Irrigated Lands, and Urban lands by subbasin directly, so it was no longer necessary to use an estimation factor as was done for 1994 – 1996. For example, ET on Irrigated Lands can be calculated as follows:

\[
ET_{\text{March,1997}}^{\text{Irrigated Lands,Kern}} = \text{Total } ET_{\text{March,1997}}^{\text{KGA GSA}} \times \frac{\text{Acreage}_{\text{Spring,1997 Irrigated Lands,Kern}}}{\text{Acreage}_{\text{Spring,1997 Total,Kern}}} \tag{4}
\]

This process was iterated for the set of monthly ITRC-METRIC ET rasters spanning March 1997 – February 2000 (i.e., the representative period of the District Water Years 1997 – 1999 land use records) to produce an aggregated monthly estimate of ET on each subdomain, by basin, within this timeframe. Because the 1997 – 1999 land use data is reported biannually, whereas the ITRC-METRIC data is collected monthly, the following time periods were employed to link reclassified land use data to the ITRC-METRIC dataset:

---

12 The portion of AEWSD within the Kern River GSA (i.e., the overlap area within East Niles Community Service District) was not included within the water budget domain, as this area this area is not included in the ITRC-METRIC ET rasters provided by GEI for the AEWSD service area. Additionally, it is appropriate to remove the East Niles CSD overlap area as this area is managed by the KRGSA for SGMA compliance and is thus not considered to be within AEWSD’s SGMA jurisdiction.
• “Spring” – March through August of the calendar year
• “Fall” – September through February of the following calendar year

As an example, under this scenario an ITRC raster developed for July 1997 would be linked to the “Spring 1997” land use dataset, whereas an ITRC raster developed for February 1998 would be linked to the “Fall 1997” dataset.

District Water Years 2000 – 2015

For District Water Years 2000 – 2015, land use information was available in a shapefile format by parcel, thus making it possible to summarize monthly ET information by overlying parcel boundaries using the GIS model. Land use shapefiles were first cut to remove the portion within the KRGS boundary13, and were subsequently input into the GIS model to produce a monthly ET breakdown by parcel within the AEWSG SGMA management area.

This process was iterated for the set of monthly ITRC-METRIC ET rasters spanning March 2000 – December 2015 (apart from 2013, where ITRC-METRIC data was not provided) to produce an aggregated monthly estimate of ET on each parcel within this timeframe. These values were then joined to the reclassified Crop Type & Irrigation Type information using a unique parcel-based key incorporated into both datasets, allowing for the calculation of total ET on each subdomain, by basin, for each month. Because the land use data is reported biannually14, whereas the ITRC-METRIC data is collected monthly, the following time periods were employed to link reclassified land use data to the ITRC-METRIC dataset:

• “Spring” – March through August of the calendar year
• “Fall” – September through February of the following calendar year

Determining Additional Irrigation Demands

As mentioned above, ITRC-METRIC data provides a reasonable estimate of actual ET occurring within the District but should not be considered to represent total applied water on District lands. In addition to accounting for irrigation inefficiencies, estimates of total applied water must also consider the additional irrigation demands associated with crop leaching and other operational water requirements, as well as account for any contributions of effective precipitation in meeting the ET demand measured by ITRC-METRIC. The following subsections detail how additional irrigation demands are estimated within the analytical water budget model.

Crop Leaching Requirements

As mentioned above, soil leaching is a common practice that can significantly increase the volume of applied water required for long-term operations beyond the ET demands estimated by ITRC-METRIC data. As no specific information on leaching practices (i.e., amounts, locations, timing) was available from the District, a conventional approach outlined by the FAO and employed by the District’s agricultural consultant JMLord, Inc. was used to determine leaching requirements based on crop-specific salinity

13 Ibid [12].
14 For 2000, 2001, and 2003, Spring data was available only and thus was used as the representative land use dataset for the entire water year.
thresholds and estimates of leaching water salinity\(^{15}\). For a given crop, the “leaching fraction” (i.e., the incremental portion of irrigation water in excess of crop ET demands required to maintain the soil salinity at levels conducive to optimal crop yield) is defined as follows:

\[
LF = \frac{EC_w}{5(EC_e) - EC_w}
\]  

\(^{(5)}\)

where \(LF\) = leaching fraction [dimensionless], \(EC_w\) = electrical conductivity of the irrigation water [deciSiemens per meter; dS/m], and \(EC_e\) = crop salinity threshold [dS/m].

From here, the volumetric “leaching requirement” can be calculated as the incremental volume of water needed to satisfy the leaching demand:

\[
LR = \frac{ET_c \cdot LF}{1 - LF}
\]  

\(^{(6)}\)

where \(LR\) = leaching requirement [AF] and \(ET_c\) = crop evapotranspiration [AF].

For the purposes of this analysis, leaching demands are calculated for the entire irrigated lands portion of the agricultural lands subdomain for each month. To achieve this, an area-weighted crop-salinity threshold is calculated for the irrigated lands area for each basin based on the relative acreages of each crop category included in “CROPS.shp.” (see Attachment J-4-2 for the list of indicative crop salinity thresholds used in this methodology). A leaching fraction \((LF)\) is then calculated per equation \((5)\) above within the water budget based on the area-weighted crop salinity threshold and an assumed electrical conductivity of irrigation water \((EC_w)\). The \(EC_w\) is implemented as a user-adjustable input parameter within the water budget spreadsheet, and was ultimately set at 500 microsiemens per centimeter (µS/cm) in line with the general water quality profile of AEWSD's imported surface water supplies. Crop evapotranspiration \((ET_c)\) is estimated from the monthly ITRC-METRIC ET data for irrigated lands, and a monthly leaching requirement \((LR)\) is calculated using equation \((6)\) above.

**Other Operational Demands**

As mentioned above, in addition to soil leaching, other operational practices that require additional applied water are commonly employed for purposes such as pre-irrigation requirements, harvesting, pest control, frost control, crop uniformity, germination, and dust control. As no specific information on specific operational water uses (i.e., amounts, locations, timing) was available from the District, these additional “operational demands” are estimated from the JMLord, Inc. historical agricultural demand reports\(^{16}\) provided for the District.

Based on the JMLord, Inc. reports, it was determined that on a District scale, agricultural water users were historically applying an additional \textbf{0.16 AFY/acre} to their lands on average (over Water Years 1994 – 2015) to meet additional operational demands beyond leaching. This value was employed for the “Additional Operational Demands” User Input Parameter within the analytical water budget model to estimate operational water demands within the District for any given month:


Effective Processing

where \(OD^i\) = operational demands for month \(i\) [AF] and \(Acreage^{irrigated\ Lands}_i\) = irrigated acreage for month \(i\).

**Processing Precipitation Data**

As mentioned above, estimates of total applied water should also take into account any contribution of effective precipitation in meeting ET demands on District lands. The residual “ineffective precipitation” (i.e., the portion of precipitation which is not considered available to meet ET demands) may also contribute to groundwater recharge to a certain degree and should thus be quantified and routed to appropriate subdomains within the analytical water budget to ensure mass balance is fully conserved within the model.

**Calculating Effective Precipitation**

Effective precipitation as defined as “the part of rainfall that can be used to meet the evapotranspiration of growing crops. It does not include surface runoff or percolation below the crop root zone.” (USDA-SCS, 1970)\(^{17}\). Since limited data exists to quantify historical rates of effective precipitation within the District, we have chosen to employ an empirical equation developed by the United States Department of Agricultural Soil Conservation Service (USDA-SCS)\(^{18}\) which factors in measurements of monthly rainfall, evapotranspiration (i.e. crop consumptive use), and estimated depth of application (or “usable soil water storage” depths) to approximate effective rainfall (in inches) for any given month\(^{19}\). The resulting equation for estimating monthly effective precipitation [in] is:

\[
pe = f * (0.70917 * p_t^{0.82416} - 0.1156) * 10^{0.02426*ET_c} \tag{8}
\]

where \(pe\) = effective precipitation [in], \(p_t\) = total precipitation [in], \(ET_c\) = crop evapotranspiration [in], and \(f\) = correction factor for irrigation application depths different from 3 inches, where:

\[
f = (0.531747 + 0.295164 * D - 0.057697 * D^2 + 0.003804 * D^3) \tag{9}
\]

where \(D\) = net depth of application during irrigation [in].

Effective precipitation (\(pe\)) was calculated for each month for both irrigated and non-irrigated lands, where \(D\) was set to the default value of 3 inches for irrigated lands and set to zero inches for non-irrigated lands. These normalized values were subsequently converted into volumetric effective precipitation rates (in AF per month) using the acreages of irrigated and non-irrigated lands for the given month. For example:

---


\(^{18}\) Ibid [17].

\(^{19}\) “SCS scientists analyzed 50 years of rainfall records at 22 locations throughout the United States to develop a technique to predict [monthly] effective precipitation (USDA 1970). A daily soil moisture balance incorporating crop [ET], rainfall, and irrigation was used to determine the ET effectiveness.” (USDA-SCS, 1993).
Precipitation carryover term

While a soil moisture balance is not explicitly modeled in this analytical water budget, it is recognized that excess effective precipitation in the rainy winter months of the year may be retained temporarily in the root zone and can help contribute to meeting ET demands in the early growing season, thus reducing the irrigation demand during these months. To account for this phenomenon, we have included an effective precipitation “carryover” term to allow for any residual effective precipitation in excess of ITRC-METRIC ET signal to remain available for meeting ET demands in the following month(s) throughout the model period. This effective precipitation carryover term is defined as:

$$ P_{e,\text{carryover}}^i = \max(0, \ P_e^i - ET^i) $$

where $P_{e,\text{carryover}}^i$ = carryover of excess effective precipitation from month $i$ [AF], $P_e^i$ = effective precipitation for month $i$ [AF], and $ET^i$ = ITRC-METRIC measured ET for month $i$ [AF].

This effective precipitation carryover term is subsequently added to the effective precipitation value calculated for the following month:

$$ P_e^{i+1} = +P_e^{i+1} + P_{e,\text{carryover}}^i $$

where $P_e^{i+1}$ = adjusted effective precipitation for month $i + 1$ [AF], $P_e^{i+1}$ = initial effective precipitation for month $i + 1$ (calculated from equations 8 – 10) [AF], and $P_{e,\text{carryover}}^i$ = effective precipitation carryover term from month $i$ [AF] (calculated from equation 11).

**Parsing Ineffective Precipitation**

As mentioned above, “ineffective precipitation” is defined as the portion of total (direct) precipitation that is not considered available to meet ET demands:

$$ P_{\text{ineff}}^i = P_t^i - P_{\text{initial}}^i $$

where $P_{\text{ineff}}^i$ = ineffective precipitation for month $i$ [AF], $P_t^i$ = total precipitation for month $i$ [AF], and $P_{\text{initial}}^i$ = initial effective precipitation for month $i$ [AF] (calculated from equations 8 – 10).

Ineffective precipitation can either (1) runoff as a surface outflow from the water budget domain; (2) evaporate from the land surface before infiltrating into the root zone; or (3) percolate from the root zone into the vadose zone, where it eventually becomes groundwater recharge. As mentioned above, (1) surface runoff outside of the District is considered negligible in this water budget, leaving (2) evaporation
and (3) deep percolation as the only pathways for parsing ineffective precipitation. Very little historical data or reference information exists for quantifying the proportions of evaporation versus deep percolation for ineffective precipitation, so we have chosen to define an “ineffective precipitation deep percolation coefficient” \( f_{DP} \) user input parameter to apportion these flux components within the model. Here, the portion of ineffective precipitation contributing to deep percolation for a given month \( P_{DP}^i \) is defined as:

\[
P_{DP}^i = P_{ineff}^i \times f_{DP}
\]  

(14)

where \( P_{ineff}^i \) = ineffective precipitation for month \( i \) [AF], and \( f_{DP} \) = ineffective precipitation deep percolation coefficient [-].

Consequently, the portion of ineffective precipitation that will evaporate from the land surface for a given month \( P_{evap}^i \) is defined as:

\[
P_{evap}^i = P_{ineff}^i \times (1 - f_{DP})
\]  

(15)

Notably, \( P_{evap}^i \) is included as a unique evaporative flux component from the water budget domain in addition to ITRC-METERIC derived ET, as opposed to assuming that evaporation of ineffective precipitation was included in the ITRC-METERIC signal. Though the ITRC-METERIC method is considered a generally reliable estimator of actual ET over large spatial domains, it faces certain limitations, particularly in the winter months where usable LANDSAT satellite imagery may not be available due to the presence of clouds, etc., and/or satellite imagery may not adequately capture the evaporation occurring from wetted soils immediately following a precipitation event\(^{20}\). With this constraint in mind, and under the observation that ITRC-METERIC measured ET in the winter months (i.e., November – February) was usually significantly lower than reference ET (ETo) measured at the nearby Arvin CIMIS Station 125 for the same months, it was determined that an additional “evaporation of ineffective precipitation” term \( P_{evap}^i \) was warranted for estimating evaporation of ineffective rainfall during the winter months when it is likely to be underestimated by the ITRC-METERIC method. Inclusion of \( P_{evap}^i \) also results in a more reasonably conservative estimate of groundwater recharge from ineffective precipitation \( P_{DP}^i \) during the wet season.

The ineffective precipitation deep percolation coefficient \( f_{DP} \) user input parameter was ultimately determined via calibration of the water budget model, as described further in Appendix J-5. A constant value of \( f_{DP} = 0.2 \) (i.e., 20% deep percolation of ineffective precipitation) was used for the AEWSD analytical water budget model.

**Calculating the Total Irrigation Demand and Agricultural Groundwater Pumping**

Following the above methodologies to calculate the monthly ET demand, irrigation efficiency, leaching and other operational demands, and contributions of effective precipitation, the total irrigation demand within the District can be determined. After accounting for the volume of surface water deliveries to

irrigated lands from the District’s monthly operations records, the volume of groundwater pumping for irrigation (otherwise termed “agricultural groundwater pumping”) can also be estimated for any given month during the water budget period.

For any given month \((i)\), the unadjusted irrigation demand is defined as the ET demand on irrigated lands minus any contributions of effective precipitation:

\[
I_{\text{demand}}^i = \max(0, ET_{\text{irrigated lands}}^i - P_{e\text{irrigated lands}}^i)
\]  

(16)

where \(I_{\text{demand}}^i\) = unadjusted irrigation demand [AF], \(ET_{\text{irrigated lands}}^i\) = ITRC-METRIC ET on irrigated lands [AF], and \(P_{e\text{irrigated lands}}^i\) = effective precipitation on irrigated lands [AF] (equation 12) for month \(i\).

The adjusted irrigation demand is then computed as follows:

\[
I_{\text{demand,adj}}^i = I_{\text{demand}}^i \times (1 + (1 - e_{\text{irr}}^i)) + LR^i + OD^i
\]  

(17)

where \(e_{\text{irr}}^i\) = irrigation efficiency coefficient (equation 1), \(LR^i\) = leaching requirement (equation 6), and \(OD^i\) = operational demands (equation 7) for month \(i\).

As seen in equations (16) and (17), if the unadjusted irrigation demand \((I_{\text{demand}})\) is less than zero (i.e., if there is effective precipitation in excess of the measured ET on irrigated lands) than \(I_{\text{demand}}\) is set to zero and the adjusted irrigation demand only includes the leaching requirements & operational demands for that given month.

From here, we can calculate agricultural groundwater pumping \((GW_{\text{pumping}}^i)\) for month \(i\) as the residual of the surface water deliveries to irrigated lands and the adjusted irrigation demand:

\[
GW_{\text{pumping}}^i = \max(0, I_{\text{demand,adj}}^i - SW_{\text{deliveries}}^i)
\]  

(18)

where \(SW_{\text{deliveries}}^i\) = surface water deliveries\(^{21}\) [AF] for month \(i\).

If surface water deliveries to irrigated lands are greater than the adjusted irrigation demand, then there is no additional need for irrigation water and agricultural groundwater pumping term is thus set to zero.

**Calculating Instantaneous and Time-Averaged Deep Percolation**

Using the above methodology, total applied water (TAW) [AF] is intrinsically calculated within the water budget as follows:

\[
TAW^i = SW_{\text{deliveries}}^i + GW_{\text{pumping}}^i
\]  

(19)

For the irrigated lands, TAW includes groundwater pumping and surface water deliveries after accounting for effective precipitation on the irrigated portion of the District (see equation 16). The TAW term therefore inherently reflects all assumptions about irrigation efficiency, leaching, operational requirements, and effective precipitation, as these values are included in the calculation of groundwater pumping within the irrigated portion of the District. TAW reduces to zero for non-irrigated lands, while

\(^{21}\) The term “surface water deliveries” is used here to refer to deliveries by the District to its customers within the Surface Water Service Area through the District’s conveyance system. These deliveries may in fact include some groundwater recovered from storage by the District’s recovery wells.
for urban lands TAW will only include surface water deliveries to municipal & industrial (M&I) customers, and/or any M&I groundwater pumpage.

From here, the total instantaneous deep percolation on irrigated lands \(DP_{\text{inst irrigated lands}}^i\) [AF] for month \(i\) is calculated as:

\[
DP_{\text{inst irrigated lands}}^i = TAW^i - ET_{\text{irrigated lands}}^i + P_{DP_{\text{irrigated lands}}}^i
\]

where \(ET_{\text{irrigated lands}}^i = \text{ITRC-METRIC ET on irrigated lands [AF]}\) and \(P_{DP_{\text{irrigated lands}}}^i = \text{portion of ineffective precipitation contributing to deep percolation on irrigated lands (equation 14) [AF]}\).

For the irrigated lands, this term will reflect all deep percolation resulting from inefficient precipitation, irrigation inefficiency, leaching demands and any other operational water uses.

For the non-irrigated lands, TAW is, by definition, zero and the total instantaneous deep percolation on non-irrigated lands \(DP_{\text{inst Non-irrigated lands}}^i\) can be re-written as:

\[
DP_{\text{inst Non-irrigated lands}}^i = P_{e_{\text{Non-irrigated lands}}}^i - ET_{\text{Non-irrigated lands}}^i + P_{DP_{\text{Non-irrigated lands}}}^i
\]

Note that in equation 21 deep percolation includes a contribution from effective precipitation on non-irrigated lands \(P_{e_{\text{Non-irrigated lands}}}^i\). This term is included in equation 21 as a mass-balance closure term, since it is not intrinsically considered in the calculation of TAW as it is for the irrigated lands subdomain. By definition of \(P_{e}^i\) in equation 12, this term should include all carryover effective precipitation from previous months where \(P_{e_{\text{Non-irrigated lands}}}^i > ET_{\text{Non-irrigated lands}}^i\) so as to prevent any effective precipitation from percolating below the root zone, thus reducing equation (21) to only include \(P_{DP_{\text{Non-irrigated lands}}}^i\). However, it has been noted that the ITRC-METRIC measured \(ET_{\text{Non-irrigated lands}}\) routinely exceeds \(P_{e_{\text{Non-irrigated lands}}}^i\) estimates during the dry season, thus resulting in a negative \(DP_{\text{inst Non-irrigated lands}}^i\) during the summer months. Whether or not this high ET signal in the non-irrigated portions of the District is an artifact of the ITRC-METRIC method or is in fact a real signal, for the purposes of this water budget a negative \(DP_{\text{inst Non-irrigated lands}}^i\) value results in a net reduction of groundwater storage from the non-irrigated subdomain for the given month.22

Though the instantaneous deep percolation value serves as a closure term within the irrigated and non-irrigated lands water budget subdomains, in reality, because the groundwater table can occur several hundred feet below the ground surface, it may take a considerable time for deep percolation to travel through the thick vadose zone before it actually reaches the groundwater table and adds to groundwater storage. For the purposes of this water budget, this “lag effect” is represented by including a “Deep

---

22 It should be noted that the excess non-irrigated demand likely does not come from groundwater storage depletion, but is rather made up by a combination of local runoff from adjacent irrigated lands, contributions from streamflows, and/or seepage from natural and artificial water systems. Functionally, it is justified to attribute this demand to groundwater storage depletion, because if it were to come from surface water it would then reduce the amount of surface water available for delivery to agricultural lands which would increase the demand for pumping, and so the same result is achieved.
Percolation Lag Period" as a user input parameter within the water budget. This allows the user to specify an estimated time (in months) that it would take for any deep percolation water to travel through the vadose zone and reach the groundwater table. The resulting “time-averaged” deep percolation, \( DP_{avg} \) [AF], is thus calculated as a moving average as follows:

\[
DP_{avg} = \frac{\sum_{i=1}^{N} DP_{i}^{in}}{N+1}
\]

where \( N \) = the deep percolation lag period [months].

This value represents the estimated volume of “deep percolation” that actually reaches the groundwater table on a given month. For the AEWSD water budget, a final deep percolation lag period of 11 months was selected, so the amount of deep percolation recharging the groundwater basin for a given month would equal the time-averaged deep percolation \( (DP_{avg}) \) percolation for the past 11 months up to the present. Use of this time-averaged deep percolation (i.e., use of a moving average) results in a smoothed-out time series of recharge. This method was also applied to the recharge from stream flows into the District, seepage from man-made channels (negligible), return flows from urban water use, and recharge from spreading basin operations (spreading basin lag period = 3 months).

**Conclusions**

The result of the above processing steps is a water budget for the agricultural lands subdomain that:

- Incorporates direct measurements of ET from the land surface using ITRC-METRIC data as well as estimates of direct precipitation from local climate stations;
- Links monthly ITRC-ET data to seasonal, parcel-based land use details;
- Parses ET into buckets of (1) irrigated lands, (2) non-irrigated lands, and (3) urban lands;
- Calculates estimates of agricultural pumping and deep percolation on irrigated lands due to ineffective precipitation, irrigation inefficiencies, leaching, and operational demands;
- Calculates estimates of deep percolation on non-irrigated lands due to ineffective precipitation;
- Factors in a user-defined lag period to represent the time lag effect of vadose-zone flow on groundwater recharge due to deep percolation; and
- Accounts for evaporation of ineffective precipitation in the winter months where ITRC-METRIC ET data may not fully capture evaporation after rain events due to gaps in imaging frequency and/or less-reliable interpolations between imaging dates.

The attached **Figure J-4-2** provides a schematic of the irrigated agricultural lands subdomain equations and their interrelationships as described above.
For Irrigated Lands:

Legend
- Raw Data
- Quantity of Interest
- Calculated by Sum
- Calculated by Difference
- Calculated using Multiplication by a Calibration Factor or other constant
- Corresponding equation in Appendix J-4-2

Abbreviations
- ft = feet
- ft msl = feet above mean sea level

Irrigated Agricultural Lands
Equations & Interrelationships
Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure J-4-2
Attachment J-4-1

2015 ITRC-METRIC ET Study Report (GEI)
Kern Groundwater Authority

1993-2016 ITRC-METRIC ETc for Kern County

Prepared by
Daniel J. Howes, Ph.D., P.E.
Project Manager
Irrigation Training and Research Center
California Polytechnic State Univ.
Office: 805-756-2347, Mobile: 858-354-0504
djhowes@calpoly.edu

Prepared for
Kern Groundwater Authority
c/o Eric Averett, General Manager
Rosedale-Rio Bravo WSD
P.O. Box 20820, Bakersfield, CA 93390-0820
Phone: 661-589-6045
eaverett@rrbwsd.com

June 2018

Reference to any specific process, product or service by manufacturer, trade name, trademark or otherwise does not necessarily imply endorsement or recommendation of use by either California Polytechnic State University, the Irrigation Training & Research Center, or any other party mentioned in this document. No party makes any warranty, express or implied and assumes no legal liability or responsibility for the accuracy or completeness of any apparatus, product, process or data described previously. This report was prepared by ITRC as an account of work done to date. All designs and cost estimates are subject to final confirmation.
# Table of Contents

Introduction .......................................................................................................................... 1

**ITRC-METRIC Procedures** ............................................................................................... 2
- Satellite Images .................................................................................................................. 2
- Weather Data ...................................................................................................................... 5
- Corrected Spatial ET\(_o\) ...................................................................................................... 9
- Calibration near Primary Weather Station ........................................................................ 10
- Elevation Data ................................................................................................................... 10
- Land Use Map .................................................................................................................... 11
  - Land Use Data 2007 to Present ....................................................................................... 11
  - Land Use Data 1997 to 2006 ........................................................................................ 12
  - Land Use Data 1993-1996 ............................................................................................. 12
- Interpolation between Image Dates .................................................................................... 13
- Accuracy of ITRC-METRIC ET\(_c\) Estimates ..................................................................... 13

**Summary of Results** ...................................................................................................... 15
- Evaluation of ET\(_c\) Variation .......................................................................................... 17
- Conclusion ......................................................................................................................... 21
- Future Work ...................................................................................................................... 21
  - Net To/From Groundwater (NTFGW) ......................................................................... 21
  - ITRC-METRIC ET\(_c\) ....................................................................................................... 22

**Attachment A** .................................................................................................................. 22
- Annual ITRC-METRIC ET\(_c\)
List of Figures

Figure 1. Aerial image of the area of interest within which actual evapotranspiration was provided to KGA ......................................................................................................................................... 1
Figure 2. Cloud free LandSAT image (left) and LandSAT image with clouds (right)................................. 3
Figure 3. Locations of the CIMIS weather stations used in this evaluation .................................................. 6
Figure 4. Example of solar adjustments made on Famoso CIMIS Station for 2010-2014. The same analysis was conducted for all weather stations in the Central Valley ............................................. 8
Figure 5. Example of uncorrected Spatial CIMIS ETo compared to corrected Spatial ETo for July 15, 2015 ........................................ 9
Figure 6. Famoso CIMIS station calibration area of interest (AOI) ................................................................. 10
Figure 7. Example original NASS land use (left) compared to corrected land use based on the majority crop type within each agricultural field (right). Each color identifies a different land use type (i.e., almonds, alfalfa, developed, etc.) ............................................................................. 11
Figure 8. County of Kern agricultural land use fields (left). Combined County of Kern and NASS land use image (right) ....................................................................................................................................... 12
Figure 9. 2008 ETc image with Valley floor and field boundaries used for the summary analysis .......... 15
Figure 10. Annual volume of ETc for the Kern County Valley floor and within fields in Kern County. Grass reference ETo and precipitation depths are shown for each year as a reference. ........ 16
Figure 11. Annual volume of ETc for irrigation/water districts in Kern County and just Kern Groundwater Authority member districts ................................................................. 16
Figure 12. Annual crop coefficient (Kc) for the Kern County Valley floor and within fields in Kern County. Reported Ag Commissioner total harvested acres per year on the right axis of the graph. ................................................................................................................................. 17
Figure 13. Crop acreage for major crops in Kern County from 1992-2015 (top) and total harvested acres (bottom) from Ag Commissioner Reports ................................................................. 18
Figure 14. Annual Kc by field sorted from lowest to highest for four different years .............................. 19
Figure 15. Annual ITRC METRIC ET in 1993 (top) and 2015 (bottom) with field boundaries ..................... 20

List of Tables

Table 1. Time frame of available images for LandSAT 5, 7, and 8 ................................................................. 2
Table 2. Chosen image dates for 1993-2016 Kern County METRIC process ............................................. 4
Table 3. Months with data estimated by the factor process ........................................................................ 4
Table 4. Weather stations used for the METRIC modeling process ............................................................ 7
Introduction

The Irrigation Training & Research Center (ITRC) at California Polytechnic State University, San Luis Obispo was contracted by the Kern Groundwater Authority (KGA) to compute actual evapotranspiration (ETc) from the Southern San Joaquin Valley within and near the Kern Groundwater Basin. The area of interest is shown in Figure 1 with a “natural color” image in the background.

ITRC uses a modified Mapping of EvapoTranspiration with Internal Calibration (METRIC™) procedure to compute actual evapotranspiration using LandSAT Thematic Mapper (LandSAT) data. The original METRIC procedure was developed by Dr. Richard Allen (University of Idaho). ITRC has made a number of modifications to the original procedures including using a grass reference evapotranspiration instead of alfalfa, a semi-automated calibration procedure, spatially interpolated ETo, modifications to the aerodynamic resistance and albedo computations for certain crops, improved open water evaporation algorithm, etc.

Figure 1. Aerial image of the area of interest within which actual evapotranspiration was provided to KGA

This report will describe the general process and some results of the modeling over the timeframe. The monthly and annual results of ITRC-METRIC for this project have been transmitted to KGA (care of Eric Averett, General Manager, Rosedale-Rio Bravo WSD).
ITRC- METRIC Procedures

This Procedures section will discuss the information that was gathered and used to compute the actual crop evapotranspiration (ET) in the Delta. The ITRC-METRIC process is based on a surface energy balance and includes corrections for aerodynamic resistance. It depends upon both accurate and frequent LandSAT satellite thermal images and understanding of the cropping systems within a region. The METRIC programs have gradually evolved from research in the US and other countries with the objective of being able to directly estimate actual ET over large areas with limited data availability (such as crop type, irrigation method, irrigation practices, etc.). The image processing is relatively fast; however, the collection of significant background data (besides the satellite images) that are necessary to start the processing in a new area can be somewhat time-consuming. Proper use of METRIC also requires expert input/interpretation by those who run the program.

LandSAT 5, 7, and 8 image pixel resolution is 30 meters by 30 meters for all but the thermal band. The thermal band pixel resolution is 120 meters by 120 meters for LandSAT 5, 60 meters by 60 meters for LandSAT 7, and 100 meters by 100 meters for LandSAT 8. For this project, the thermal band was sharpened to 30 meter by 30 meter resolution using the nominal cubic spline that is provided in the raw images by USGS. ITRC has a more advanced thermal sharpening process, but that was not used because of time and budget constraints for this project. Inputs into the ITRC-METRIC model included:

- LandSAT imagery
- Digital elevation maps
- NASS CropScape data
- Corrected weather station data (hourly and daily)
- Corrected spatial grass reference evapotranspiration (ETo) maps (daily)
- Spreadsheet calculated values
- Tabulated constants

A critical benefit of using ITRC-METRIC to determine actual evapotranspiration is that land use/crop type information is not needed. Therefore, inaccuracies of determining land use are not part of the uncertainty in ETc output. General land use information (row crop, orchard, etc.) is used to correct for aerodynamic influences on ETc. The information provided through the NASS CropScape is of sufficient accuracy for this piece of the process.

Satellite Images

LandSAT 5, LandSAT 7, and LandSAT 8 images available from the United States Geological Survey (USGS) on sixteen-day intervals were used for the METRIC process. Table 1 shows the time frame of available images from each satellite.

<table>
<thead>
<tr>
<th>LandSAT 5</th>
<th>LandSAT 7**</th>
<th>LandSAT 8</th>
</tr>
</thead>
</table>

**After May 2003, LandSAT 7 began producing images with missing data, or “bandgaps” because of a defective sensor/mirror. LandSAT 7 is only used as a backup if other LandSAT data is missing. Bandgaps are filled using interpolation techniques in GIS as described in the METRIC Application Manual Version 2.0.7 (Allen et al. 2010)
The area of interest is covered by the LandSAT image path 42, rows 35 and 36. Each path identifies a path, or single trip the LandSAT takes, and the rows are different portions of that path. The rows along the same path are taken on the same day and the center of the row image is taken at approximately the same time of the day (approximately 11 a.m. Pacific Standard Time).

The METRIC modeling process relies on surface temperature data from the LandSAT thermal band. Actual ETc cannot be computed for the regions covered by clouds or fog. Figure 2 compares a non-clouded image with a cloud-covered LandSAT image. The best quality (minimal clouds and fog) LandSAT images were selected for processing. Every LandSAT image available throughout the study period was evaluated manually.

Figure 2. Cloud free LandSAT image (left) and LandSAT image with clouds (right)

All relatively cloud-free available images were used for the modeling process. Table 2 lists the images processed from late 1992 through early 2016. A total of 234 images were used to cover the study period.

If a cloud-free image was not available during a month, the image with the fewest clouds was selected or LandSAT 7 imagery was used. If an image with clouds had to be used, the clouds were masked out of the results and replaced with interpolated results from images processed before and after the image date. For the cloud masking interpolation, the two previous and three subsequent processed images were used to estimate the actual crop coefficient for the cloudy region.

Some months (generally during winter) had no usable images because of significant cloud cover. Available images, before and after the month with no data, were selected to be used to interpolate the missing image.

For those cases when three or more consecutive months did not have usable images, the closest available image was used in combination with a correction factor, to get an average estimated Kc map for the missing month. Those correction factors were established based on data from years with usable winter images. Because this process was used only for winter months, which have low ET, the overall accuracy should not be influenced significantly. However, users should understand that the uncertainty of the data for these months is greater than if LandSAT images were available. The months when this process was used can be seen in Table 3.
### Table 2. Chosen image dates for 1993-2016 Kern County METRIC process

|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

### Table 3. Months with data estimated by the factor process

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>November</td>
<td>January</td>
<td>February</td>
<td>March</td>
<td>December</td>
<td>January</td>
<td>February</td>
<td>March</td>
<td>November</td>
<td>December</td>
</tr>
</tbody>
</table>

*Note: * indicates Landsat 7, ** indicates Landsat 8, and no asterisk indicates Landsat 5 images.
Weather Data

ITRC-METRIC utilizes daily spatially varied grass reference ET₀ for interpolation between image dates. SpatialCIMIS is a product provided by the California Irrigation Management Information System (CIMIS) maintained by the California Department of Water Resources (DWR). Spatially varied ET₀ is developed by interpolating ET₀ between CIMIS weather stations, which measure and compute the ET₀ on an hourly basis. However, the collected data could have errors. Therefore, ITRC quality controls the hourly weather data at each weather station in the Central Valley (Redding to south of Bakersfield) and corrects the daily Spatial CIMIS data.

ITRC-METRIC also relies on hourly weather data from a station within the area of interest for processing the instantaneous images (prior to interpolation). The Shafter and Famoso CIMIS stations were utilized as the “primary” weather stations. These stations were selected because of their centralized locations within the primary area of interest. Shafter was used from 1992-1997 and Famoso was used from 1998-2015. The same quality control procedure was used at all weather stations, as will be described.

Hourly weather data for the project time frame was collected from CIMIS weather stations located throughout the project area. Forty-nine weather stations were used for the METRIC modeling process. Figure 3 shows the majority of weather stations used in this project. Not all stations were available during the entire analysis period. Each station is listed in Table 4 showing the approximate range of time that the station was utilized. A station may have become active or inactive within this timeframe.

The weather component data collected from the weather stations included:
1. Solar radiation (W/m²)
2. Vapor pressure (kPa)
3. Air temperature (°C)
4. Wind speed (m/s)
5. Precipitation (mm)
6. Relative humidity (%)  
7. Dew point temperature (°C)
8. PM ET₀ (mm)
Figure 3. Locations of the CIMIS weather stations used in this evaluation
Table 4. Weather stations used for the METRIC modeling process

<table>
<thead>
<tr>
<th>1993-2004 CIMIS Station</th>
<th>2005-2015 CIMIS Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arvin-Edison</td>
<td>Arvin-Edison</td>
</tr>
<tr>
<td>Auburn</td>
<td>Auburn</td>
</tr>
<tr>
<td>Belridge</td>
<td>Blackwells Corner</td>
</tr>
<tr>
<td>Blackwells Corner</td>
<td>Brentwood</td>
</tr>
<tr>
<td>Brentwood</td>
<td>Browns Valley</td>
</tr>
<tr>
<td>Browns Valley</td>
<td>Bryte</td>
</tr>
<tr>
<td>Bryte</td>
<td>Colusa</td>
</tr>
<tr>
<td>Colusa</td>
<td>Davis</td>
</tr>
<tr>
<td>Davis</td>
<td>Dixon</td>
</tr>
<tr>
<td>Dixon</td>
<td>Durham</td>
</tr>
<tr>
<td>Durham</td>
<td>Esparto</td>
</tr>
<tr>
<td>Esparto</td>
<td>Fair Oaks</td>
</tr>
<tr>
<td>Fair Oaks</td>
<td>Famoso</td>
</tr>
<tr>
<td>Famoso</td>
<td>Firebaugh</td>
</tr>
<tr>
<td>Firebaugh</td>
<td>Firebaugh-Telles</td>
</tr>
<tr>
<td>Firebaugh-Telles</td>
<td>FivePoints</td>
</tr>
<tr>
<td>FivePoints</td>
<td>Fresno State</td>
</tr>
<tr>
<td>Fresno State</td>
<td>Gerber</td>
</tr>
<tr>
<td>Gerber</td>
<td>Gerber South</td>
</tr>
<tr>
<td>Gerber South</td>
<td>Hastings Tract East</td>
</tr>
<tr>
<td>Hastings Tract East</td>
<td>Kesterson</td>
</tr>
<tr>
<td>Kesterson</td>
<td>Kettleman</td>
</tr>
<tr>
<td>Kettleman</td>
<td>Lindcove</td>
</tr>
<tr>
<td>Lindcove</td>
<td>Los Banos</td>
</tr>
<tr>
<td>Los Banos</td>
<td>Madera</td>
</tr>
<tr>
<td>Madera</td>
<td>Manteca</td>
</tr>
<tr>
<td>Manteca</td>
<td>Merced</td>
</tr>
<tr>
<td>Merced</td>
<td>Modesto</td>
</tr>
<tr>
<td>Modesto</td>
<td>Orange Cove</td>
</tr>
<tr>
<td>Orange Cove</td>
<td>Panoche</td>
</tr>
<tr>
<td>Panoche</td>
<td>Parlier</td>
</tr>
<tr>
<td>Parlier</td>
<td>Shafter*</td>
</tr>
<tr>
<td>Shafter*</td>
<td>Shasta College</td>
</tr>
<tr>
<td>Shasta College</td>
<td>Stratford</td>
</tr>
<tr>
<td>Stratford</td>
<td>Twitchell Island</td>
</tr>
<tr>
<td>Twitchell Island</td>
<td>Verona</td>
</tr>
<tr>
<td>Verona</td>
<td>Westlands</td>
</tr>
<tr>
<td>Westlands</td>
<td>Winters</td>
</tr>
<tr>
<td>Winters</td>
<td>Woodland</td>
</tr>
<tr>
<td>Woodland</td>
<td></td>
</tr>
</tbody>
</table>

* “Primary” stations
All collected hourly weather data from the stations went through a quality control check and correction procedure. A detailed procedure on the quality control conducted can be found in FAO Irrigation and Drainage Paper No. 56\(^1\) along with correction procedures. The main variable needing correction to accurately compute the hourly ETo is solar radiation. However, relative humidity was also examined using the procedures described in Allen et al. (1998). Figure 4 contains a graph of the corrected solar radiation for the Famoso CIMIS station for 2010-2014. This weather parameter is often in error if a pyranometer becomes covered with dust or debris, or if it loses calibration. This can be identified by comparing the daily incoming solar radiation with the maximum potential solar radiation (computed based on elevation, latitude, and time of year). If the measured value does not approach or become equal to the maximum potential over a time frame of several weeks, this could indicate an error in the measurement. Day-to-day variability is expected, but during a clear day, the measured should approach the potential. High values of solar radiation can be caused by incorrect sensor calibration.

![Figure 4. Example of solar adjustments made on Famoso CIMIS Station for 2010-2014. The same analysis was conducted for all weather stations in the Central Valley.](image)

For missing data, or if an error was flagged on the CIMIS station signifying missing, incomplete, or odd data results, data were examined for general consistency. Missing data and data believed to be in error were corrected. The correction procedure used in this analysis replaced the missing or flawed data with the averages from nearby weather stations. Once all hourly data was corrected, the data was input into REF-ET\(^\text{TM}\) (Dr. Richard Allen, University of Idaho) to compute the corrected hourly ASCE Standardized ETo that was used in this study.

ETo and individual weather data are used within the ITRC-METRIC process to compute inputs into the software. METRIC computes the instantaneous ETc for every pixel within the LandsAT image at the instant the image is taken. Knowing the ETo at that instant from the local weather station, a crop coefficient (Kc) can be computed (Kc = ETc/ETo). It has been shown that this instantaneous actual Kc at the time of image acquisition (approximately 11 a.m.) is a very good representation of the Kc for that entire day. These instantaneous Kc results are interpolated using a cubic spline procedure between image dates. The interpolated pixel Kc for each day is then multiplied by the daily corrected spatial ETo discussed in the next section.

**Corrected Spatial ETo**

Spatial CIMIS ETo is a relatively new resource available through the DWR. A specialized algorithm uses weather station data, elevations and other inputs to interpolate ETo between stations. However, Spatial CIMIS ETo rasters rely on CIMIS weather data that could have errors. In order to improve accuracy, ITRC incorporated the corrected CIMIS weather data into the Spatial CIMIS ETo raster images using a model we developed for ArcGIS 10.1.

The basic correction procedure first included adding the locations of all 49 stations into GIS. The uncorrected Spatial ETo at the weather station location was extracted for each day over the time frame investigated. The difference between the corrected daily ETo for each station and the uncorrected Spatial ETo was computed. These differences were used to generate a difference raster using Inverse Distance Weighting (IDW) interpolation. The difference raster was combined with the uncorrected Spatial ETo to generate the corrected Spatial ETo image.

Figure 5 shows a comparison of the uncorrected Spatial CIMIS ETo and the corrected Spatial ETo for July 15, 2015. The corrected Spatial ETo represents the combination of our corrected ETo data blended with the original Spatial CIMIS ETo.

![Figure 5. Example of uncorrected Spatial CIMIS ETo compared to corrected Spatial ETo for July 15, 2015](image)
Calibration near Primary Weather Station

The METRIC process requires calibration of the hot and cold pixel for each image processed. The calibration should be conducted near a primary weather station within the image. Therefore, a primary weather station was selected for each image path. The stations selected (Shafter (1993-1997) and Famoso (1998-2015)) were chosen on the basis of the stations’ history of reliable, relatively error-free data. Other reasons for choosing primary stations included:

- The location within intensive agricultural areas.
- Relatively representative of weather throughout the agricultural regions in the path.

Shafter was used as a primary station for the years 1993 through 1997. Famoso was used as a primary station for the remainder of the study period.

For the semi-automated calibration process, an area of interest (AOI) is created around the primary weather station. This AOI is generally within a 5 to 10 mile radius of the primary station and urban areas, or large non-agricultural areas are avoided. Figure 6 shows the calibration AOI for the Famoso CIMIS station.

![Figure 6. Famoso CIMIS station calibration area of interest (AOI)](image)

Elevation Data

A Digital Elevation Model (DEM) obtained from the USGS was used to adjust the model outputs based on the surface elevation throughout the area of interest. The DEM used had a resolution of 10m (1/3 arc second) which was then re-projected into a 30m × 30m pixel size to match the resolution of the LandSAT images.
Land Use Map

As previously mentioned, accurate land use/crop types are not necessary for ITRC-METRIC. General information on whether land is natural vegetation, row/field crops, orchards, or vineyards is used to adjust for aerodynamic resistance of the canopy, and is also a function of leaf area index. NASS CropScape provides sufficient accuracy for this information.

Land Use Data 2007 to Present

For years 2007 to present, only the land use data from the NASS annual rasters were used. While this information is sufficient for METRIC, there are issues with consistency within fields. Land use surveys were conducted by the California DWR on a field-by-field basis for all of the counties located in the Central Valley. DWR land use survey shapefiles were downloaded for each county, some of which may have last been surveyed in the 1990s. The shapefiles contain field boundaries or in some cases boundaries of the same crop that cover multiple fields. All non-agricultural areas in the DWR land use surveys were removed from the shapefile. Using the zonal statistics tool in ArcGIS, the NASS land use was summarized for each DWR agricultural field boundary in the Central Valley. The crop that made up the majority of the field area was assumed to cover the entire field area.

The final corrected land use maps went through a quality control check to ensure that a single land use value was uniform across an entire field. Figure 7 shows an example of the original uncorrected NASS land use compared to the land use used in this analysis, which is much more consistent. The inconsistent “pixelated” areas in the corrected land use were identified as non-cropped areas in the DWR land use survey. Therefore, these non-ag areas use the original NASS data.

Figure 7. Example original NASS land use (left) compared to corrected land use based on the majority crop type within each agricultural field (right). Each color identifies a different land use type (i.e., almonds, alfalfa, developed, etc.)
Land Use Data 1997 to 2006

The earliest NASS land use raster available for California is from 2007. The County of Kern Agriculture and Measurement Standards provides land use shapefiles only for agricultural fields in the county from 1997 to present. The shapefiles did not provide land use data outside of the agricultural fields. Therefore, information from the last available NASS land use raster (2007) was used to fill in the missing background. The following process was used to combine the two sources to create land use maps for 1997 through 2006:

1. The crop data for each individual field from the Kern County data was converted to a specific value to match the crop identification value used by NASS. For example, a field containing alfalfa in the Kern County data was converted to the NASS crop value of 16.
2. The Kern County shapefile, with the added NASS crop value, was then converted to a raster image to represent the crop value.
3. The DWR survey shapefile was used to quality control the 2007 NASS land use raster so that the raster values within the field boundaries were all uniform.
4. The new Kern County raster was then mosaicked with the corrected 2007 NASS raster. The land use values from the Kern County raster had top priority over the 2007 NASS values and therefore were utilized in the final land use raster. Then 2007 NASS values were used in the non-agricultural areas as well as the background portion of the image.

Figure 8. County of Kern agricultural land use fields (left). Combined County of Kern and NASS land use image (right)

Land Use Data 1993-1996

No land use data was available prior to 1997. Therefore, the final quality controlled 1997 land map was used for 1993 through 1996.
Interpolation between Image Dates

The selected images were processed, resulting in instantaneous actual crop coefficients (Actual Kc) on those dates for each pixel. The crop coefficient has been shown to remain constant during the majority of the daylight hours. Therefore, the instantaneous actual Kc was used as a surrogate for the daily actual Kc. In order to estimate the actual ETc between dates that images are available, actual Kc’s are interpolated between image dates. A modified cubic spline approach is used to examine images within the month to be computed, prior to that month, and after that month. For example, to interpolate the ETc in the month of July, the July image(s) would be used along with May and June, and August and September. Cubic spline interpolation provides a smooth, non-linear interpolation between image dates. The interpolation takes place for every pixel in the image and the results are temporary Kc images for every day in the month. The daily pixel actual Kc values are then multiplied by the daily corrected Spatial ETo to compute the daily actual ETc for each pixel. These daily ETc images are summed together for each month. Finally, the corrected Spatial ETo is summed for each month and the monthly ETc is divided by the ETo to generate the final monthly Kc image.

Monthly actual Kc and actual ETc results for Kern County for the period 1993-2016 have been provided to the Kern Groundwater Authority in GIS raster (image) format.

Accuracy of ITRC-METRIC ETc Estimates

Uncertainty is the quantification of accuracy in measurements and estimates. The most accurate method to estimate ETc is using a weighing lysimeter (correctly) but this is not feasible except in research situations. There are various methods that can be used to estimate ETc, each with different levels of uncertainty:

1. Traditional crop coefficient models (not used here but common in groundwater modeling) have uncertainty due to the assumptions that ETc is constant within a field and between fields in a region. Additionally, errors in land use determination (acreage of each crop), planting and harvest dates (or budbreak and dormancy for permanent crops), and crop management (irrigation, pruning, etc.) all impact the ETc uncertainty. Errors in weather data collection to determine grass reference ETo also impact the uncertainty. As a reference, uncertainties with crop coefficient methods are in the range of 20-25%.

2. Sensor-based measurements such as eddy covariance and surface renewal only measure a small footprint in a field and have potential for sensor errors due to improper calibration, loss of calibration over time, or sensor fouling. Additionally, the sensors must be adjusted, installed correctly, and some (e.g., surface renewal) depend on assumptions that may not hold. Data management and technical support make these infeasible when examining ETc over many fields.

3. NDVI-based ETc estimates have some advantages over (1) and (2) in that they provide spatial variation over a field and field to field. But these still rely on accurate crop surveys. Additionally, this method does not account for crop stress, unless that stress is so severe that it impacts the vegetative index. As with (1) above, the ETo errors translate to ETc uncertainty.

4. ITRC-METRIC ETc overcomes many of the issues with other methods, which is why it was developed. This method does not rely on accurate crop surveys. It also accounts for crop stress before it impacts the vegetation. Spatial variation in ETc throughout a field and between fields is accounted for. ETo continues to be an important part of ITRC-METRIC, which is why quality control of the data is important. In order to limit errors in ETo, ITRC conducts an extensive quality control of the weather station data and utilize spatially varied ETo to account for different climates within a region. As with other methods, it is imperative that the person doing the processing understands agronomic aspects.
within the region being evaluated. Errors in processing will generate errors in ETc estimation. All ITRC-METRIC images are reviewed by project managers with many years of experience in farming, irrigation, and crop water use estimation to ensure that the outputs are correct. This overcomes potential errors in LandSAT sensor data since each image is calibrated independently.

ITRC-METRIC uncertainty is estimated to be +/-7 to 10% in this study. On a large scale (GSA or county-wide ETc volumes) the error is on the lower end of this range. On a field scale, it may be on the upper end currently. We have continued to make improvements to our methodology and feel that in the future field-scale ETc will be on the lower end of the range provided. Additionally, the launch of LandSAT 9 (planned for December 2020) will improve the temporal resolution, providing images every 16 days, offset by 8 days from LandSAT 8 (potential for images on an 8 day interval). There are no other ETc computational methods available with uncertainties on both a large scale and field scale within these ranges.
Summary of Results

The annual results have been summarized for the Kern County Valley floor and the field boundaries (majority) within the Valley floor of Kern County. Figure 9 shows the boundaries used for the data extraction for the summaries discussed in this section. Average annual ITRC-METRIC ETc was extracted using the Zonal Statistics tool in ArcGIS. The average ETc from the extracted area was multiplied by the area within the boundaries (overall boundary or each field boundary for the fields) to compute volumes. Over the 23-year period, the field boundaries and overall boundary were the same.

![Figure 9. 2008 ETc image with Valley floor and field boundaries used for the summary analysis](image)

The volume of actual ETc for the overall area and only within fields is shown in Figure 10. For reference, the grass reference evapotranspiration (ETo) and precipitation from the Shafter CIMIS station (1992-1997) and Famoso CIMIS (1998-2015) are also shown. ET0 provides an idea of the weather conditions that drive evapotranspiration. Hotter, drier years have a higher ET0.

![Figure 10. Volume of ETc for overall area and only within fields](image)

Figure 11 shows the volume of ETc for all water districts in Kern County and Kern Groundwater Authority members. The acreage of all districts is greater than the “Valley Floor Area” because of district boundaries covering areas outside of the valley floor (e.g., West Kern W.D.). Some districts with
substantial overlap of other districts were removed from the evaluation to limit double counting. However, some minor overlap may cause the estimates to be slightly higher than the actual volume of ETc.

**Figure 10.** Annual volume of ETc for the Kern County Valley floor and within fields in Kern County. Grass reference ETo and precipitation depths are shown for each year as a reference.

**Figure 11.** Annual volume of ETc for irrigation/water districts in Kern County and just Kern Groundwater Authority member districts
Evaluation of ETc Variation

In general, there is an overall decline in ETc volume from the Valley floor starting over the 23 years that the ET analysis covers. The field ETc decline is not as significant but does trend downward. The difference between the Valley floor and field ETc is due to ET and evaporation occurring outside of field boundaries. Year to year variability in ETc volume might be explained by weather differences between years. To examine this, the data was normalized to exclude weather variation by examining the annual crop coefficient (Kc), computed as the actual ETc divided by ETo (ETo is computed based on weather data, not including precipitation). Annual Kc values are shown in Figure 12 for the study period (bar graphs) for the entire Kern valley floor area (includes urban, streets, undeveloped areas, etc.) and within fields only (only agricultural fields in the same area).

![Figure 12. Annual crop coefficient (Kc) for the Kern County Valley floor and within fields in Kern County. Reported Ag Commissioner total harvested acres per year on the right axis of the graph.](image)

As expected, the Kc is higher when only looking within field boundaries compared to the entire Valley floor of Kern County. Areas outside of the fields are in large part reliant on precipitation or are a mix of landscape and residential areas. Urban areas and open water are also included. As with the volume, there seems to be a general decline in overall Kc over the 23 years.

In the mid-2000s the Kc increases. Figure 12 also includes the Kern County Ag Commissioners total harvested acres over the 23 year period for reference and to possibly explain some of the variation. Interestingly, the Ag Commissioners’ total harvested acreage increases from 1993 to 2016. While there are some general trends indicating that the annual Kc increases as the acreage increases, the trends do not follow as closely as one might expect. This could be due to the types of crops harvested over the period or the age of permanent crops being grown. It is important to restate that crop types are not used to determine ETc using ITRC-METRIC. They are only shown here as a reference to potentially explain the variation in ETc.
To delve further into the theory that crop type shifts may explain ETc variation, crop acreages of the major crops in Kern County (Kern County Agricultural Commissioner Reports) are shown in Figure 13. The higher ETc and Kc values in the mid-2000s are likely due to the increase in alfalfa acreage during this period in combination with the higher almond acreage. However, the higher ETc and Kc values in the mid-1990s are more challenging to explain. Obviously there is more cotton acreage and likely more double cropping of different row crops (although cotton is not commonly double cropped). Other crops in the cotton rotations likely include double cropping, such as corn and grain hay, which are not shown.

![Figure 13. Crop acreage for major crops in Kern County from 1993-2016 (top) and total harvested acres (bottom) from Ag Commissioner Reports](image)

As previously discussed, the Kern County Ag Commissioner reports showed an overall increase in harvested acreage from 1993 to 2015. The Ag Commissioner reports showed the 1993 total harvested acres at approximately 809,700 compared to the 2015 harvested acreage of 881,000. Year-to-year variations are shown in Figure 12.
There are also some unexplainable anomalies in the Ag Commissioner data, such as the increase in almond acreage from 2013 to 2014. Figure 13 shows that total acres (bearing and non-bearing) for almonds increased by over 50,000 acres from 2013-2014. The bearing acreage showed the most significant increase from 2013 to 2014 even though only 1,600 acres of non-bearing trees were reported for 2013. The bottom line is that over 50,000 acres of bearing almonds showed up in 2014 without explanation. This could be due to an error in the Ag Commissioner’s reporting or a shifting methodology of accounting for certain crops.

The annual Kc by field in Kern County from ITRC-METRIC was plotted from lowest to highest Kc for four selected years (Figure 14). The fields with the lowest Kc would be fallow or young orchards/vineyards. Notice that there are more fields with Kc values below 0.2 in 2008 and 2015 than in 1993 or 1996. Of these, 1996 has the fewest low Kc fields while 2015 has the most. Different fields have different Kc values each of these years. The key point is that the lower Kc values in 2014 and 2015 (Figure 12) are likely driven down by increased fallowing or young orchards. Additionally, Figure 14 indicates that the overall field acreage was probably lower in 2015 than in 1993. While field acreage is not the same as harvested acreage because it does not account for double-cropping, it is unlikely that double cropping accounts for the full difference in reported acreage.

Visually, significantly more non-cropped fields can be seen in 2015 than in 1993 (Figure 15). Portions of Kern County (red circles which include portions of Lost Hills Water District, Buena Vista WSD, and Henry Miller WD) show much lower ET in 2015 than 1993. These areas were fallowed or not cropped during the drought. In other areas, new permanent crop plantings may be the cause of lower ET. Additionally, the Kern Lake and areas south of Bakersfield have much lower ET values indicating new permanent crops or fallowing.
Figure 15. Annual ITRC METRIC ET in 1993 (top) and 2015 (bottom) with field boundaries
Conclusion

Over the 1993-2016 period, the volume of evapotranspiration from fields within the valley floor of Kern County ranged from approximately 2-2.5 million acre-feet. Evapotranspiration varies year to year in the valley floor portion of Kern County. This is caused by several factors including weather, crop mix, water availability, precipitation, and land fallowing. It was beyond the scope of this study to investigate exactly why evapotranspiration varied. However, the previous figures indicate that there seems to be increased fallowing or young orchards and vineyards planted in more recent years, resulting in lower evapotranspiration in this period. This acreage reduction does not coincide with Kern County Ag Commissioner’s reported harvest acreage changes over the period.

The monthly and annual evapotranspiration and Kc imagery in GIS format has been transmitted to Kern Groundwater Authority.

Future Work

Net To/From Groundwater (NTFGW)

ITRC has developed a process to examine net groundwater use without the need to monitor groundwater pumping. This process is called the Net To and From Groundwater (NTFGW) and can be conducted at various scales from the farm/field, GSA, and Basin. This method incorporates surface water diversions, turnout deliveries (for farm/field scale), surface outflows, and precipitation with the monthly ETc to determine net groundwater use. Basically, if precipitation and surface water deliveries exceed ETc, the excess water would be stored in the root zone or moves to the groundwater (net to groundwater). If ETc exceed surface supplies, there is a net extraction from the groundwater to make up the difference. Results are provided spatially at the 30 meter pixel resolution. NTFGW is being used for two purposes:

1. Using historical data, to assist in calibration/verification of groundwater models. Equally important, the results provide a directly computed future ETc with net zero extraction.
2. For future management and regulation of groundwater use within the GSA. Monthly results will be provided to each GSA participant in near real-time (approximately 15 days after surface delivery information is provided to ITRC). Some GSAs are planning on providing this to farmers via a web mapping portal.

The benefits of NTFGW include:

- No groundwater metering program with meters at each well is needed. DWR has approved the method as a best-available science alternative.
- No estimates on irrigation efficiency are needed. Irrigation efficiency estimates have a high level of uncertainty, vary from field to field, and will change over time. NTFGW simplifies the evaluation of sustainable yield because inherently sustainable yield is a net value of how much groundwater can be consumed in a GSA. There is no need to estimate leaching requirements or other non-consumptive uses of groundwater. Comparing net values eliminates many uncertainties.
- It offers the ability to track net canal seepage and net recharge basin recharge by basin.
- It offers the ability to continuously track banked or over-drafted groundwater on a farm, district, and GSA level.
- It is cost-effective: the anticipated cost will be $30,000-$50,000 per year per district/GSA. Actual cost will depend on the district/GSA size and the level of evaluation.
**ITRC-METRIC ETc**

There are several options moving forward. ITRC-METRIC ETc will be an important tool. Over the past several years there have been lessons learned which will impact the process in the future:

1. Thermal sharpening has not been extensively used because it is time-consuming. However, ITRC is working on expediting this process. Currently, the thermal sharpening process increases the overall processing cost by a factor of 50%. It is expected that this cost will be reduced in the future. On a larger scale it is not important because the overall ETc is not increased or decreased. On a field level, it may be more important.

2. In the past we used at least 1 image per month to compute ETc. ITRC now uses all available good-quality images (mostly cloud/fog free, some cloud coverage is okay). Again, on a large scale (over a district for example) it is not as critical, but for individual fields, especially for row and field crops, it is critical to have images at least on a 16-day interval to capture harvests appropriately.

Future implementation of continuous ETc will be important for groundwater management in the Kern subbasin. The historical data generated as part of this project is being implemented in the groundwater modeling efforts in the subbasin. The next steps are towards monitoring sustainable use of the groundwater into the future. ITRC believes that NTFGW is the best methodology to monitor groundwater use since net groundwater use is more important than gross groundwater pumping. Pilot projects using NTFGW compared to groundwater pumping have been successfully implemented in a subbasin just north of Kern. ITRC would be pleased to share these results with interested parties.
Attachment J-4-2

List of Crop Salinity Thresholds Used for Leaching Estimate (JMLord)
<table>
<thead>
<tr>
<th>Crop</th>
<th>Salinity Threshold (dS/m)</th>
<th>Crop</th>
<th>Salinity Threshold (dS/m)</th>
<th>Crop</th>
<th>Salinity Threshold (dS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>2</td>
<td>Garlic</td>
<td>1.2</td>
<td>Pecans</td>
<td>1.5</td>
</tr>
<tr>
<td>Almonds</td>
<td>1.5</td>
<td>Garlic (Early)</td>
<td>1.2</td>
<td>Peppers</td>
<td>1.5</td>
</tr>
<tr>
<td>Almonds, Young</td>
<td>1.5</td>
<td>Grain Hay</td>
<td>6</td>
<td>Peppers (Late)</td>
<td>1.5</td>
</tr>
<tr>
<td>Apples</td>
<td>1.5</td>
<td>Grapefruit</td>
<td>1.7</td>
<td>Persimmons</td>
<td>1.5</td>
</tr>
<tr>
<td>Apricots</td>
<td>1.6</td>
<td>Grapefruit, Young</td>
<td>1.7</td>
<td>Pistachios</td>
<td>2.5</td>
</tr>
<tr>
<td>Apricots, Young</td>
<td>1.6</td>
<td>Grapes</td>
<td>1.5</td>
<td>Pistachios, Young</td>
<td>2.5</td>
</tr>
<tr>
<td>Artichokes</td>
<td>1</td>
<td>Irrigated Pasture</td>
<td>4</td>
<td>Pistachios Standard</td>
<td>2.5</td>
</tr>
<tr>
<td>Barley</td>
<td>8</td>
<td>Jojoba</td>
<td>1.7</td>
<td>Plums</td>
<td>1.5</td>
</tr>
<tr>
<td>Beans (Blackeye)</td>
<td>1.3</td>
<td>Kiwi</td>
<td>1.5</td>
<td>Plums, Young</td>
<td>1.5</td>
</tr>
<tr>
<td>Beans (Dry)</td>
<td>1</td>
<td>Lettuce (Fall)</td>
<td>1.3</td>
<td>Potatoes</td>
<td>1.7</td>
</tr>
<tr>
<td>Beans (Green)</td>
<td>1</td>
<td>Lettuce (Spring)</td>
<td>1.3</td>
<td>Pumpkins</td>
<td>2.2</td>
</tr>
<tr>
<td>Berries</td>
<td>1.5</td>
<td>Melons</td>
<td>2.2</td>
<td>Radishes</td>
<td>1.2</td>
</tr>
<tr>
<td>Broccoli (Fall)</td>
<td>2.8</td>
<td>Melons (Early)</td>
<td>2.2</td>
<td>Rice</td>
<td>3</td>
</tr>
<tr>
<td>Broccoli (Spring)</td>
<td>1.8</td>
<td>Melons, cucumbers, squash</td>
<td>2.2</td>
<td>Safflower</td>
<td>5.3</td>
</tr>
<tr>
<td>Bushberries</td>
<td>1.5</td>
<td>Milo (Sorghum)</td>
<td>6.8</td>
<td>Safflower (Early)</td>
<td>5.3</td>
</tr>
<tr>
<td>Bushberries, Young</td>
<td>1.5</td>
<td>Misc. Deciduous</td>
<td>1.7</td>
<td>Safflower (Late)</td>
<td>5.3</td>
</tr>
<tr>
<td>Cabbage (Fall)</td>
<td>1.8</td>
<td>Misc. Field</td>
<td>6</td>
<td>Silage (Early)</td>
<td>6.8</td>
</tr>
<tr>
<td>Cabbage (Spring)</td>
<td>1.8</td>
<td>Misc. Hay &amp; Grain</td>
<td>6</td>
<td>Silage (Late)</td>
<td>6.8</td>
</tr>
<tr>
<td>Cactus</td>
<td>4</td>
<td>Misc. Subtropical Fruits</td>
<td>1.7</td>
<td>Small Grains</td>
<td>6</td>
</tr>
<tr>
<td>Cantaloupes</td>
<td>2.2</td>
<td>Misc. Subtropical Fruits, Young</td>
<td>1.7</td>
<td>Sod</td>
<td>4</td>
</tr>
<tr>
<td>Carrots (Fall)</td>
<td>1</td>
<td>Misc. Trees</td>
<td>1.7</td>
<td>Spinach</td>
<td>1.2</td>
</tr>
<tr>
<td>Carrots (Spring)</td>
<td>1</td>
<td>Misc. Truck/Berry</td>
<td>1.5</td>
<td>Squash</td>
<td>2.5</td>
</tr>
<tr>
<td>Cauliflower (Fall)</td>
<td>1.8</td>
<td>Misc. Veg.</td>
<td>1.2</td>
<td>Strawberries</td>
<td>1</td>
</tr>
<tr>
<td>Cauliflower (Spring)</td>
<td>1.8</td>
<td>Mixed Hay &amp; Grain</td>
<td>6</td>
<td>Sudan Grass</td>
<td>2.8</td>
</tr>
<tr>
<td>Celery</td>
<td>2.2</td>
<td>Native Pasture</td>
<td>6</td>
<td>Sugar Beets</td>
<td>7</td>
</tr>
<tr>
<td>Cherries</td>
<td>1.5</td>
<td>Nectarines</td>
<td>1.7</td>
<td>Sunflowers</td>
<td>5.3</td>
</tr>
<tr>
<td>Cherries, Young</td>
<td>1.5</td>
<td>Nursery Roses</td>
<td>0</td>
<td>Sweet Corn (Early)</td>
<td>1.7</td>
</tr>
<tr>
<td>Christmas</td>
<td>1.5</td>
<td>Oats</td>
<td>6</td>
<td>Sweet Corn (Late)</td>
<td>1.7</td>
</tr>
<tr>
<td>Citrus (All)</td>
<td>1.7</td>
<td>Onions &amp; Garlic</td>
<td>1.2</td>
<td>Sweet Potatoes</td>
<td>1.5</td>
</tr>
<tr>
<td>Cole Crops (Fall)</td>
<td>2.3</td>
<td>Onions (Early)</td>
<td>1.2</td>
<td>Tomatoes</td>
<td>2.5</td>
</tr>
<tr>
<td>Cole Crops (Spring)</td>
<td>2.3</td>
<td>Onions (Late)</td>
<td>1.2</td>
<td>Tomatoes (Late)</td>
<td>2.5</td>
</tr>
<tr>
<td>Corn – Fall</td>
<td>1.7</td>
<td>Oranges</td>
<td>1.7</td>
<td>Turf Farm</td>
<td>4</td>
</tr>
<tr>
<td>Corn – Spring</td>
<td>1.7</td>
<td>Oranges, Young</td>
<td>1.7</td>
<td>Turnip</td>
<td>1</td>
</tr>
<tr>
<td>Cotton</td>
<td>7.7</td>
<td>Parsnips</td>
<td>1</td>
<td>Vineyards</td>
<td>1.5</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td>8</td>
<td>Peaches</td>
<td>1.7</td>
<td>Vineyards, Young</td>
<td>1.5</td>
</tr>
<tr>
<td>Eggplant</td>
<td>1.1</td>
<td>Peaches &amp; Nectarines</td>
<td>1.7</td>
<td>Walnuts</td>
<td>1.7</td>
</tr>
<tr>
<td>Figs</td>
<td>2.7</td>
<td>Peaches &amp; Nectarines, Young</td>
<td>1.7</td>
<td>Watermelon</td>
<td>2.2</td>
</tr>
<tr>
<td>Flowers &amp; Nursery</td>
<td>2.5</td>
<td>Pears</td>
<td>1.5</td>
<td>Wheat</td>
<td>6</td>
</tr>
</tbody>
</table>
Appendix J-5

Water Budget Model Calibration
This appendix documents the processes used to calibrate the Arvin-Edison Water Storage District (AEWSD) long-term water budget spreadsheet model and reports the final water budget calibration results.

**Calibration Process**

As described in Appendix J-1, the water budget model is a spreadsheet-based tool that quantifies 36 individual hydrologic flow “components” and then uses mass balance principles to link components and calculate a residual change in storage from the groundwater system at a monthly timestep.

Included in the water budget spreadsheet model are various “User Input Parameters” that can be adjusted to improve model performance. Values for these adjustable parameters were initially set to reasonable values based on review of previous relevant studies and local information, where possible (see Appendices J-1 through J-4), and were subsequently adjusted to minimize the difference between model-calculated change in storage and the change in storage derived from rasterized groundwater elevation monitoring data.

**Development of Groundwater Storage Change Rasters**

The change in groundwater storage was estimated within the District’s SGMA jurisdictional area1 between various time periods using local groundwater elevation data provided by the District2 along with data downloaded from the DWR’s “CAGEM” portal. Local groundwater level data within and proximate to the District boundaries were interpolated using kriging3 to create continuous groundwater elevation surfaces (rasters) for several “bookend” years of interest within the water budget period4. Interpolated water level surfaces were subsequently compared between bookend years to calculate the change in storage, as follows:

\[
GW\ Storage\ Change_{t1 \to t2} = (GWEL_{t2} - GWEL_{t1}) \times \text{Specific\ Yield}
\]

where GWEL is the groundwater elevation and the subscripts t1 and t2 refer to the beginning and ending bookend years, respectively. For the purposes of this analysis, a uniform specific yield value of 0.08 was used.

---

1 AEWSD’s “SGMA jurisdictional area” includes the portions of the District within the Kern Groundwater Authority Groundwater Sustainability Agency (KGA GSA) area within the Kern Subbasin and all portions of the District within the White Wolf Subbasin.

2 Local groundwater level data also included records from Wheeler Ridge-Maricopa Water Storage District (WRMWSD) for wells located in the AEWSD-WRMWSD “overlap area”.

3 Data were interpolated using kriging, a geostatistical method commonly used to interpolate groundwater elevation data, in the software package Surfer. The output of this interpolation process is a raster file with 100-ft by 100-ft pixels, which can be subtracted from or multiplied by other raster files covering the same area, and for which total volume can be calculated.

4 The interpolated surfaces vary significantly depending on which well data sets are used. Based on significant analysis, we have more confidence in the change in storage estimates generated from surfaces constructed using groundwater elevation data from paired and/or “nearby” wells within a 1-mile buffer radius between each other between datasets (i.e., when groundwater elevation data from each season and year were only selected if the same well or a “nearby” well also had a measurement for the other season and year used for the storage change analysis). Use of the full dataset would allow for greater data density in each bookend year, but, because of historically variable groundwater monitoring patterns, the groundwater storage change estimates are then impacted by changes in monitoring locations.
used to calculate groundwater storage change from the rasterized water level data, in line with the representative average specific yield value of the unconfined aquifer (i.e., Layer 1) within the District used in DWR’s California Central Valley Groundwater-Surface Water Simulation model, “fine-grid” Beta version (C2VSim-FG)\(^5\).

Using this approach, groundwater storage change was calculated within the District’s SGMA jurisdictional area for the following five periods, each of which representing unique timescales and/or climatic conditions within the historical/current water budget time period:

- Spring 1994 – Spring 2015 (entire KGA water budget period)
- Spring 1994 – Spring 2007: (representative long-term “wet” period)
- Spring 2007 – Spring 2015: (representative long-term “dry” period)
- Spring 2009 – Spring 2011: (representative short-term “wet” period)
- Spring 2014 – Spring 2015: (representative short-term “dry” period)

**Water Budget Calibration to Change in Storage Rasters**

User input parameters specified within the water budget spreadsheet model (see Appendix J-1) were subsequently adjusted within reasonable limits to improve the fit between the water budget-calculated change in storage and the water level-based change in storage estimates for each of the five time periods mentioned above\(^6\).

First, a sensitivity analysis was conducted to determine the most “critical” user input parameters (i.e., those that have the greatest effect on the water budget) for adjustment during model calibration. The most “critical” input parameters identified were those related to subsurface inflows and outflows, streamflow, and contributing precipitation to the District, including:

- **Hydraulic conductivity of the aquifer along the District’s western boundary** (i.e., the AEWSD-Kern Delta Water District [KDWD] boundary), which controls the rate of groundwater inflows/outflows between the District and KDWD (see Appendix J-3);
- **Hydraulic conductivity of the aquifer near the White Wolf Fault**, which controls the rate of groundwater flux across the fault (see Appendix J-3);
- **Watershed Consumptive Use Fraction and Watershed Precipitation Threshold for Runoff**. These parameters determine the amount of precipitation on contributing watersheds that runs off and becomes streamflow recharge within the District service area (see Appendix J-2);

---

\(^5\) C2VSim-FG beta is the latest release of C2VSim from DWR and is currently being used for SGMA planning and GSP development within the Kern Subbasin. Note, this model is currently uncalibrated. C2VSim input files downloaded 13 June 2018 from: [https://data.cnra.ca.gov/dataset/c2vsimfg-beta-model](https://data.cnra.ca.gov/dataset/c2vsimfg-beta-model)

\(^6\) March 1\(^{st}\) was chosen as the representative date for which to compare “Spring” water level data to within the water budget model spreadsheet.
• **Ineffective Precipitation Deep Percolation Coefficient.** This parameter controls how much ineffective precipitation is expected to percolate back into the groundwater subdomain, with the remainder assumed to evaporate from the wetted land surface (see Appendix J-4).

The above parameters were used as the primary calibration parameters to achieve an acceptable fit with the storage change estimated using the water level change method. Calibration was conducted by systematically adjusting the values of these key parameters to try to minimize the difference (in terms of root-mean-squared error [RMSE]) between the “observed” (i.e., based on water level records) change in storage for a given time period and the water budget model-calculated change in storage. Other user input parameters are less sensitive and were therefore left at their initial values in the final calibration.

**Calibration Results**

Table J-5-1 below reports the final calibrated values of each “User Input Parameter” included in the water budget model spreadsheet. Parameters listed in **bold** are those whose values were adjusted during the calibration process; all other parameters were held at their initial values during calibration.

<table>
<thead>
<tr>
<th>User Input Parameter</th>
<th>Calibrated Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwestern Boundary Hydraulic Conductivity (ft/day) (^1)</td>
<td>5</td>
</tr>
<tr>
<td>Southwestern Boundary Hydraulic Conductivity (ft/day) (^1)</td>
<td>5</td>
</tr>
<tr>
<td>White Wolf Fault Hydraulic Conductivity (ft/day) (^1)</td>
<td>3</td>
</tr>
<tr>
<td>Kern Watershed Consumptive Use Fraction (-)</td>
<td>0.98</td>
</tr>
<tr>
<td>Kern Watershed Precipitation Threshold for Runoff (in)</td>
<td>0.75</td>
</tr>
<tr>
<td>White Wolf Watershed Consumptive Use Fraction (-)</td>
<td>0.95</td>
</tr>
<tr>
<td>White Wolf Watershed Precipitation Threshold for Runoff (in)</td>
<td>0.5</td>
</tr>
<tr>
<td>Ineffective Precipitation Deep Percolation Coefficient</td>
<td>0.2</td>
</tr>
<tr>
<td>Irrigation Efficiency Coefficients (-)</td>
<td>Variable, ranging from 0.65 for furrow to 0.85 for micro-drip</td>
</tr>
<tr>
<td>Deep Percolation Lag Period (months)</td>
<td>11</td>
</tr>
<tr>
<td>Spreading Basin Lag Period (months)</td>
<td>3</td>
</tr>
<tr>
<td>Leaching Water EC (uS/cm)</td>
<td>500</td>
</tr>
<tr>
<td>Artificial Channel Seepage Rate (ft/day)</td>
<td>0.01</td>
</tr>
<tr>
<td>Additional Operational Demands (AFY/irrigated acre)</td>
<td>0.16</td>
</tr>
<tr>
<td>M&amp;I Consumptive Use Fraction (-)</td>
<td>1</td>
</tr>
<tr>
<td>Natural Channels Seepage Fraction (-)</td>
<td>1</td>
</tr>
</tbody>
</table>
### Abbreviations:
- AFY = acre-feet per year; EC = electrical conductivity; ft/day = feet per day; in = inches; M&I = municipal and industrial; uS/cm = microSiemens per centimeter;

### Notes:
1. The hydraulic conductivity values for the northwestern and southwestern District boundaries in the Kern Basin and the White Wolf Fault function were adjusted as calibration parameters for the groundwater inflow/outflow components. Other factors affecting this component (i.e., vertical saturated thickness of the inflow/outflow boundary) are assumed to be fixed for the purposes of calibration.

**Table J-5-2 and Figure J-5-1 (attached) present the results of the water budget model calibration in terms of the water budget spreadsheet model-calculated change in storage compared to the change in storage estimated using the water level change method for all five calibration periods mentioned above.**

**Table J-5-2. Water Budget Calibration Results to Raster-Based Storage Change Estimates**

| Time Period | Rationale for Selection of Time Period Employed for Model Calibration | Average Annual Groundwater Storage Change Calculated from Water Level Rasters (AFY)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 1994 – Spring 2015</td>
<td>Entire KGA Water Budget Period</td>
<td>-5,400 (-2,300) 3,100</td>
</tr>
<tr>
<td>Spring 1994 – Spring 2007</td>
<td>A representative long-term “wet” period</td>
<td>32,700 42,200 9,500</td>
</tr>
<tr>
<td>Spring 2007 – Spring 2015</td>
<td>A representative long-term “dry” period</td>
<td>-73,700 (-74,700) -1,000</td>
</tr>
<tr>
<td>Spring 2009 – Spring 2011</td>
<td>A representative short-term “wet” period</td>
<td>17,300 41,000 23,700</td>
</tr>
<tr>
<td>Spring 2014 – Spring 2015</td>
<td>A representative short-term “dry” period</td>
<td>-157,500 (-164,000) -6,500</td>
</tr>
</tbody>
</table>

**Notes:**
1. March 1st was chosen as the representative date for which to compare “Spring” water level data to within the water budget model spreadsheet.
2. Results shown are rounded to the nearest 100 AFY.
3. Storage change estimates are calculated assuming a uniform storage coefficient of 0.08.
Table J-5-2 and Figure J-5-1 demonstrate the successful calibration of the water budget spreadsheet model to change in storage estimates deduced from the water level change method. Adjustment of the “critical” user input parameters resulted in a model calibration with a RMSE between “observed” and model-calculated annual change in storage of 11,900 AFY when considering all five calibration targets, and 5,800 AFY when only considering the three long-term calibration targets (i.e., Spring 1994 – 2015, 1994 – 2007, and 2007 – 2015). For context, the residuals in calculated vs. “observed” change in storage estimates for the three long-term periods (approximately -1,000 to 23,700 AFY) represent 0.35% to 8.16% of the total annual average inflows into the District, thus demonstrating the spreadsheet model’s accuracy in simulating long-term changes in groundwater storage relative to the total magnitude of the water budget domain.

Figure J-5-2 (attached) demonstrates the water budget-calculated change in water levels\(^7\) relative to a set of long-term hydrographs compiled from the District’s local groundwater elevation records. This figure further demonstrates the general agreement between observed and model-calculated changes in water levels, both in terms of magnitude and directionality, throughout the 22-year water budget timeframe.

---

\(^7\) The model-calculated change in water levels is based on the model-calculated change in storage and an assumed storage coefficient value of 0.08.
Comparison of Modeled & Water Level-Based Estimated Change in Storage

Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure J-5-1

Notes
1. Calibration of the water budget spreadsheet model was performed for the District's entire service area, including the portion within the White Wolf Subbasin.
Observed vs. Modeled Change in Water Levels, WY 1995 - 2015
Arvin-Edison Water Storage District
Kern County, California
December 2019
EKI B60064.01
Figure J-5-2
Appendix J-6

Overview of Projected Water Budget Models
APPENDIX J-6
OVERVIEW OF PROJECTED WATER BUDGET MODELS

As described in Appendix J-1, results from the historical and current (California Department of Water Resources [DWR] Water Years 1994 – 2015) analytical water budget were subsequently used to inform development of three projected (i.e. future) water budget scenarios for the Arvin-Edison Kern Subbasin Management Area. These scenarios are consistent with the Kern Subbasin-wide projected water budget modelling effort that AEWSD is participating in as a member of the KGA. A basic description of the projected water budget model assumptions and framework is provided below.

Description of Projected Water Budget Timeline

As described in Section 9.4.1. of the Arvin-Edison Kern Subbasin Management Area Plan, per 23-CCR § 354.18(e)(2)(A), the projected water budgets must use 50 years of historical precipitation, evapotranspiration, and streamflow information as the basis for evaluating future conditions under baseline and climate-modified scenarios. The process by which a 50-year period of precipitation, evapotranspiration and streamflow information was developed is based on the process adopted by all GSAs within the Basin, as described in the KGA Umbrella GSP and Appendix XX of the Coordination Agreement. That process is briefly summarized here.

To develop the required 50 years-worth of hydrologic input information, first an “analog period” was created from the 20 years-worth of historical information (DWR Water Years 1995-2014) by combining the years in a specific way that, on average, maintained the long-term average hydrologic conditions. This approach, which was used for both the spreadsheet water budget model approach and the basin-wide C2VSim-FG modeling approach, allowed for the creation of a complete 50-year period to inform the projected water budget analysis, even when certain component datasets were not available for that length of time. The sequence of actual years that were combined to create the 50-year analog period is as follows:

- Analog Years 1-12: Based on actual years 2003-2014
- Analog Years 13-32: Based on actual years 1995-2014
- Analog Years: 33-50: Based on actual years 1995-2012

The above mapping of actual years to analog years within the required 50-year projected water budget period applies to precipitation and ET datasets. It also applies to datasets of imported surface water and exports to MWD with some additional modifications as described in the following section.

Description of Projected Water Budget Scenarios

As described in Section 9.4.2. of the Arvin-Edison Management Area Plan, using the 50-year analog period, three projected water budget scenarios were developed for this analysis:

- **Baseline Scenario** – uses “the most recent water supply information as the baseline condition for estimating future water supply”, per 23-CCR § 354.18(e)(2)(C);
- **2030 Climate Change Scenario** – uses 2030 climate change factors developed by DWR and the Friant Water Authority to estimate future water supplies, changes to precipitation and evapotranspiration; and
• **2070 Climate Change Scenario** – uses 2070 climate change factors developed by DWR and the Friant Water Authority to estimate future water supplies, changes to precipitation and evapotranspiration.

Development of the three scenarios was done consistent with the agreed-upon process being used basin-wide. Further details of the scenario development are contained within Section 9.4.2. of the Arvin-Edison Management Area Plan, in the KGA Umbrella GSP, and in Appendix XX of the Coordination Agreement.

**Description of Projected Water Budget Model Framework**

A projected water budget was developed for each of the three scenarios described above under the same framework and methodologies used to develop the historical and current water budget model. Given the scope of this effort was limited to completion of water budget requirements for the Arvin-Edison Management Area Plan, projected scenarios were only developed for the portion of AEWSD contained within the Kern Subbasin.

**Building the 50-year Analog Period**

As described above, a 50-year “analog” period was first created using partial repeats of the 20-year historical AEWSD water budget model (DWR Water Years 1995 – 2014) for the development of projected water budget scenarios. This was accomplished in the “master” projected water budget tabs of the spreadsheet model (see Appendix J-1) by creating a 50-year monthly sequence (i.e., 600 months) where, for any given month, each water budget component within the spreadsheet model directly referenced the analogous “analog” month of the historical Kern budget.

**Applying Change Factors**

After the 50-year “analog period” was replicated in the projected water budget “master” tabs, monthly change factors were applied to selected water budget components to incorporate projected changes to surface water supply availability, as well as precipitation and evapotranspiration intensity under each of the (3) projected water budget scenarios. These monthly change factors were provided directly from the KGA and are being used for the Basin-wide C2VSim-FG projected water budget effort. In summary, the following change factors were applied to the AEWSD projected water budget model:

- Changes to State Water Project (SWP) imports, based on data from DWR’s CalSim water resources planning model and the 2008/2009 Long-Term Operations Criteria and Plan (OCAP) Biological Opinion;
- Changes to Friant Kern Canal Imports, based on Friant Water Authority (FWA) modeling projections;

---

1 For more information see Section 9.4.2. of the Arvin-Edison Kern Subbasin Management Area GSP Chapter, the KGA Umbrella GSP, and in Appendix XX of the Coordination Agreement
• Changes to Kern River supplies, based on data from DWR’s CalSim water resources planning model4;
• Changes to precipitation and evapotranspiration, based on DWR’s “gridded change factors for precipitation and reference evapotranspiration” for 2030 and 2070 climate change projections5.

Change factors were provided by KGA either as a monthly multiplier to each analog month within the projected water budget period, or in the case of the FWA projections, as direct estimates of projected monthly deliveries to AEWSD. These change factors were applied to their respective water budget components within the AEWSD projected water budget models to evaluate the projected impacts to groundwater storage underlying the District given the estimated changes to surface water supply availability and climate under each projected scenario.

**Applying Additional Surface Water Supply Adjustments**

As described in Sections 9.4.3.-9.4.4. of the Arvin-Edison Management Area Plan, two additional adjustments were applied to the AEWSD projected water budget models in addition to the change factors described above:

1) After applying climate change factors, all non-Friant Kern Canal surface water imports were further halved in each scenario, to account for potential reduced availability of non-contract surface water supplies historically acquired by AEWSD via transfer/exchange/purchase (see Section 9.4.3. for details); and
2) For the baseline and 2030 scenarios, an additional **153,000 AF** was exported to Metropolitan Water District (MWD) over the 50-year period to simulate return of the existing “balance” of MWD supplies in AEWSD’s groundwater bank as of February 2019 (see Section 9.4.4. for details).

**Modeling Projects & Management Actions**

After developing the projected water budget scenarios through the methodologies described above, the approximate groundwater storage deficits resulting from each projected scenario (see Table WB-6) were used to inform the development of Projects and Management Actions (P&MA) for the Arvin-Edison Kern Subbasin Management Area. These proposed P&MAs were subsequently simulated under the 2030 and 2070 projected water budgets to assess how proposed P&MA implementation would address the groundwater storage change deficits identified from the model (see Table WB-7).

P&MAs were incorporated in the model as either (1) increases in surface water deliveries to the irrigated portion of the District, to simulate supply augmentation benefits, or (2) reductions in evapotranspiration from irrigated lands, to simulate demand reduction benefits. Both surface water supply augmentation and demand reduction P&MAs were applied uniformly for each year of the projected water budget model scenarios, so as to simulate the projected impacts of “full P&MA implementation” under each scenario. For each year, additional surface water supplies were delivered on a monthly basis according to AEWSD’s average historical monthly delivery patterns, whereas reductions in evapotranspiration were performed in line with the average historical breakdown of monthly ET within the irrigated portion of the District.

---

4 Ibid [2].
5 [https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f86f75e8-0de6-4232-968d-8352116496e](https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f86f75e8-0de6-4232-968d-8352116496e)
Appendix K

AEWSD CASGEM Monitoring Plan
# Table of Contents

1. Introduction ........................................................................................................................................... 3

2. Background ............................................................................................................................................... 3
   a. Location ........................................................................................................................................... 3
   b. Topography ....................................................................................................................................... 3
   c. Groundwater ....................................................................................................................................... 3
   d. Groundwater Basin Description ........................................................................................................ 4
   e. Physical Structure ............................................................................................................................... 4
   f. Historic Groundwater Levels ............................................................................................................. 5
   g. District Aquifer Characteristics .......................................................................................................... 5

3. Well Water Level Monitoring Network ................................................................................................ 6

4. Network Data Gaps ................................................................................................................................. 6

5. Monitoring Schedule ............................................................................................................................. 7

6. Description of Field Methods ................................................................................................................ 8

7. Well Location Surveys ............................................................................................................................ 8

Figure 1: Monitoring Well Locations ........................................................................................................... 9
Figure 2: Hydrograph of Water Level Fluctuations at Sycamore Well #1 .................................................. 10
Figure 3: Average Static Groundwater Depth in District ............................................................................ 11
Figure 4: Field Well Measurement Form .................................................................................................. 12
Figure 5: Monitoring Well Table ............................................................................................................... 13
1. Introduction

The Arvin-Edison Water Storage District (AEWSD or District) has notified the Department of Water Resources (DWR) that it intends to be a monitoring entity pursuant to the California Statewide Groundwater Elevation Monitoring (CASGEM) program. This monitoring plan discusses the characteristics of the groundwater basin, historic water levels, monitoring schedule, and field methods, and is intended to meet the requirements for monitoring groundwater levels pursuant to the CASGEM program.

2. Background

a. Location

AEWSD is situated at the extreme southern end of the San Joaquin Valley in California and approximately 14 miles southeast of the City of Bakersfield. The District lies mostly south of Highway 58 on the southern side of the Kern River.

b. Topography

The District lands overlie alluvial fans and cones (a piedmont alluvial plain) built up by the Kern River, the streams of the Caliente Creek group, and the southern stream group, that drain from the westerly slope of the Sierra Nevada and Tehachapi Mountains across the District’s east and southern boundaries. Land elevations vary from below 400 feet at the west edge of the District to 1,000 feet at points along the east boundary. Prevailing land slopes are approximately 66 feet per mile southwesterly in the north end of the District, about 30 feet per mile westerly in the north central portion and approximately 44 feet per mile northwesterly in the south half of the District.

c. Groundwater

Groundwater is found underlying essentially all parts of the District. Groundwater management within the District is rooted in the conjunctive use of surface water and groundwater resources, since water supplies from these two sources are integrated to accomplish optimum utilization of each supply. District landowners have conjunctively used imported surface water supplies with groundwater since the completion of the District’s irrigation distribution system facilities in the 1960’s. Since the availability of most of the imported water supply is extremely erratic, the District devised a plan of conjunctive use where the underlying groundwater reservoir is utilized directly for seasonal and long-term carry-over storage. Because of this, the District’s distribution system, from the beginning, has incorporated recharge basins and District-owned extraction wells to capture, store, and recover wet period water for later use during dry periods.
d. Groundwater Basin Description

The District lies within the southeastern portion of the Kern County Sub-basin of the San Joaquin Valley Basin (Basin 5-22.14). The Kern County Sub-basin has been identified by the DWR as a basin with boundaries appropriate for groundwater management purposes, as defined in DWR Bulletin 118 “Ground Water Basins in California.” Bulletin 118 Basin boundaries are identified on the basis of geological and hydrological conditions as well as political boundary lines.

The Kern County Basin extends from the Sierra Nevada foothills on the east to the eastern boundary of the San Luis Obispo/ Santa Barbara County line on the west, and from the Southern boundary of Tulare/ Kings County line on the north to the northern boundary of the Santa Barbara/ Ventura/ Los Angeles County line on the south.

e. Physical Structure

The Kern County Basin is a large, deep asymmetric sedimentary basin consisting of deep depositional centers separated by a basement feature known as the Bakersfield Arch; located generally along the Kern River. The San Joaquin basin is bordered on the south and east by the crystalline igneous and metamorphic rocks exposed in the Sierra Nevada, Tehachapi, and San Emigdio Mountains. These rocks also underlie the basin at depth and are considered to be non-water bearing. Overlying these rocks is a thick sequence of consolidated marine sedimentary rocks exposed in the Coast Ranges to the west and the San Emigdio Mountains to the south and extending eastward to lap onto the crystalline rocks of the Sierra Nevada. The consolidated marine sedimentary deposits play no significant role in the developed part of the groundwater basin.

Miocene to Pleistocene-aged continental sediments overlies the marine sedimentary rocks in the basin. These sediments are several thousand feet thick in the subsiding portions of the basin but considerably thinner where deposited on and draped over the Bakersfield Arch. In the west, these continental sediments form the Tulare Formation, a thick sequence of water-lain sands, silts, and clays exposed along the western side of the San Joaquin Valley and in the Elk Hills. In the east, continental sediments form the Kern River Formation; a westward thickening series of sands, conglomerates, and mudstones.

The geology and groundwater features of the District area were studied by the USGS and DWR in the late 1950’s. Results were summarized in Geological Survey Water-Supply Paper 1656. While the field of geology has advanced tremendously since it was published, Water Supply Paper 1656 contains the last
comprehensive mapping of the geology of the area. Also, USGS Water Supply Paper 1469, while covering a much larger area than the District, also provides significant comprehensive information on the geology and hydrology for that area. There are also two faults (or fault zones) within the District, the White Wolf (southern portion) and the Edison (northern portion).

f. Historic Groundwater Levels

Included as Figure 2 is a long-term hydrograph of a well located at District Headquarters. As seen in Figure 3, the effect of District operations, which were initiated on July 1966, is reflected by a general stabilization of groundwater levels by the late 1970’s, and significant recovery since then. The water level decline shown to have occurred during the pre-project period represents a continuation of the average annual long-term decline in groundwater levels of 7 to 8.5 feet per year throughout most of the District. Under non-project conditions, it is estimated that by the end of the 2010, assuming the same amount of water that was imported was, instead, pumped from the aquifer, pumping season average static groundwater depths in the District area would have been approximately 646 feet depth to water, instead of the actual 360 feet. This represents a higher groundwater table of 286 feet.

Based on water level measurements in the District’s wells collected in December 2010, average static water level depths below ground surface at the District’s spreading grounds were as follows: 383 feet at the North Canal basins, 386 feet at the Sycamore Basins, and 376 feet at the Tejon Basins.

g. Aquifer Characteristics

The District’s aquifer was essentially formed out of a series of coalescing alluvial fans that have been formed by streams channeling from the southernmost Sierra Nevada Mountains, Tehachapi Mountains and San Emigdio Mountains. The relatively coarse-grained alluvial deposits along the margins of the basin grade into more fine-grained deposits in the central portion of the basin. The aquifers include (from shallowest to deepest) recent alluvial deposits, older Pleistocene alluvium and the late-Tertiary Kern River and Chanac Formations. These deposits range from about 800 to 4,800 feet thick in the District. Within the District, the upper 260 to 580 feet is older and younger alluvium primarily consisting of discontinuous beds of sand, silt, clay and gravel deposited on alluvial fans. These deposits are generally coarser at the apices of the fans and become finer-grained toward the center of the valley. The Kern River Formation consists of coarse to fine grained sand and sandy clay with lenses of gravels and cobbles. The Chanac Formation consists of continental conglomerate deposits with lenses of coarse sand and clays.

In addition, two faults, or “fault zones” that traverse the District are the White Wolf and Edison Faults. These faults are believed to impede groundwater flow
and affect the movement from one side of the fault to the other. A small portion of the District lies north of the Edison Fault. Another relatively large area lies south of the White Wolf Fault. A major portion of the District lies between the two faults and comprises the majority of the District area.

While these faults do appear to provide some impediment to groundwater flow across these faults, this is a subject that may merit additional study in the future. In this regard, there has been some more recent work done in this area, such as a thesis prepared by Karin Hagan1. This thesis studied the White Wolf fault zone, and concluded that groundwater elevation data indicate that the fault is a “partial barrier” to groundwater flow. An analysis of groundwater quality data found little difference in water quality on either side of the fault.

In many portions of the San Joaquin Valley, the Corcoran Clay separates a generally unconfined aquifer system above and a confined aquifer system below. The District area and immediately neighboring areas are believed to be situated too far south for this regional confining layer to be present. However, there are other relatively fine-grained materials beneath the District that cause varying levels of confinement within different locations in the District. This confinement tends to be more pronounced towards the more central portions of the District.

3. Well Water Level Monitoring Network

The District attempts to monitor levels with approximately 230 wells distributed over about 200 square miles. The vast majority of these are privately owned production wells. The District maintains approximately 70 privately owned dedicated monitoring wells. These monitoring wells are evenly dispersed throughout the District and are utilized for bi-annual groundwater contour maps and other essential activities (i.e. budget process). The District owns, operates and maintains 76 operational wells for water supply needs. The majority of District wells are located within or near spreading basins.

Figure 1 illustrates the 40 wells that will be monitored as part of CASGEM (12 CASGEM and 28 voluntary wells). CASGEM wells have construction details whereas voluntary well currently do not have construction details.

4. Network Data Gaps

Due to the difficulty of obtaining landowner permission for the use of well construction details for the CASGEM system, 28 of the 40 wells are designated as voluntary.

---

1 “The Effects of the White Wolf Fault on Groundwater Hydrology in the Southern San Joaquin Valley, California” Thesis dated December 2001 for California State University Bakersfield - Masters of Science in Geology Degree
The remaining 12 are District-owned and designated as CASGEM wells that include construction details. The 12 District-owned CASGEM wells are situated along or near the main canal conveyance system, which bisects the District and can be described as being situated along the entire north to south boundary and near the center of the east to west District boundary. As a result, the remaining District areas towards the east, west and southern boundaries need future CASGEM coverage. At this point, these areas are currently covered with voluntary wells in the AEWSD monitoring program.

7 of the 12 CASGEM wells are currently located in or near spreading basins and accordingly, they will eventually be replaced with wells that less likely to be influenced by recharge and extraction facilities/operations.

In order to determine the extent of any potential confining layers beneath the District, as AEWSD adds wells to the CASGEM notification to enhance coverage or close data gaps, nearby well logs will be examined. If possible, geologic units identified on the logs will be correlated to determine if a confining layer exists. If a true confining layer is identified based on log data, existing wells selected for the program will be appropriately screened, or if installing dedicated monitoring wells, the wells will be screened such that the confined aquifer(s) is represented in the monitoring program.

For all above mentioned “data gaps”, in order to obtain a level of coverage consistent with CASGEM guidelines, District will continue outreach efforts to the owners of dedicated monitoring wells to incorporate and convert voluntary wells into CASGEM as well as contact other landowners for inclusion into AEWSD’s network. Additionally, the District could pursue grant funds for the construction of new monitoring wells and/or video logging existing wells where the construction details are unknown.

5. Monitoring Schedule

Water levels are measured bi-annually (spring and fall) to, among other things, document fluctuations in groundwater levels. The bi-annual District surveys correlate to request for water level information from both DWR and USBR.

Specifically, spring levels represent a seasonal high prior to peak summer irrigation demands and as such the District typically measures water levels in during the March/April time frame.

Additionally, fall levels represent a seasonal low after the summer irrigation demands and as such the District typically measures water levels in September/October time frame as well.
6. Description of Field Methods

District staff attempts to measure depth to water at approximately 230 wells on a bi-annual basis (Spring and Fall). Depth is measured in one of three ways: an electrical well sounder, an acoustic well sounder, and/or by the use of airlines and compressed air. Depths are measured to the nearest foot.

a. Preparation for Field Work
Prior to collecting semiannual field measurements and before going to the field, the District personnel will assemble the equipment and supplies, summarize location details and utilize the field measurement form (See Figure 4) to document the survey.

b. Calibration of Field Equipment
District routinely cleans, maintains, and tests the accuracy of measurement devices by comparing the various methods.

c. Quality Control
During each field visit, the prior level readings are noted so as to provide a benchmark and approximate location of water levels.

d. Data Entry
Upon completion of field methods, the data is entered into an electronic spreadsheet, which is then shared with other staff, consultants and other agencies, as requested.

7. Well Location Surveys

About every 5 years, the District staff conducts a visual survey of the District and update a map showing the locations, as well as drivers (electrical, diesel and natural gas) of all wells (active and inactive) in the District.
Figure 1: Monitoring Well Locations
Figure 2: HYDROGRAPH OF WATER LEVEL FLUCTUATIONS AT SYCAMORE WELL #1
Arvin-Edison Water Storage District

Figure 3: Average Static Groundwater Depth in District

- **With Project**
  - First Project Deliveries
  - Depth to Water in Wells (Feet): 360 feet
- **Without Project**
  - Depth to Water in Wells (Feet): 646 feet

![Graph](image-url)
<table>
<thead>
<tr>
<th>TWP</th>
<th>Range</th>
<th>Sec.</th>
<th>Tr</th>
<th>BM at M.P.</th>
<th>Date</th>
<th>N</th>
<th>Q</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>31S</td>
<td>29E</td>
<td>12</td>
<td>M</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>14</td>
<td>L</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>17</td>
<td>H</td>
<td>2 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>21</td>
<td>J</td>
<td>2 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>23</td>
<td>B</td>
<td>M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>23</td>
<td>K</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>23</td>
<td>N</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>25</td>
<td>C</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>26</td>
<td>G</td>
<td>2 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>26</td>
<td>R</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>27</td>
<td>C</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>31</td>
<td>D</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>31</td>
<td>E</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>34</td>
<td>A</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>34</td>
<td>C</td>
<td>3 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>35</td>
<td>D</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>35</td>
<td>K</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>29E</td>
<td>36</td>
<td>G</td>
<td>1 M</td>
<td>31S 29E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>30E</td>
<td>6</td>
<td>E</td>
<td>1 M</td>
<td>31S 30E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>30E</td>
<td>7</td>
<td>D</td>
<td>1 M</td>
<td>31S 30E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>30E</td>
<td>16</td>
<td>G</td>
<td>1 M</td>
<td>31S 30E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31S</td>
<td>30E</td>
<td>16</td>
<td>N</td>
<td>1 M</td>
<td>31S 30E</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remarks</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
</tbody>
</table>

**Figure 4: Field Well Measurement Form**

<table>
<thead>
<tr>
<th>NO MEASUREMENT</th>
<th>Questionable Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. Measurement Disc.</td>
<td>0. Caved or other Obs.</td>
</tr>
<tr>
<td>1. Pumping</td>
<td>1. Pumping</td>
</tr>
<tr>
<td>2. Pump House locked</td>
<td>2. Nearby Pumping</td>
</tr>
<tr>
<td>3. Tape hung up</td>
<td>3. Casing leaking</td>
</tr>
<tr>
<td>4. Can’t get tape in casing</td>
<td>4. Pumped recently</td>
</tr>
<tr>
<td>5. Unable to locate well</td>
<td>5. Air gauge mea.</td>
</tr>
<tr>
<td>6. Well destroyed</td>
<td>6. M.P change</td>
</tr>
<tr>
<td>7. Special</td>
<td>7. Recharge</td>
</tr>
<tr>
<td>8. Casing leaking</td>
<td>8. Oil in casing</td>
</tr>
<tr>
<td>9. temporarily inaccessible</td>
<td>9. Acoustical sounding</td>
</tr>
<tr>
<td>State Well Number</td>
<td>CASGEM Status</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>1 30S29E09M002M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>2 30S29E16L001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>3 30S29E21G001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>4 30S29E27M001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>5 30S29E34A001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>6 31S29E02D001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>7 31S29E11D001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>8 31S29E11J001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>9 31S30E20G002M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>10 31S30E29M001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>11 32S29E16R004M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>12 32S29E28A001M</td>
<td>CASGEM</td>
</tr>
<tr>
<td>13 11N19W05R001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>14 11N19W09P001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>15 11N19W14H001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>16 11N19W21Q001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>17 11N19W24H001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>18 11N20W04G001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>19 11N20W05J001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>20 11N20W08R001S</td>
<td>Voluntary</td>
</tr>
<tr>
<td>21 29S29E33N001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>22 29S29E34C001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>23 30S29E06A001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>24 30S29E10N001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>25 30S29E14G001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>26 30S29E16F002M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>27 30S29E27C001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>28 30S29E29A001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>29 30S30E19E001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>30 31S29E01D001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>31 31S29E05J003M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>32 31S29E34A001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>33 31S30E20J003M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>34 31S30E31H001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>35 32S28E13F001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>36 32S28E23R001M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>37 32S29E08R002M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>38 32S29E10R002M</td>
<td>Voluntary</td>
</tr>
<tr>
<td>39 32S29E28R001M</td>
<td>Voluntary</td>
</tr>
</tbody>
</table>
Appendix L

AEWSD Long-term Access Agreement
MONITORING WELL ACCESS AGREEMENT

This Monitoring Well Access Agreement (“Agreement”) is made and entered into by and between the ARVIN-EDISON WATER STORAGE DISTRICT (hereafter “District”) and _________ (hereafter “Landowner”), both of whom shall be referred to individually as a “Party” to this Agreement and collectively as the “Parties” to this Agreement.

RECITALS

WHEREAS, the District is a member of the Kern Groundwater Authority (“KGA”) which has adopted or will adopt a Groundwater Sustainability Plan (“GSP”) to comply with the Sustainable Groundwater Management Act (“SGMA”); and

WHEREAS, the District developed and is responsible for implementing a chapter of the KGA GSP; and

WHEREAS, SGMA requires the long-term monitoring of groundwater levels; and

WHEREAS, to comply with this requirement, the District may need access rights from Landowners within its service area to monitor groundwater elevations; and

WHEREAS, Landowner’s Land (as described and depicted in Exhibit A) contains one or more groundwater wells in the District GSP chapter area for which the District is required to monitor for groundwater elevation activities; and

WHEREAS, Landowner has agreed to grant the District limited access onto Landowner’s Land, subject to the terms and conditions as set forth in this Agreement.

NOW, THEREFORE, the Parties have entered into this Agreement to allow the District to access to Landowner’s Land under the following terms and conditions:

TERMS AND CONDITIONS

1. Incorporation of Recitals. The foregoing recitals are incorporated herein as terms and conditions of this Agreement.

2. Right of Entry. Landowner grants to the District and its employees, agents, consultants, and contractors a non-exclusive year-round license to enter onto Landowner’s Land (as described and depicted in Exhibit A) to obtain groundwater elevation data from Landowner’s well(s). Unless otherwise agreed to by the Parties in a written amendment to this Agreement, the Parties agree that the District’s access to Landowner’s Land shall be limited to wells described in Exhibit A’s “Monitoring Well Locations” and in compliance with any conditions listed under “Access Instructions.”

3. Access and Control. Except as otherwise provided in this Agreement, Landowner retains the exclusive right of access to and control over the Landowner’s Land. Nothing contained in this Agreement shall be construed as affording the public a right of access to any portion of the Landowner’s Land or precluding Landowner’s right to grant access to third parties across the Landowner’s Land, provided that such access is not inconsistent with this Agreement.
4. **Duration of Right.** The Parties agree that this Agreement shall remain in effect until either of the following occurs: (a) Termination of the Agreement by either Party, or (b) Change in Ownership of Landowner’s Land.

   a. **Termination by a Party.** The Parties agree that this Agreement may be terminated at any time, with or without cause, by either Party upon sixty (60) days written notice to the other Party.

   b. **Landowner’s Land: Change in Ownership.** The Parties agree that this agreement shall terminate upon any change in ownership of Landowner’s Land. Thereafter, the District acknowledges that it will need to enter into a new access agreement with the new owner(s) of Landowner’s Land.

5. **No Easement.** The Parties agree that this Agreement does not grant the District a possessory right, easement, or other land interest with respect to Landowner’s Land.

6. **Costs.** The Parties agree that all groundwater elevation monitoring performed by the District under this Agreement shall be funded by the District.

7. **No Storage.** The right of entry does not include permission to store soil, groundwater, or measurement apparatus on the Landowner’s Land. All materials and tools shall be removed from the Landowner’s Land on the date of entry.

8. **Maintenance of Landowner’s Land.** The Parties acknowledge that this Agreement grants the District a non-exclusive year-round license to access Landowner’s Land for the limited purpose of obtaining groundwater elevation data from Landowner’s well(s). Accordingly, except as provided in section 5 of this Agreement below ("Damage/Restoration"), the Parties agree that the District (including its employees, agents, consultants, and contractors) is under no obligation to maintain or otherwise repair the Landowner’s Land.

9. **Damage/Restoration.** The District (including its employees, agents, consultants, and contractors) shall take all reasonable precautions to avoid damaging Landowner’s Land. If any damage is caused to Landowner’s Land by the District in the course of performance of this Agreement, the District shall notify the Landowner immediately. In addition, the District will at its sole cost and expense work with the Landowner to take all action reasonably necessary to repair the damage and restore the areas of Landowner’s Land to the condition that existed immediately prior to the damage caused by the District.

10. **Schedule or Notice of Access.** The District may develop a schedule of dates/times it will access Landowner’s Land for the purposes of groundwater elevation monitoring. If the District does not provide a schedule, it shall undertake reasonable efforts to notify the Landowner at least twenty-four (24) hours in advance of accessing Landowner’s Land pursuant the access rights granted under this Agreement.

11. **Indemnity.** The District agrees to defend, indemnify, and hold harmless Landowner for any costs, claims, damages, losses or other liabilities arising out of the District’s (including any
employees, agents, consultants, and contractors) actions on Landowner’s Land under this Agreement, with the exception that the District shall not be responsible for defending, indemnifying, or holding harmless Landowner with regard to costs, claims, damages, losses, or other liabilities arising out of the sole negligence or intentional misconduct of Landowner.

12. **Insurance.** Prior to entering onto Landowner’s Land, District shall provide to Landowner a certificate that the District or District’s consultant a certificate evidencing general liability insurance in the amount of at least One Million Dollars ($1,000,000) aggregate limit.

13. **Written Notices.** Written notices between the Parties shall be sent via U.S. mail to the addresses listed below:

   Arvin-Edison Water Storage District  
   P.O. Box 175  
   Arvin, CA 93203  

   [Landowner’s Name]  
   [Address]  
   [City], CA [zip code]

14. **Entire Agreement.** This Agreement contains the entire understanding of the Parties and supersedes all prior agreements and understandings among the Parties related to the subject matter of this Agreement.

15. **Amendment.** Amendments to this Agreement shall become effective upon execution of a written amendment signed by both Parties.

16. **Severability.** If any provision of this Agreement is held to be unenforceable for any reason, it shall be adjusted, rather than voided, if possible, to achieve the intent of the Parties, and the balance of the Agreement shall remain in full force and effect.

17. **Governing Law.** This Agreement shall be interpreted and enforced pursuant to the laws of the state of California.

18. **Effective Date.** This Agreement shall become effective as of the latest date of execution below.

   Arvin Edison Water Storage District  
   By ____________________________  
   [Name, title]  
   Date: __________

   [Landowner]  
   By ____________________________
   [Name, title]  
   Date: __________

**EXHIBIT A**

MONITORING WELL ACCESS AGREEMENT - 3
Appendix M

Project and Management Action Information Forms
ARVIN-EDISON WATER STORAGE DISTRICT  
PROJECT / MANAGEMENT ACTION  
INFORMATION FORM  

<table>
<thead>
<tr>
<th>P/MA ID: 1</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
</table>

**TITLE:** AEWSD Sunset Spreading Works

**DESCRIPTION:**
The Eastside Spreading Works (Project), approximately 150 acres, is located on the boundary between the Arvin-Edison Water Storage District (AEWSD) and Kern Delta Water District (KDWD), adjacent to KDWD’s Eastside Canal. The Project will take surface water (Federal CVP, State Water Project, or local supplies) diverted through KDWD’s Eastside Canal and recharge the surface supplies as part of AEWSD’s and KDWD’s joint water management programs. Furthermore, the Project site is located within the corridor of the AEWSD North In-Lieu Project (NILP) in which a 48” pipeline provides surface water for in-lieu recharge to the GWSA from the AEWSD North Canal. Phase 1 of the NILP has already been constructed, and upon completion of the NILP, the 48” pipeline will provide an alternative conveyance path to the Project. With AEWSD’s new 9(d) contract, certain provisions of Reclamation law are no longer applicable and all lands within the AEWSD service area can now be served with federal water supplies, which will increase the potential water supply.

The Project will include the construction of exterior and interior dikes for a direct recharge facility, a new turnout and pump station from the KDWD Eastside Canal, and interbasin structures. The Project could recharge approximately 50 to 75-AF/day. During an above average year, the site could be utilized continuously for approximately 100-days (when surplus surface water supplies are available), creating the ability to capture and recharge approximately 5,000 to 7,500-AF of flood water and other surface supplies. Assuming an above average year occurs once every 2.5 years, the project would develop a new average annual yield of 2,000 to 3,000-AF. There could be scenarios similar to 2017, when 12-months of recharge is probable, and would result in recharging approximately 18,000 to 27,000-AF/year.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

2,410 – 3,410AF = Enhanced supply (2,000 - 3,000 AF/yr) + Demand reduction (410 AF/yr)

**AGENCY(s):**
- Primary/Lead: AEWSD
- Supporting: KDWD

**LOCATION:**
- Township / Range: M31S29E17
- Coordinates (Latitude / Longitude): approximately 35° 13’ 37.46”, 118° 52’ 52.94”
- Description: East of KDWD Eastside Canal, west of Edison Rd., north of Sunset Blvd., Arvin, CA

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):
- Chronic Lowering of Groundwater Levels
- Seawater Intrusion
- Land Subsidence
- Reduction of Groundwater Storage
- Degraded Water Quality
- Depletions of Interconnected Surface Water

**TYPE** (check all that apply):
- Water Supply Augmentation
  - Surface Water
  - Groundwater (Recharge)
  - Recycled Water
  - Transfer
  - Stormwater
  - Other
- Source of Outside Water (if applicable): 
- Water Demand Reduction
  - Conservation
  - Land / Water Use Changes
  - Other
- Infrastructure / Capital Project
  - Policy Project
- Data Gap Filling / Monitoring
  - Water Quality Improvement
  - Other:

---

1 Please continue to next page or attach additional pages to this form as necessary
### COSTS & FUNDING SOURCE(s):
- **Capital / Up-front ($): $7,330,000 (including property purchase; scalable)**
  - Source(s): AEWSD (50%), KDWD (50%)
- **O&M / On-going ($ per year): TBD**
  - Source(s): AEWSD (50%), KDWD (50%)

### REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):
- **Permits (name of authority, type of permit): KDWD encroachment permit**
- **CEQA: required**
- **Other: NEPA if federal grant funds used**

### SCHEDULE / TIMING:
- **Implementation Trigger(s): Grant funding. Land acquisition and conceptual plans in progress.**
- **Termination Trigger(s): Project completion**
- **Timeframe to Accrue Expected Benefits: 1 year post construction**

### ADDITIONAL DETAILS (as necessary):

The Project is located within the AEWSD Groundwater Service Area (GWSA) of the District, consisting of landowners that rely solely on groundwater supplies to meet crop demand requirements, resulting in an area of historically lower regional groundwater levels. The Project will address an area of historical chronic lowering of groundwater levels, allowing AEWSD / KDWD to address potential undesirable results in the immediate area (chronic lowering of groundwater levels) as identified by the Sustainable Groundwater Management Act (SGMA). No recovery is currently planned as part of the Project. Thus, all water supplies created from the Project will offset historical groundwater supplies used to meet crop demand requirements in the area.

Approximately 15 cfs per storm event breaches the KDWD Eastside Canal, the Project will allow for capture and recharge of the floodwater.
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID: 2</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
</table>

**TITLE:** AEWSD Private & Caltrans Basin Connections

**DESCRIPTION:**
There are multiple on-farm private basins and some Caltrans sumps near AEWSD facilities that could be connected by gravity pipeline and utilized for groundwater recharge and floodwater capture. The existing Murray Basin Connection Project is a prime example of how private basins can be better utilized District wide.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

Depending on number of basin connections, ~50 - 500 AF

**AGENCY(s):**
- Primary/Lead: AEWSD
- Supporting: Private party and Caltrans

**LOCATION:**
- Township / Range: N/A
- Coordinates (Latitude / Longitude): various
- Description: various

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):

- [ ] Chronic Lowering of Groundwater Levels
- [ ] Reduction of Groundwater Storage
- [ ] Seawater Intrusion
- [ ] Degraded Water Quality
- [ ] Land Subsidence
- [ ] Depletions of Interconnected Surface Water

**TYPE** (check all that apply):

- [ ] Water Supply Augmentation
  - [ ] Surface Water
  - [ ] Groundwater (Recharge)
  - [ ] Recycled Water
  - [ ] Stormwater
  - [ ] Other
  - [ ] Source of Outside Water (if applicable):
- [ ] Water Demand Reduction
  - [ ] Conservation
  - [ ] Land / Water Use Changes
  - [ ] Infrastructure / Capital Project
  - [ ] Policy Project
  - [ ] Data Gap Filling / Monitoring
  - [ ] Water Quality Improvement
  - [ ] Other:

---

1 Please continue to next page or attach additional pages to this form as necessary
**COSTS & FUNDING SOURCE(s):**
- Capital / Up-front ($): 100,000 - 500,000 depending upon pipe size and length
  - Source(s): AEWSD, Grants
- O&M / On-going ($ per year): Not applicable
  - Source(s): Not applicable

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):**
- Permits (name of authority, type of permit): Caltrans encroachment
- CEQA: required for longer pipeline connections
- Other: NEPA if federal grant funds used

**SCHEDULE / TIMING:**
- Implementation Trigger(s): Participant interest, Caltrans permitting, Grant funding
- Termination Trigger(s): project completion
- Timeframe to Accrue Expected Benefits: 1-3 years post construction

**ADDITIONAL DETAILS (as necessary):**
ARVIN-EDISON WATER STORAGE DISTRICT

PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIN/MANAGEMENT AREA (if any):</td>
<td>AEWSD</td>
</tr>
</tbody>
</table>

**TITLE:** AEWSD Sycamore Creek Detention & Sedimentation Basin

**DESCRIPTION:**
Sycamore Creek is an intermittent stream that intersects the District’s South Canal where it parallels the southerly section of the Sycamore Spreading Basin lying on the west side of the canal. Upstream of this location, the creek runs in a westerly direction at a longitudinal slope of about 1.5%. At the point of intersection with the South Canal, the creek turns 90 degrees to the south and flows in a southerly direction along the east side of the South Canal at a slope of about 0.1%. Each time the creek flows, large amounts of sediment have deposited in the creek bed at this location. Historically, much effort has been expended clearing the sediment to prevent blockage of the channel section and reduce the potential of a catastrophic breach in the canal and adjacent spreading basin. The proposed basin would serve to intercept sediment laden flows upstream of the 90 degree bend and be sized sufficiently to provide ample detention time to drop out the sediments, reduce the peak outflow and prevent the likelihood of a canal and spreading basin breach. Detained water could be recirculated for irrigation demands or recharged for in-lieu groundwater pumping.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

~200-300 AF depending upon basin size.

<table>
<thead>
<tr>
<th>AGENCY(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary/Lead: AEWSD</td>
</tr>
<tr>
<td>Supporting: __________________________________________________________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOCATION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Township / Range: N/A</td>
</tr>
<tr>
<td>Coordinates (Latitude / Longitude): 35.203100, 118.779200</td>
</tr>
<tr>
<td>Description: South Canal</td>
</tr>
</tbody>
</table>

**AFFECED SUSTAINABILITY INDICATOR** (check all that apply):

- □ Chronic Lowering of Groundwater Levels
- □ Seawater Intrusion
- □ Land Subsidence
- □ Reduction of Groundwater Storage
- □ Degraded Water Quality
- □ Depletions of Interconnected Surface Water

**TYPE** (check all that apply):

- □ Water Supply Augmentation
  - □ Surface Water
  - □ Groundwater (Recharge)
  - □ Recycled Water
  - □ Stormwater
  - □ Other
- □ Water Demand Reduction
  - □ Conservation
  - □ Land / Water Use Changes
- □ Infrastructure / Capital Project
  - □ Policy Project
- □ Data Gap Filling / Monitoring
  - □ Water Quality Improvement

1 Please continue to next page or attach additional pages to this form as necessary
### COSTS & FUNDING SOURCE(s):

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($)</td>
<td>2-3M</td>
<td>AEWSD, Grants</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year)</td>
<td>10,000 - 30,000</td>
<td>AEWSD, Grants</td>
</tr>
</tbody>
</table>

### REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits</td>
<td>County grading required</td>
</tr>
<tr>
<td>NEPA</td>
<td>NEPA if federal grant funds used, SMARA potential</td>
</tr>
</tbody>
</table>

### SCHEDULE / TIMING:

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Trigger(s)</td>
<td>Grant funding</td>
</tr>
<tr>
<td>Termination Trigger(s)</td>
<td>Project completion</td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits</td>
<td>1-3 years post construction</td>
</tr>
</tbody>
</table>

### ADDITIONAL DETAILS (as necessary):

- County grading required
- NEPA if federal grant funds used, SMARA potential
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>4</th>
<th>BASIN/MANAGEMENT AREA (if any):</th>
<th>AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>AEWSD South Canal Flood Study / Improvements</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| DESCRIPTION:

The South Canal Improvement Project (SCIP), completed in 2009, provided reverse flow capability for the District’s South Canal. Canal banks were raised to facilitate the increase in the level of the hydraulic grade line. However, the banks were not raised within the FEMA designated floodplain area consisting of a portion of the canal stretch between David Road and Wheeler Ridge Road. This was because gaining FEMA and/or Kern County approval (required by law) to raise the canal banks would have required additional flood studies and more time than was available during the SCIP CEQA and design processes. The end result is that the South Canal’s bank freeboard in the FEMA designated floodplain area is less than in other portions of the South Canal. The South Canal Flood Study would review and possibly revise the FEMA floodplain in this area in order to increase the height of the canal bank to provide additional operational freeboard and accordingly reduce the potential for canal spills and subsequent flooding. It would also address public safety by potentially reducing the ability of floodwaters from nearby El Paso Creek channel from entering the canal and thus reduce the risk of floodwaters reaching Highway 99 just north of Highway 166. The additional canal storage could allow for the capature and use of additional floodwater in-lieu of groundwater pumping.

EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):

~100-200 AF

AGENCY(s):

Primary/Lead: AEWSD
Supporting: ________________________________________________________________

LOCATION:

□ Check here if Basin-wide

Township / Range: T12N / R19W
Coordinates (Latitude / Longitude): 35.082900, 118.895800
Description: David Road and Wheeler Ridge Road

AFFECTED SUSTAINABILITY INDICATOR (check all that apply):

☒ Chronic Lowering of Groundwater Levels ☑ Reduction of Groundwater Storage
☐ Seawater Intrusion ☐ Degraded Water Quality
☐ Land Subsidence ☐ Depletions of Interconnected Surface Water

TYPE (check all that apply):

☒ Water Supply Augmentation
☐ Surface Water ☑ Groundwater (Recharge) ☐ Recycled Water
☐ Transfer ☑ Stormwater ☐ Other

Source of Outside Water (if applicable): ______________________________________

☐ Water Demand Reduction
☐ Conservation ☐ Land / Water Use Changes

☒ Infrastructure / Capital Project ☐ Policy Project
☐ Data Gap Filling / Monitoring ☐ Water Quality Improvement
☐ Other: __________________________________________

1 Please continue to next page or attach additional pages to this form as necessary
**COSTS & FUNDING SOURCE(s):**

- Capital / Up-front ($): $200K - $300K for study plus construction costs estimated at $2M  
  Source(s): AEWSD, FEMA Grants  
- O&M / On-going ($ per year): Not applicable  
  Source(s): Not applicable

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):**

- Permits (name of authority, type of permit): Not applicable for study  
- CEQA: Not applicable for study

**SCHEDULE / TIMING:**

- Implementation Trigger(s): Grant funding  
- Termination Trigger(s): Study completion  
  Timeframe to Accrue Expected Benefits: 1-3 years post construction of improvements recommended in study

**ADDITIONAL DETAILS (as necessary):**
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

P/MA ID: 5  BASIN/MANAGEMENT AREA (if any): AEWSD

TITLE: Stormwater Management and Flood Control Improvements

DESCRIPTION:
The District’s canal system needs modifications/improvements to comply with storm runoff pollution prevention. Additionally, there is a need to modify old and build new facilities for flood protection from intermittent creeks (Caliente Creek, Sycamore Creek, Tejon Creek, El Paso Creek, their tributaries and others). The project integrates with projects identified in Kern County RMA’s studies for improved stormwater management and flood control for the Southern Stream Group. This project integrates with flood protection for Lamont, Arvin, and Mettler. Construction of new sedimentation/detention basins, flood ditch erosion protection, Spillway Basin expansion, lengthening the South Canal’s siphon under David Road or the flood study and extension of the South Canal liner through designated floodplain reaches, are example projects. District infrastructure (including conveyance interconnections including California Aqueduct), landowners, communities and cities and the City of Lamont will benefit from the improved stormwater management (i.e., erosion, scouring, flooding).

EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):

TBD

AGENCY(s):
Primary/Lead: AEWSD
Supporting: Kern County RMA, Lamont CSD, City of Arvin, Mettler CWD, Tejon Ranch (possible)

LOCATION:
Township / Range: T30S / R28E
Coordinates (Latitude / Longitude): 35° 17’ 15” N. 118°56’ 04”W
Description: AEWSD North and South Canals; City of Bakersfield and parts of Kern County outside AEWSD.

AFFECTED SUSTAINABILITY INDICATOR (check all that apply):
- Chronic Lowering of Groundwater Levels
- Seawater Intrusion
- Land Subsidence
- Reduction of Groundwater Storage
- Degraded Water Quality
- Depletions of Interconnected Surface Water

TYPE (check all that apply):
- Water Supply Augmentation
  - Surface Water
  - Groundwater (Recharge)
- Recycled Water
- Stormwater
- Other

- Water Demand Reduction
  - Conservation
  - Land / Water Use Changes

- Infrastructure / Capital Project
  - Policy Project

- Data Gap Filling / Monitoring
  - Water Quality Improvement

- Other:

1 Please continue to next page or attach additional pages to this form as necessary
### COSTS & FUNDING SOURCE(s):

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($):</td>
<td>$1-10 Million</td>
<td>AEWSD and partnering agencies</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year):</td>
<td>TBD</td>
<td>AEWSD and partnering agencies</td>
</tr>
</tbody>
</table>

### REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):

<table>
<thead>
<tr>
<th>Requirement Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits (name of authority, type of permit):</td>
<td>TBD</td>
</tr>
<tr>
<td>CEQA: portions exempt under 15301 Existing Facilities and 15303 New Construction of Small Structures</td>
<td></td>
</tr>
<tr>
<td>Other: NEPA if federal grant funds used, SMARA exemption for basins</td>
<td></td>
</tr>
</tbody>
</table>

### SCHEDULE / TIMING:

<table>
<thead>
<tr>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Trigger(s):</td>
<td>Grant funding</td>
</tr>
<tr>
<td>Termination Trigger(s):</td>
<td></td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits:</td>
<td>1-3 years post construction</td>
</tr>
</tbody>
</table>

### ADDITIONAL DETAILS (as necessary):

- Portions exempt under 15301 Existing Facilities and 15303 New Construction of Small Structures
- NEPA if federal grant funds used, SMARA exemption for basins
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID: 7</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE: AEWSD Intake Canal / KDWD Buena Vista Canal Intertie</td>
<td></td>
</tr>
</tbody>
</table>

DESCRIPTION:
There is a need to improve existing interties and/or construct new interties between AEWSD’s Intake Canal and KDWD’s canals to facilitate water exchanges between the two districts. Many existing and potential future water exchange and banking programs benefiting the two districts, their banking and exchange partners in Kern County and Southern California depend upon successful construction and operation of the Project. Primary benefits of the Project are improved water supplies and operational efficiency. Ancillary benefits include water quality improvements for SWP customers and floodplain management in Kern County and other areas in the San Joaquin Valley. Project location could benefit other conveyance facilities in the near vicinity (CVC, FKC, Kern River) and assist in exchanges. The River Canal is owned and operated by the City of Bakersfield. KDWD has rights to deliver water through the River Canal to the head of the Buena Vista Canal. There is potential for recharge within KDWD for a shared benefit with a specific amount to be determined by future agreement. The expected annual benefit

EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):
Increased delivery flexibility and transfer/exchange potential up to 8,000AF (100cfs per day for 40 annual average floodwater days)

AGENCY(s):
Primary/Lead: AEWSD
Supporting: KDWD

LOCATION:
Township / Range: T29S / R27E
Coordinates (Latitude / Longitude): 35° 21’ 25” N, 119° 05’ 39”W
Description: On Intake Canal near Stockdale Hwy & Coffee Road, Bakersfield, Kern County

AFFECTED SUSTAINABILITY INDICATOR (check all that apply):
- Chronic Lowering of Groundwater Levels
- Seawater Intrusion
- Land Subsidence
- Reduction of Groundwater Storage
- Degraded Water Quality
- Depletions of Interconnected Surface Water

TYPE (check all that apply):
- Water Supply Augmentation
  - Surface Water
  - Groundwater (Recharge)
  - Recycled Water
  - Transfer
  - Stormwater
  - Other
  - Source of Outside Water (if applicable):
- Water Demand Reduction
  - Conservation
  - Land / Water Use Changes
- Infrastructure / Capital Project
  - Policy Project
- Data Gap Filling / Monitoring
  - Water Quality Improvement
- Other:

1 Please continue to next page or attach additional pages to this form as necessary
### COSTS & FUNDING SOURCE(s):
- **Capital / Up-front ($):** 1-2.5M  
  **Source(s):** AEWSD, KDWD
- **O&M / On-going ($ per year):** 20,000  
  **Source(s):** AEWSD, KDWD

### REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):
- **Permits (name of authority, type of permit):**  
  
- **CEQA:** exempt under 15301 Existing Facilities and 15303 New Construction of Small Structures
- **Other:**

### SCHEDULE / TIMING:
- **Implementation Trigger(s):** Completion of feasibility study and design drawings
- **Termination Trigger(s):** Project completion
- **Timeframe to Accrue Expected Benefits:** 1 year post construction

### ADDITIONAL DETAILS (as necessary):

---

1. 2.5M AEWSD, KDWD
2. 20,000 AEWSD, KDWD
3. exempt under 15301 Existing Facilities and 15303 New Construction of Small Structures
4. Completion of feasibility study and design drawings
5. Project completion
6. 1 year post construction
<table>
<thead>
<tr>
<th>P/MA ID: 8</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
</table>

**TITLE:** AEWSD Intake Canal and KDWD Farmer's Canal Intertie

**DESCRIPTION:**
There is a need to improve existing interties and/or construct new interties between AEWSD’s Intake Canal and KDWD’s canals to facilitate water exchanges between the two districts. Many existing and potential future water exchange and banking programs benefiting the two districts, their banking and exchange partners in Kern County and Southern California depend upon successful construction and operation of the Project. Primary benefits of the Project are improved water supplies and operational efficiency. Ancillary benefits include water quality improvements for SWP customers and floodplain management in Kern County and other areas in the San Joaquin Valley. Project location could benefit other conveyance facilities in the near vicinity (CVC, FKC, Kern River) and assist in exchanges. There is potential for recharge within KDWD for a shared benefit with a specific amount to be determined by future agreement. The project would construct a check structure in the Intake Canal in order to gravity flow into KDWD Farmer's Canal.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

Increased delivery flexibility and transfer/exchange potential up to 4,000AF (50cfs per day for 40 annual average floodwater days)

**AGENCY(s):**
- **Primary/Lead:** AEWSD
- **Supporting:** KDWD

**LOCATION:**
- **Township / Range:** T30S / R27E
- **Coordinates (Latitude / Longitude):** 35° 17' 46" N, 119° 03' 37"W
- **Description:** On Intake Canal near Panama Lane and Stine Road, Bakersfield, Kern County

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):

- Chronic Lowering of Groundwater Levels
- Reduction of Groundwater Storage
- Seawater Intrusion
- Degraded Water Quality
- Land Subsidence
- Depletions of Interconnected Surface Water

**TYPE** (check all that apply):

- **Water Supply Augmentation**
  - Surface Water
  - Groundwater (Recharge)
  - Recycled Water
- **Water Transfer**
  - Stormwater
  - Other

- **Water Demand Reduction**
  - Conservation
  - Land / Water Use Changes

- **Infrastructure / Capital Project**
  - Policy Project

- **Data Gap Filling / Monitoring**
  - Water Quality Improvement

- **Other:**

---

1 *Please continue to next page or attach additional pages to this form as necessary*
**COSTS & FUNDING SOURCE(s):**

- **Capital / Up-front ($):** $1-2.5M depending upon turnout capacity size  
  **Source(s):** AEWSD, KDWD
- **O&M / On-going ($ per year):** $20,000  
  **Source(s):** AEWSD, KDWD

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS** (describe all that apply):

- **Permits (name of authority, type of permit):**  
  - PG&E power
- **CEQA:** exempt under 15301 Existing Facilities and 15303 New Construction of Small Structures
- **Other:**

**SCHEDULE / TIMING:**

- **Implementation Trigger(s):** Completion of feasibility study and design drawings
- **Termination Trigger(s):** Project completion
- **Timeframe to Accrue Expected Benefits:** 1 year post construction

**ADDITIONAL DETAILS** (as necessary):

Attached vicinity map with two proposed options that require further analysis.
AEWSD Intake Canal / KDWD Farmer’s Canal Intertie

Vicinity Map
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>9</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>AEWSD Wasteway Basin Improvements</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION¹:</td>
<td>The primary use of the existing AEWSD Basin is to provide emergency water storage in the event of power failure at the Forrest Frick Pumping Plant (FFPP). Since the irrigation water entering the FFPP is ordered approximately 24 hours in advance, a loss of power at the FFPP could result in canal overtopping and hours of unexpected flooding. In addition, the Basin can also serve as a detention facility for the City of Bakersfield stormwater which is conveyed through the AEWSD’s Intake Canal. There are some locations where City flood flows can be rediverted. The City flood conveyance infrastructure is not existing or incapable of containing the floodwater. The proposed project will improve and fortify the capacity allowing for the detention of approximately 1,550 acre-feet of emergency and/or floodwater that would otherwise cause localized and non-localized flooding in other areas of Kern County and the San Joaquin Valley. Without the permanent proposed Basin improvements, there is a greater risk of Basin levee failure and flooding. The project would include construction of a HDPE liner along the levees, installation of recirculation pumps, and basin grading. It would also provide a location for the district to divert and clarify sediment impaired waters that periodically enter the Intake Canal, fill canals, damage pumps, and reduce recharge rates at spreading works.</td>
<td></td>
</tr>
<tr>
<td>EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):</td>
<td>+1,550 AF storage, could increase depending upon amount of recirculated water and frequency of storm events</td>
<td></td>
</tr>
<tr>
<td>AGENCY(s):</td>
<td>Primary/Lead: AEWSD</td>
<td></td>
</tr>
<tr>
<td>Supporting: FEMA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCATION:</td>
<td>□ Check here if Basin-wide</td>
<td></td>
</tr>
<tr>
<td>Township / Range:</td>
<td>T30S / R28E</td>
<td></td>
</tr>
<tr>
<td>Coordinates (Latitude / Longitude):</td>
<td>35.291944, 118.975278</td>
<td></td>
</tr>
<tr>
<td>Description:</td>
<td>southeast of the City of Bakersfield in Kern County</td>
<td></td>
</tr>
<tr>
<td>AFFECTED SUSTAINABILITY INDICATOR (check all that apply):</td>
<td>□ Chronic Lowering of Groundwater Levels</td>
<td></td>
</tr>
<tr>
<td>□ Seawater Intrusion</td>
<td>□ Reduction of Groundwater Storage</td>
<td></td>
</tr>
<tr>
<td>□ Land Subsidence</td>
<td>□ Degraded Water Quality</td>
<td></td>
</tr>
<tr>
<td>□ Other:</td>
<td>□ Depletions of Interconnected Surface Water</td>
<td></td>
</tr>
<tr>
<td>TYPE (check all that apply):</td>
<td>□ Water Supply Augmentation</td>
<td></td>
</tr>
<tr>
<td>□ Surface Water</td>
<td>□ Groundwater (Recharge)</td>
<td></td>
</tr>
<tr>
<td>□ Transfer</td>
<td>□ Recycled Water</td>
<td></td>
</tr>
<tr>
<td>□ Stormwater</td>
<td>□ Other</td>
<td></td>
</tr>
<tr>
<td>Source of Outside Water (if applicable):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Water Demand Reduction</td>
<td>□ Land / Water Use Changes</td>
<td></td>
</tr>
<tr>
<td>□ Conservation</td>
<td>□ Policy Project</td>
<td></td>
</tr>
<tr>
<td>□ Infrastructure / Capital Project</td>
<td>□ Data Gap Filling / Monitoring</td>
<td></td>
</tr>
<tr>
<td>□ Other:</td>
<td>□ Water Quality Improvement</td>
<td></td>
</tr>
</tbody>
</table>

¹ Please continue to next page or attach additional pages to this form as necessary
<table>
<thead>
<tr>
<th><strong>COSTS &amp; FUNDING SOURCE(s):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($) : 2.5M</td>
</tr>
<tr>
<td>Source(s): AEWSD (25%) FEMA (75%)</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year): $32,000</td>
</tr>
<tr>
<td>Source(s): AEWSD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>REGULATORY / LEGAL AUTHORITY REQUIREMENTS</strong> (describe all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits (name of authority, type of permit): SJVAPCD Dust Control &amp; SWPPP</td>
</tr>
<tr>
<td>CEQA: exempt under 15301 Existing Facilities and 15303 New Construction of Small Structures</td>
</tr>
<tr>
<td>Other: NEPA Cultural Resources</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SCHEDULE / TIMING:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Trigger(s): Grant funding, construction to be completed within 2 years</td>
</tr>
<tr>
<td>Termination Trigger(s): Project completion</td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits: 1-3 years post construction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ADDITIONAL DETAILS</strong> (as necessary):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attached maps.</td>
</tr>
</tbody>
</table>
Intake Canal
Panama Ln
E Panama Rd
Cottonwood Rd

0 750 1,500 Feet

Soil Agricultural Groundwater Banking Index

SAGBI Rating - Modified
0 - 15 Very Poor
15 - 29 Poor
29 - 49 Moderately Poor
49 - 69 Moderately Good
69 - 85 Good
85 - 100 Excellent

Legend

Project Boundary

AEWSD Wasteway Basin
Kern County, CA

4/16/2019 : G:\Arvin-Edison WSD-1215\_On-Going\110 - Applications-Funding\2019 HMGPI\Wasteway Basin Improvements\GIS\Map\SAGBI.mxd
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID: 10</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>Forrest Frick Pipeline / KDWD Eastside Canal Intertie</td>
</tr>
<tr>
<td>DESCRIPTION:</td>
<td>The Ground Water Service Area (GWSA) within the District consists of landowners that rely only on Groundwater (GW) sources to meet their crop irrigation requirements. If the Forrest Frick Pipeline were connected to the KDWD Eastside Canal, surface water supplies could be wheeled by KDWD to serve portions of the GWSA with temporary water contracts, utilizing existing infrastructure (turnouts, pipelines that are both District and landowner owned). With the District’s new 9(d) contract, certain provisions of Reclamation law are no longer applicable and all lands within the service area can now be served with federal water supplies. Connections to KDWD may also allow for use of other local recharge facilities including the earthen Eastside Canal when not in use by KDWD.</td>
</tr>
</tbody>
</table>

| EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year): |
| Eastside Canal recharge ~0.25 AF/day x 40 annual average floodwater days = 10AF + Additional service area at 3AF/ac |

<table>
<thead>
<tr>
<th>AGENCY(s):</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary/Lead: AEWSD</td>
<td>Supporting: KDWD</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Township / Range: N/A</td>
<td>Check here if Basin-wide</td>
<td></td>
</tr>
<tr>
<td>Coordinates (Latitude / Longitude): approximately 35.3216°, -118.9193°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description: FFP &amp; KDWD Eastside Canal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| AFFECTED SUSTAINABILITY INDICATOR (check all that apply): |
|慢性降低地下水水平 | 减少地下水存储 |
|海水入侵 | 腐蚀水质 |
|土地沉降 | 其他：使用水资源变化 |

| TYPE (check all that apply): |
|水供应增加 | 地下水（补给） | 再生水 |
| | 补给 | 雨水 |
| | 水需求减少 | 农业或资本项目 |
| | | 数据缺口填充 / 监控 |

1 Please continue to next page or attach additional pages to this form as necessary
### COSTS & FUNDING SOURCE(s):  
**Capital / Up-front ($)**: 0.5M - 1.5M  
Source(s): AEWSD  
**O&M / On-going ($ per year)**: TBD  
Source(s): AEWSD  

### REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):  
Permits (name of authority, type of permit): potential County encroachment permits, private  
CEQA: required  
Other: NEPA if federal grant funds used  

### SCHEDULE / TIMING:  
Implementation Trigger(s): Grant funding  
Termination Trigger(s): Project completion  
Timeframe to Accrue Expected Benefits: 1-3 years post construction  

### ADDITIONAL DETAILS (as necessary):
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

P/MA ID: 11  BASIN/MANAGEMENT AREA (if any): AEWSD

TITLE: AEWSD North Canal Balancing Reservoir Expansion & Discharge Pipelines

DESCRIPTION:
The District maintains four (4) groundwater wells (NC#15,16,17&18) within the limits of its North Canal Balancing Reservoir site. The basin serves to provide delivery flexibility to on-farm users by allowing water storage and regulation of flow mismatches in the canal system during operation or emergencies such as a power outage as well as water quality blending. Well discharges are currently directed to shallow unlined channels within the basin that interconnect and drain by gravity to the basin’s outlet structure that meters and ties supplies directly to the District’s concrete lined North Canal.

The proposed project will consist of the installation of a pipeline system that will convey flows from the four (4) wells directly to the basin discharge structure and no longer through the basin low flow channels. The pipeline network will be approximately 4,300 feet in total length. Infiltration and evaporation losses on well discharge flows will be eliminated and power efficiency for the wells (kwh/af) will be significantly enhanced since all water pumped will be discharged into the North Canal. Environmental work would be minimal since the work area is within the confines of a highly disturbed existing District facility.

EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):
16 AF increased storage capacity; 100 AF/yr recharge; 50AF/yr reduced evaporative losses

AGENCY(s):
Primary/Lead: AEWSD
Supporting: ____________________________

LOCATION:
Township / Range: M30S29E09
Coordinates (Latitude / Longitude): 35.329 / 118.877
Description: Northeast of Edison Road and Muller Road intersection

AFFECTED SUSTAINABILITY INDICATOR (check all that apply):
- Chronic Lowering of Groundwater Levels
- Reduction of Groundwater Storage
- Seawater Intrusion
- Degraded Water Quality
- Land Subsidence
- Depletions of Interconnected Surface Water

TYPE (check all that apply):
Water Supply Augmentation
- Surface Water
- Groundwater (Recharge)
- Recycled Water
- Transfer
- Stormwater
- Other
Source of Outside Water (if applicable): ____________________________

Water Demand Reduction
- Conservation
- Land / Water Use Changes

Infrastructure / Capital Project
- Policy Project
- Water Quality Improvement

Data Gap Filling / Monitoring
- Other:

1 Please continue to next page or attach additional pages to this form as necessary
<table>
<thead>
<tr>
<th><strong>COSTS &amp; FUNDING SOURCE(s):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital / Up-front ($):</strong> $300,000</td>
</tr>
<tr>
<td>Source(s): AEWSD, Grants</td>
</tr>
<tr>
<td><strong>O&amp;M / On-going ($ per year):</strong> TBD</td>
</tr>
<tr>
<td>Source(s): AEWSD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>REGULATORY / LEGAL AUTHORITY REQUIREMENTS</strong> (describe all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Permits (name of authority, type of permit):</strong> none</td>
</tr>
<tr>
<td><strong>CEQA:</strong> none</td>
</tr>
<tr>
<td><strong>Other:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SCHEDULE / TIMING:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation Trigger(s):</strong> grant funding</td>
</tr>
<tr>
<td><strong>Termination Trigger(s):</strong> project completion</td>
</tr>
<tr>
<td><strong>Timeframe to Accrue Expected Benefits:</strong> 1-3 years post implementation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ADDITIONAL DETAILS</strong> (as necessary):</th>
</tr>
</thead>
</table>
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>12</th>
<th>BASIN/MANAGEMENT AREA (if any):</th>
<th>AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>AEWSD Lateral Capacity Improvement Projects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION:</td>
<td>AEWSD has 6 subareas (Units) of its Surface Water Service Area for operational purposes which are served by 12 pump stations along the North and South Canals. Currently there are 5 pump stations and lateral pipeline systems in need of improvements to meet current needs. Improvements to the plumbing of pipelines and storage tanks on the N-55 lateral system (in the Eastern-Central part of the District) and/or relocation of turnouts on N-55 lateral pipelines are examples of projects under review. Selected plumbing of landowner wells into constrained lateral pipelines is another example. The project would potentially increase existing pumping station capacities, add new pump stations, pipelines, etc. Various reasons have led to increased water demand in certain parts of the District. AEWSD customers will benefit from increased delivery capacity, water ordering and delivery flexibility, water use efficiency, and improved yields and quality. The District will likely see reduced costs of operation through energy conservation and reduced labor. As a result of limited on-farm deliveries, water users are forced at times to supplement District water from their groundwater wells. Improvements to lateral capacity could therefore reduce groundwater demands.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):</td>
<td>~1,000AF (assuming 25cfs increase for 60 flood days every 3 years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGENCY(s):</td>
<td>Primary/Lead: AEWSD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supporting:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCATION:</td>
<td>Township / Range: various</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coordinates (Latitude / Longitude): various</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description: multiple locations along North and South Canal subareas (Units)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AFFECTED SUSTAINABILITY INDICATOR (check all that apply):</td>
<td>□ Chronic Lowering of Groundwater Levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Seawater Intrusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Land Subsidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Reduction of Groundwater Storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Degraded Water Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Depletions of Interconnected Surface Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TYPE (check all that apply):</td>
<td>□ Water Supply Augmentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Surface Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Groundwater (Recharge)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Recycled Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Transfer</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Stormwater</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Source of Outside Water (if applicable):</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Water Demand Reduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Conservation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Land / Water Use Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Infrastructure / Capital Project</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Policy Project</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Data Gap Filling / Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Water Quality Improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Other:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Please continue to next page or attach additional pages to this form as necessary
<table>
<thead>
<tr>
<th><strong>COSTS &amp; FUNDING SOURCE(s):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital / Up-front ($)</strong>: $10-20 Million</td>
</tr>
<tr>
<td>Source(s): AEWSD</td>
</tr>
<tr>
<td><strong>O&amp;M / On-going ($ per year)</strong>: TBD</td>
</tr>
<tr>
<td>Source(s): AEWSD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>REGULATORY / LEGAL AUTHORITY REQUIREMENTS</strong> (describe all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Permits</strong> (name of authority, type of permit): TBD</td>
</tr>
<tr>
<td><strong>CEQA</strong>: Portions exempt under 15301 Existing Facilities and 15303 New Construction of Small Structures</td>
</tr>
<tr>
<td><strong>Other</strong>: NEPA if federal grant funds used</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SCHEDULE / TIMING:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation Trigger(s)</strong>: Grant funding</td>
</tr>
<tr>
<td><strong>Termination Trigger(s)</strong>: Reduction of groundwater demands in various Units</td>
</tr>
<tr>
<td><strong>Timeframe to Accrue Expected Benefits</strong>: 1-3 years post construction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ADDITIONAL DETAILS</strong> (as necessary):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID: 13</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TITLE:</strong> Conversion of Granite Quarry to Sycamore Reservoir</td>
<td></td>
</tr>
<tr>
<td><strong>DESCRIPTION</strong>: Upstream of the AEWSD Sycamore Spreading Basins adjacent to Sycamore Creek is an existing granite quarry. The quarry is approaching the end of its operational life and could be converted into a balancing/detention/spreading reservoir. Excess flows in the North Canal would be pumped into the quarry reservoir, so the detained water could be recirculated for irrigation demands and/or recharged for in-lieu groundwater pumping. Additional storage may also allow the District to better match available surface water supply (to its peak irrigation season demands) and groundwater supply (i.e., well capacity) (to demands any time of year), both of which increase water supply for the year. Additional storage would also provide delivery flexibility to on-farm users. Additional in-District storage may allow increased water ordering and delivery flexibility (more variable rate and duration allowed with shorter notice vs. now). In addition, if environmental permitting allowed, Sycamore Creek flows could be diverted into the quarry reservoir to circumvent localized flooding and detain the sediment laden water for recharge and/or recirculated for irrigation demands.</td>
<td></td>
</tr>
</tbody>
</table>

| **EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year): |
| 3,000-6,000 recharge / 2,500 increased storage |

| **AGENCY(s):** |
| Primary/Lead: AEWSD |
| Supporting: Granite Co. |

| **LOCATION:** |
| Township / Range: N/A |
| Coordinates (Latitude / Longitude): 35.197141, 118.752213 |
| Description: Quarry east of AEWSD Sycamore Spreading Basins & North Canal |

| **AFFECTED SUSTAINABILITY INDICATOR** (check all that apply): |
| ☐ Chronic Lowering of Groundwater Levels | ☐ Reduction of Groundwater Storage |
| ☐ Seawater Intrusion | ☐ Degraded Water Quality |
| ☐ Land Subsidence | ☐ Depletions of Interconnected Surface Water |

| **TYPE** (check all that apply): |
| ☐ Water Supply Augmentation |
| ☑ Surface Water | ☐ Groundwater (Recharge) | ☐ Recycled Water |
| ☐ Transfer | ☐ Stormwater | ☐ Other |
| Source of Outside Water (if applicable): | |
| ☐ Water Demand Reduction |
| ☐ Conservation | ☐ Land / Water Use Changes |
| ☑ Infrastructure / Capital Project | ☐ Policy Project |
| ☐ Data Gap Filling / Monitoring | ☐ Water Quality Improvement |
| ☐ Other: | |
**COSTS & FUNDING SOURCE(s):**

- **Capital / Up-front ($):** 10-20M  
  - **Source(s):** AEWSD, TCWD, Grants
- **O&M / On-going ($ per year):** TBD  
  - **Source(s):** TBD

---

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS** (describe all that apply):

- **Permits (name of authority, type of permit):**  
  - NEPA if federal grant funds used, SMARA potential
- **CEQA:** required
- **Other:**

---

**SCHEDULE / TIMING:**

- **Implementation Trigger(s):** Grant funding
- **Termination Trigger(s):** Project completion
- **Timeframe to Accrue Expected Benefits:** 1-3 years post construction

---

**ADDITIONAL DETAILS** (as necessary):

The abandonment of an active quarry and conversion to a major reservoir would likely include extensive hydrogeologic, biological, and environmental studies.
ARVIN-EDISON WATER STORAGE DISTRICT

PROJECT / MANAGEMENT ACTION

INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID: 14</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>AEWSD South Canal Balancing Reservoir</td>
</tr>
<tr>
<td>DESCRIPTION:</td>
<td>District is in need of additional infrastructure to allow water storage and regulation of flow mismatches in the Canal System during operation or emergencies (e.g., a local/global power outage in one or more pumping plants). This infrastructure is most needed in the lower third of the canal system. Additional storage may also allow the District to better match available surface water supply (to its peak irrigation season demands) and groundwater supply (i.e., well capacity) (to demands any time of year), both of which increase water supply for the year. Additional storage will also provide delivery flexibility to on-farm users. Additional in-District storage may allow increased water ordering and delivery flexibility (more variable rate and duration allowed with shorter notice vs. now). This will benefit customers District-wide and result in improved water use efficiency and increased crop yields and quality. Ancillary floodplain management benefits would result from additional ability to capture and store floodwaters.</td>
</tr>
<tr>
<td>EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):</td>
<td>Depends on selected location, ~500AF</td>
</tr>
<tr>
<td>AGENCY(s):</td>
<td>Primary/Lead: AEWSD</td>
</tr>
<tr>
<td></td>
<td>Supporting:</td>
</tr>
<tr>
<td>LOCATION:</td>
<td>□ Check here if Basin-wide</td>
</tr>
<tr>
<td>Township / Range: TBD</td>
<td></td>
</tr>
<tr>
<td>Coordinates (Latitude / Longitude): TBD</td>
<td></td>
</tr>
<tr>
<td>Description: along South Canal northeast of the City of Mettler in Kern County</td>
<td></td>
</tr>
<tr>
<td>AFFECTED SUSTAINABILITY INDICATOR (check all that apply):</td>
<td>□ Chronic Lowering of Groundwater Levels</td>
</tr>
<tr>
<td>□ Seawater Intrusion</td>
<td>□ Degraded Water Quality</td>
</tr>
<tr>
<td>□ Land Subsidence</td>
<td>□ Depletions of Interconnected Surface Water</td>
</tr>
<tr>
<td>TYPE (check all that apply):</td>
<td>□ Water Supply Augmentation</td>
</tr>
<tr>
<td>□ Surface Water</td>
<td>□ Groundwater (Recharge)</td>
</tr>
<tr>
<td>□ Transfer</td>
<td>□ Stormwater</td>
</tr>
<tr>
<td>Source of Outside Water (if applicable):</td>
<td></td>
</tr>
<tr>
<td>□ Water Demand Reduction</td>
<td>□ Conservation</td>
</tr>
<tr>
<td>□ Infrastructure / Capital Project</td>
<td>□ Policy Project</td>
</tr>
<tr>
<td>□ Data Gap Filling / Monitoring</td>
<td>□ Water Quality Improvement</td>
</tr>
<tr>
<td>□ Other:</td>
<td></td>
</tr>
</tbody>
</table>

1 Please continue to next page or attach additional pages to this form as necessary
**COSTS & FUNDING SOURCE(s):**

<table>
<thead>
<tr>
<th>Capital / Up-front ($)</th>
<th>Source(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1-10M</td>
<td>AEWSD, Grant funding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>O&amp;M / On-going ($ per year)</th>
<th>Source(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>~$5,000</td>
<td>AEWSD</td>
</tr>
</tbody>
</table>

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):**

<table>
<thead>
<tr>
<th>Permits (name of authority, type of permit):</th>
<th>SJVAPCD Dust Control, MND</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEQA:</td>
<td>MND</td>
</tr>
<tr>
<td>Other:</td>
<td>NEPA if federal grant funds used, SMARA exemption</td>
</tr>
</tbody>
</table>

**SCHEDULE / TIMING:**

<table>
<thead>
<tr>
<th>Implementation Trigger(s):</th>
<th>Grant funding, South County flooding response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termination Trigger(s):</td>
<td>Project completion</td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits:</td>
<td>1-3 years post construction</td>
</tr>
</tbody>
</table>

**ADDITIONAL DETAILS (as necessary):**
The Ground Water Service Area (GWSA) within the District consists of landowners that rely only on Groundwater (GW) sources to meet their crop irrigation requirements. With the In-lieu Banking Program the District will supply Surface Water (SW) when available through new facilities to the GWSA to meet its water requirements with the intent of reducing District-wide GW use. With the District’s new 9(d) contract, certain provisions of Reclamation law are no longer applicable and all lands within the service area can now be served with federal water supplies. In addition, water users have inquired about District supplied power to provide an alternative to current power suppliers. The project would include new irrigation conveyance facilities consisting of pipelines, turnouts, booster pumps, etc. in the Frick Unit GWSA (see attached map). A connection to KDWD’s Eastside Canal may also allow for use of other local recharge facilities including the earthen Eastside Canal when not in use by KDWD. In addition, another component of the in-lieu project, considering the District is a participant in the Power and Water Resources Pooling Authority (PWRPA), is the potential of District landowner to be eligible to receive PWRPA power (instead of current PG&E service). As a part of the program, District landowner could provide their wells for overall District operations and in return the District would provide the landowner surface water during times of available supplies.

3,500 AF/yr increased surface water deliveries

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

**AGENCY(s):**

Primary/Lead: AEWSD
Supporting: Multiple possibilities given project description and benefits including energy grants

**LOCATION:**

 Township / Range: N/A
 Coordinates (Latitude / Longitude): N/A
 Description: Between AEWSD North Canal, KDWD Eastside Canal (see attached map)

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):

- Reducing/Improving Groundwater Levels
- Reduction of Groundwater Storage
- Degraded Water Quality
- Depletions of Interconnected Surface Water

**TYPE** (check all that apply):

- Water Supply Augmentation
  - Surface Water
  - Groundwater (Recharge)
  - Recycled Water
- Water Demand Reduction
  - Conservation
- Infrastructure / Capital Project
  - Land / Water Use Changes
- Data Gap Filling / Monitoring
  - Policy Project
- Water Quality Improvement
- Other:
**COSTS & FUNDING SOURCE(s):**

- Capital / Up-front ($): TBD
  - Source(s): AEWSD
- O&M / On-going ($ per year): TBD
  - Source(s): AEWSD

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS** (describe all that apply):
- Permits (name of authority, type of permit): potential County encroachment permits, private
- CEQA: required
- Other: NEPA if federal grant funds used, PWRPA

**SCHEDULE / TIMING:**
- Implementation Trigger(s): Grant funding
- Termination Trigger(s): Project completion
- Timeframe to Accrue Expected Benefits: 1-3 years post construction

**ADDITIONAL DETAILS** (as necessary):

The District, water exchangers, water banking partners, and neighboring areas will benefit from increased conjunctive water management programs in the area. Possible water quality benefits may result for banking partners from high quality recovered water. Note that the District and drinking water users have a variety of water quality issues. These include salts, boron, nitrates, Bromides, and disinfection byproducts.

See Attachment for Project location.
# ARVIN-EDISON WATER STORAGE DISTRICT
## PROJECT / MANAGEMENT ACTION
### INFORMATION FORM

**P/MA ID:** 16  
**BASIN/MANAGEMENT AREA (if any):** AEWSD

**TITLE:** DiGiorgio Unit In-Lieu Project

**DESCRIPTION:**

The Ground Water Service Area (GWSA) within the District consists of landowners that rely only on Groundwater (GW) sources to meet their crop irrigation requirements. With the In-lieu Banking Program, the District will supply Surface Water (SW) when available through new facilities to the GWSA to meet its water requirements with the intent of reducing District-wide GW use. However, when SW is in short supply and under agreement, the landowners could recover and return GW from their own wells to the District canal system through new pipelines once they have satisfied their own water needs. With the District’s new 8(e) contract, certain provisions of Reclamation Law are no longer applicable and all lands within the service area can now be served with federal water supplies. In addition, water users have inquired about District supplied power to provide an alternative to current power suppliers. The project would include new irrigation conveyance facilities consisting of pipelines, turnouts, booster pumps, etc. in the DiGiorgio Unit ILP GWSA (see attached map).  

A connection to KDWD’s Eastside Canal may also allow for use of other local recharge facilities including the earthen Eastside Canal when not in use by KDWD. In addition, another component of the in-lieu project, considering the District is a participant in the Power and Water Resources Pooling Authority (PWRPA), is the potential of District landowner to be eligible to receive PWRPA power (instead of current PG&E service). As a part of the program, District landowner could provide their wells for overall District operations and in return the District would provide the landowner surface water during times of available supplies.

---

### EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):

4,250 AFY increased surface water deliveries

**AGENCY(s):**

- **Primary/Lead:** AEWSD  
- **Supporting:** Multiple possibilities given project description and benefits including energy grants

**LOCATION:**

- **Township / Range:** N/A  
- **Coordinates (Latitude / Longitude):** N/A  
- **Description:** Between AEWSD North Canal, KDWD Eastside Canal, Di Giorgio Rd, and Sunset Blvd.

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):

- □ Chronic Lowering of Groundwater Levels  
- □ Seawater Intrusion  
- □ Land Subsidence  
- □ Reduction of Groundwater Storage  
- □ Degraded Water Quality  
- □ Depletions of Interconnected Surface Water

**TYPE (check all that apply):**

- □ Water Supply Augmentation
  
  - □ Surface Water  
  - □ Groundwater (Recharge)  
  - □ Recycled Water  
  - □ Stormwater  
  - □ Other
  
  Source of Outside Water (if applicable): ____________________________

- □ Water Demand Reduction
  
  - □ Conservation
  
  - □ Land / Water Use Changes

- □ Infrastructure / Capital Project
  
  - □ Policy Project
  
  - □ Water Quality Improvement

- □ Data Gap Filling / Monitoring
  
  - □ Other: ____________________________

---

1 *Please continue to next page or attach additional pages to this form as necessary*
**COSTS & FUNDING SOURCE(s):**

- **Capital / Up-front ($):** Phases 2 through 5 = $17 Million
  - **Source(s):** AEWSD, federal funds
- **O&M / On-going ($ per year):** TBD
  - **Source(s):** AEWSD, federal funds

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS** (describe all that apply):

- **Permits (name of authority, type of permit):** potential County encroachment permits, private
  - **CEQA:** required
- **Other:** NEPA if federal grant funds used, PWRPA

**SCHEDULE / TIMING:**

- **Implementation Trigger(s):** Grant funding
- **Termination Trigger(s):** Project completion
- **Timeframe to Accrue Expected Benefits:** 1-3 years post construction

**ADDITIONAL DETAILS** (as necessary):

The District, water exchangers, water banking partners, and neighboring areas will benefit from increased conjunctive water management programs in the area. Possible water quality benefits may result for banking partners from high quality recovered water. Note that the District and drinking water users have a variety of water quality issues. These include salts, boron, nitrates, Bromides, and disinfection byproducts.

See AEWSD NILP Map Attachment.
## ARVIN-EDISON WATER STORAGE DISTRICT
### PROJECT / MANAGEMENT ACTION
#### INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>17</th>
<th>BASIN/MANAGEMENT AREA (if any):</th>
<th>AEWSD</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>TITLE:</strong></th>
<th>General In-Lieu Banking Program</th>
</tr>
</thead>
</table>

| **DESCRIPTION:** | The Ground Water Service Area (GWSA) within the District consists of landowners that rely only on Groundwater (GW) sources to meet their crop irrigation requirements. With the In-lieu Banking Program the District will supply Surface Water (SW) when available through new facilities to the GWSA to meet its water requirements with the intent of reducing District-wide GW use. However when SW is in short supply and under agreement, the landowners could recover and return GW from their own wells to the District canal system through new pipelines once they have satisfied their own water needs. With the District’s new (9d) contract, certain provisions of Reclamation law are no longer applicable and all lands within the service area can now be served with federal water supplies. In addition, water users have inquired about District supplied power to provide an alternative to current power suppliers. The project would include new irrigation conveyance facilities consisting of pipelines, turnouts, booster pumps, etc. in the GWSA. The project may integrate with the Lateral Capacity Improvement Project, North Canal Check Structure Project, South Balancing project, and other agency needs for the Kern Groundwater Basin. The District has begun increasing the in-lieu service area with temporary water contracts, utilizing existing infrastructure (turnouts, pipelines that are both District and landowner owned). The program has even involved wheeling in Kern Delta’s Eastside Canal to certain landowners. And, interconnections from the North Canal to the Eastside Canal are possible projects/pipelines that may also pass lands that are eligible for water service (dual benefit). Connections to KDWD may also allow for use of other local recharge facilities including the eastern Eastside Canal when not in use by KDWD. In addition, another component of in-lieu banking, considering the District is a participant in the Power and Water Resources Pooling Authority (PWRPA), is the potential of District landowner to be eligible to receive PWRPA power (instead of current PG&E service). As a part of the program, District landowner could provide their wells for overall District operations and in return the District would provide the landowner surface water during times of available supplies. |

<table>
<thead>
<tr>
<th><strong>EXPECTED ANNUAL BENEFIT</strong> (demand reduction or supply augmentation, in acre-feet per year):</th>
<th>2.75 AFY/ac increased surface water deliveries every 2.5 years</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>AGENCY(s):</strong></th>
<th>Primary/Lead: AEWSD</th>
</tr>
</thead>
</table>

| Supporting: | Multiple possibilities given project description and benefits including energy grants |

<table>
<thead>
<tr>
<th><strong>LOCATION:</strong></th>
<th>Township / Range: N/A</th>
</tr>
</thead>
</table>

| Coordinate (Latitude / Longitude): N/A |
|---|---|

| Description: | GWSA is located mostly on the west side of the District’s North and South Canals |

<table>
<thead>
<tr>
<th><strong>AFFECTED SUSTAINABILITY INDICATOR</strong> (check all that apply):</th>
<th>□ Chronic Lowering of Groundwater Levels</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Seawater Intrusion</th>
<th>□ Reduction of Groundwater Storage</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Land Subsidence</th>
<th>□ Degraded Water Quality</th>
</tr>
</thead>
</table>

| □ Depletions of Interconnected Surface Water |
|---|---|

<table>
<thead>
<tr>
<th><strong>TYPE</strong> (check all that apply):</th>
<th>□ Water Supply Augmentation</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Surface Water</th>
<th>□ Groundwater (Recharge)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Recycled Water</th>
<th>□ Stormwater</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Other</th>
<th>□ Water Demand Reduction</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Conservation</th>
<th>□ Land / Water Use Changes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Infrastructure / Capital Project</th>
<th>□ Policy Project</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Data Gap Filling / Monitoring</th>
<th>□ Water Quality Improvement</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>□ Other:</th>
<th></th>
</tr>
</thead>
</table>

1 Please continue to next page or attach additional pages to this form as necessary
COSTS & FUNDING SOURCE(s):
Capital / Up-front ($): $1-10 Million
Source(s): AEWSD
O&M / On-going ($ per year): TBD
Source(s): AEWSD

REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):
Permits (name of authority, type of permit): potential County encroachment permits, private CEQA: required
Other: NEPA if federal grant funds used, PWRPA

SCHEDULE / TIMING:
Implementation Trigger(s): Grant funding
Termination Trigger(s): Project completion
Timeframe to Accrue Expected Benefits: 1-3 years post construction

ADDITIONAL DETAILS (as necessary):
The District, water exchangers, water banking partners, and neighboring areas will benefit from increased conjunctive water management programs in the area. Possible water quality benefits may result for banking partners from high quality recovered water. Note that the District and drinking water users have a variety of water quality issues. These include salts, boron, nitrates, Bromides, and disinfection byproducts.
<table>
<thead>
<tr>
<th><strong>P/MA ID:</strong></th>
<th>18</th>
<th><strong>BASIN/MANAGEMENT AREA (if any):</strong></th>
<th>AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TITLE:</strong></td>
<td>Reclamation of Oilfield Produced Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DESCRIPTION:</strong></td>
<td>Reclaiming water from oil production facilities for irrigation purposes is currently an untapped water source in AEWSD. After treatment and cooling, water could be pumped into AEWSD facilities to serve irrigation demands in-lieu of groundwater pumping.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EXPECTED ANNUAL BENEFIT</strong></td>
<td>(demand reduction or supply augmentation, in acre-feet per year):</td>
<td>1,000 AF/yr</td>
<td></td>
</tr>
<tr>
<td><strong>AGENCY(s):</strong></td>
<td>Primary/Lead: TBD, Private oilfield</td>
<td>Supporting:</td>
<td></td>
</tr>
<tr>
<td><strong>LOCATION:</strong></td>
<td>Township / Range: N/A</td>
<td>Coordinates (Latitude / Longitude): various</td>
<td>Description: various</td>
</tr>
<tr>
<td><strong>AFFECTED SUSTAINABILITY INDICATOR</strong></td>
<td>(check all that apply):</td>
<td>□ Check here if Basin-wide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Chronic Lowering of Groundwater Levels</td>
<td>□ Reduction of Groundwater Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Seawater Intrusion</td>
<td>□ Degraded Water Quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Land Subsidence</td>
<td>□ Depletions of Interconnected Surface Water</td>
<td></td>
</tr>
<tr>
<td><strong>TYPE</strong></td>
<td>(check all that apply):</td>
<td>□ Water Supply Augmentation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Surface Water</td>
<td>□ Groundwater (Recharge)</td>
<td>□ Recycled Water</td>
</tr>
<tr>
<td></td>
<td>□ Transfer</td>
<td>□ Stormwater</td>
<td>□ Other</td>
</tr>
<tr>
<td></td>
<td>Source of Outside Water (if applicable):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Water Demand Reduction</td>
<td>□ Conservation</td>
<td>□ Land / Water Use Changes</td>
<td></td>
</tr>
<tr>
<td>□ Infrastructure / Capital Project</td>
<td>□ Policy Project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Data Gap Filling / Monitoring</td>
<td>□ Water Quality Improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Other:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Please continue to next page or attach additional pages to this form as necessary
<table>
<thead>
<tr>
<th>COSTS &amp; FUNDING SOURCE(s):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($)</td>
<td>TBD</td>
</tr>
<tr>
<td>Source(s):</td>
<td>AEWSD and partnering oilfield</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year)</td>
<td>TBD</td>
</tr>
<tr>
<td>Source(s):</td>
<td>AEWSD and partnering oilfield</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits (name of authority, type of permit):</td>
<td></td>
</tr>
<tr>
<td>CEQA:</td>
<td>unknown</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCHEDULE / TIMING:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Trigger(s):</td>
<td>TBD</td>
</tr>
<tr>
<td>Termination Trigger(s):</td>
<td>TBD</td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits:</td>
<td>1 year post construction</td>
</tr>
</tbody>
</table>

| ADDITIONAL DETAILS (as necessary): |  |
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID: 19</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
</table>

**TITLE:** Wastewater Reclamation with City of Arvin & Bakersfield

**DESCRIPTION:**
Reclaiming water from Cities of Arvin and Bakersfield wastewater treatment facilities for irrigation purposes is currently an untapped water source in AEWSD. After wastewater treatment, the effluent could be pumped into AEWSD facilities to serve irrigation demands in-lieu of groundwater pumping.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

10,000 AF/yr

**AGENCY(s):**
- Primary/Lead: TBD, Cities of Arvin and Bakersfield
- Supporting: ____________________________

**LOCATION:**
- Township / Range: N/A
- Coordinates (Latitude / Longitude): various
- Description: various
- Check here if Basin-wide

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):
- [x] Chronic Lowering of Groundwater Levels
- [x] Reduction of Groundwater Storage
- [ ] Seawater Intrusion
- [ ] Degraded Water Quality
- [ ] Land Subsidence
- [ ] Depletions of Interconnected Surface Water

**TYPE** (check all that apply):
- [ ] Water Supply Augmentation
  - [ ] Surface Water
  - [ ] Groundwater (Recharge)
  - [x] Recycled Water
  - [ ] Transfer
  - [ ] Stormwater
  - [ ] Other
  - Source of Outside Water (if applicable): ____________________________
- [ ] Water Demand Reduction
  - [ ] Conservation
  - [ ] Land / Water Use Changes
  - [ ] Infrastructure / Capital Project
  - [ ] Policy Project
  - [ ] Data Gap Filling / Monitoring
  - [ ] Water Quality Improvement
  - [ ] Other: ____________________________

---

1 Please continue to next page or attach additional pages to this form as necessary
### COSTS & FUNDING SOURCE(s):

<table>
<thead>
<tr>
<th>Capital / Up-front ($)</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AEWSD and partnering Cities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>O&amp;M / On-going ($ per year)</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD</td>
<td>AEWSD and partnering Cities</td>
</tr>
</tbody>
</table>

### REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):

<table>
<thead>
<tr>
<th>Permits (name of authority, type of permit)</th>
<th>CEQA</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>City encroachment permits</td>
<td>unknown</td>
<td>potentially RWQCB</td>
</tr>
</tbody>
</table>

### SCHEDULE / TIMING:

<table>
<thead>
<tr>
<th>Implementation Trigger(s)</th>
<th>Termination Trigger(s)</th>
<th>Timeframe to Accrue Expected Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD</td>
<td>TBD</td>
<td>1 year post construction</td>
</tr>
</tbody>
</table>

### ADDITIONAL DETAILS (as necessary):

TBD

AEWSD and partnering Cities

City encroachment permits

unknown

potentially RWQCB

1 year post construction
## ARVIN-EDISON WATER STORAGE DISTRICT
### PROJECT / MANAGEMENT ACTION
#### INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID: 20</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TITLE:</strong> AEWSD Groundwater Subsidies for Land Conversion</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>DESCRIPTION:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The District may adopt a management action to provide subsidies to incentivize groundwater users to convert land to alternative land uses and reduce groundwater extractions. The District may consider a subsidy structure study to determine which subsidies would result in the greatest expected annual benefit in acre-feet per year. Subsidies could be provided to growers willing to implement one or more of the following: 1. Change crop type to one with lower water demand 2. Rotate crops and temporarily fallow portions of their irrigated acreage to reduce water demand 3. Retire, or permanently fallow, land for alternative uses such as solar arrays or upland habitat creation 4. Recharge/regulation basin infrastructure for increased surface water use and recharge Since the subsidy programs would be voluntary with an unknown number of participants, it is assumed the District would define a maximum budget account with each corresponding type of subsidy. In addition, there would costs associated with field verification prior to the subsidy payment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>EXPECTED ANNUAL BENEFIT</strong> (demand reduction or supply augmentation, in acre-feet per year):</th>
</tr>
</thead>
<tbody>
<tr>
<td>~2.75 AF/ac fallowed (temporary or permanent), ~2.75 AF/ac converted to basin, ~0.5-1.0 AF/ac permanent to annual crop</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>AGENCY(s):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary/Lead: AEWSD</td>
</tr>
<tr>
<td>Supporting:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>LOCATION:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Township / Range: N/A</td>
</tr>
<tr>
<td>Coordinates (Latitude / Longitude): various</td>
</tr>
<tr>
<td>Description: various</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>AFFECTED SUSTAINABILITY INDICATOR</strong> (check all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Chronic Lowering of Groundwater Levels</td>
</tr>
<tr>
<td>☐ Seawater Intrusion</td>
</tr>
<tr>
<td>☐ Land Subsidence</td>
</tr>
<tr>
<td>☐ Reduction of Groundwater Storage</td>
</tr>
<tr>
<td>☐ Degraded Water Quality</td>
</tr>
<tr>
<td>☐ Depletions of Interconnected Surface Water</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>TYPE</strong> (check all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Water Supply Augmentation</td>
</tr>
<tr>
<td>☐ Surface Water</td>
</tr>
<tr>
<td>☐ Groundwater (Recharge)</td>
</tr>
<tr>
<td>☐ Recycled Water</td>
</tr>
<tr>
<td>☐ Transfer</td>
</tr>
<tr>
<td>☐ Stormwater</td>
</tr>
<tr>
<td>☐ Other</td>
</tr>
<tr>
<td>Source of Outside Water (if applicable):</td>
</tr>
<tr>
<td>☐ Water Demand Reduction</td>
</tr>
<tr>
<td>☐ Conservation</td>
</tr>
<tr>
<td>☐ Land / Water Use Changes</td>
</tr>
<tr>
<td>☐ Infrastructure / Capital Project</td>
</tr>
<tr>
<td>☐ Policy Project</td>
</tr>
<tr>
<td>☐ Data Gap Filling / Monitoring</td>
</tr>
<tr>
<td>☐ Water Quality Improvement</td>
</tr>
<tr>
<td>☐ Other: potential renewable energy and habitat creation</td>
</tr>
</tbody>
</table>

---

1 Please continue to next page or attach additional pages to this form as necessary
**COSTS & FUNDING SOURCE(s):**
- Capital / Up-front ($): 15,000 - 30,000, but the levied fees will recoup costs and generate on-going revenue
  - Source(s): AEWSD
- O&M / On-going ($ per year): ~10,000 - 1M as District budgets allow
  - Source(s): AEWSD

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS** (describe all that apply):
- Permits (name of authority, type of permit): GSA coordination
- CEQA: none
- Other: None

**SCHEDULE / TIMING:**
- Implementation Trigger(s): The policy may be implemented 3-5 years after the adoption of the GSP.
- Termination Trigger(s): Remain indefinitely or until subsidy funds diminish
- Timeframe to Accrue Expected Benefits: 1 year post implementation

**ADDITIONAL DETAILS** (as necessary):
The expected benefits will reduce irrigated acreage and overall groundwater pumping.
### ARVIN-EDISON WATER STORAGE DISTRICT

#### PROJECT / MANAGEMENT ACTION

**INFORMATION FORM**

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>21</th>
<th>BASIN/MANAGEMENT AREA (if any):</th>
<th>AEWSD</th>
</tr>
</thead>
</table>

#### TITLE:
On-farm Water Conservation

#### DESCRIPTION:
District growers are encouraged to take advantage of various grant programs available to improve on-farm water conservation and irrigation efficiency. The NRCS is offering landowner incentive programs to assist in implementing various conservation activities, including but not limited to, irrigation system improvements, water/nutrient/pest management, and engine replacement. Interested landowners can call (661) 336-0967 or visit the website (www.ca.nrcs.usda.gov) for more information.

#### EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):

**50 - 500 AFY**

#### AGENCY(s):

<table>
<thead>
<tr>
<th>Primary/Lead:</th>
<th>Landowner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting:</td>
<td>__________________________________________________________________</td>
</tr>
</tbody>
</table>

#### LOCATION:

| Township / Range: | N/A |
| Coordinates (Latitude / Longitude): | various |
| Description: | various |

#### AFFECTED SUSTAINABILITY INDICATOR (check all that apply):

- Chronic Lowering of Groundwater Levels
- Reduction of Groundwater Storage
- Seawater Intrusion
- Degraded Water Quality
- Land Subsidence
- Depletions of Interconnected Surface Water

#### TYPE (check all that apply):

- **Water Supply Augmentation**
  - Surface Water
  - Groundwater (Recharge)
  - Recycled Water
  - Transfer
  - Stormwater
  - Other
  - Source of Outside Water (if applicable): __________________________________________________________________

- **Water Demand Reduction**
  - Conservation
  - Land / Water Use Changes
  - Infrastructure / Capital Project
  - Policy Project
  - Data Gap Filling / Monitoring
  - Water Quality Improvement

---

1 Please continue to next page or attach additional pages to this form as necessary
**COSTS & FUNDING SOURCE(s):**

- Capital / Up-front ($): 10,000 - 100,000
  - Source(s): NRCS
- O&M / On-going ($ per year): Not applicable
  - Source(s): Not applicable

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS** (describe all that apply):

- Permits (name of authority, type of permit): 
- CEQA: 
- Other: 

**SCHEDULE / TIMING:**

- Implementation Trigger(s): Participant interest, Grant funding
- Termination Trigger(s): project completion
- Timeframe to Accrue Expected Benefits: 1-3 years post construction

**ADDITIONAL DETAILS** (as necessary):

See NRCS Attachment
Overview

The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation or improved or created wildlife habitat.

Benefits

Eligible program participants receive financial and technical assistance to implement conservation practices, or activities like conservation planning, that address natural resource concerns on their land. Payments are made to participants after conservation practices and activities identified in an EQIP plan of operations are implemented. Contracts can last up to ten years in duration.

Eligibility

Agricultural producers and owners of non-industrial private forestland and Tribes are eligible to apply for EQIP. Eligible land includes cropland, rangeland, pastureland, non-industrial private forestland and other farm or ranch lands.
Socially disadvantaged, beginning and limited resource farmers, Indian tribes and veterans are eligible for an increased payment rate and may receive advance payment of up to 50 percent to purchase materials and services needed to implement conservation practices included in their EQIP contract.

Applicants must:
- Control or own eligible land
- Comply with adjusted gross income limitation (AGI) provisions
- Be in compliance with the highly erodible land and wetland conservation requirements
- Develop an NRCS EQIP plan of operations

Additional restrictions and program requirements may apply.

**How to apply**
Visit your local USDA Service Center to apply or visit www.nrcs.usda.gov/getstarted.

NRCS will help eligible producers develop an EQIP plan of operations, which will become the basis of the EQIP contract.

EQIP applications will be ranked based on a number of factors, including the environmental benefits and cost effectiveness of the proposal.

**More Information**
For more information visit your local USDA Service Center or www.nrcs.usda.gov/farmbill.

**Find your local USDA Service Center**
http://offices.usda.gov

**What’s New in EQIP**
- The former Wildlife Habitat Incentive Program was folded into EQIP.
- Advance payment opportunities now exist for veteran agricultural producers.
- Advance payments for socially disadvantaged, beginning and limited resource farmers, Indian tribes and veterans were raised from 30 percent to 50 percent.
- Payment limitations are set at $450,000 with no ability to waive.

A water trough in a pasture keeps cattle out of critical riparian area.

---


Natural Resources Conservation Service

USDA is an equal opportunity provider and employer.
ARVIN-EDISON WATER STORAGE DISTRICT  
PROJECT / MANAGEMENT ACTION  
INFORMATION FORM  

<table>
<thead>
<tr>
<th>P/MA ID: 22</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
</table>

**TITLE:** Groundwater Fee Increase

**DESCRIPTION**:  
The District may adopt a management action to increase GWSA costs to incentivize groundwater users to reduce groundwater extractions and take surface water when available. The District may consider modifying its fee structure study to determine the best strategy for curbing groundwater overdraft without causing inequitable economic impact. The following potential fee structures would affect groundwater users differently, so a composite fee structure may also be considered.  
1. Once a groundwater allocation policy including individual allocations and chosen quantification method has been adopted, the District may adopt a policy to levy fees for pumping beyond the current groundwater allocation.  
2. The District may adopt a policy to levy tiered fees based upon usage in acre-feet of pumped groundwater.  
3. The District may adopt a policy to levy flat rate well head fees. As a prerequisite, the GSA must first ascertain a database of all groundwater extraction facilities, or only charge new permits, such that the District can efficiently and accurately collect the well head fee.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):  

| AGENCY(s): | 
|-------------|---------------------------------------------|
| Primary/Lead: AEWSD |
| Supporting: |

**LOCATION**:  

<table>
<thead>
<tr>
<th>Township / Range: N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinates (Latitude / Longitude): various</td>
</tr>
<tr>
<td>Description: various</td>
</tr>
</tbody>
</table>

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):  
- ■ Chronic Lowering of Groundwater Levels  
- □ Seawater Intrusion  
- □ Land Subsidence  
- ■ Reduction of Groundwater Storage  
- □ Degraded Water Quality  
- □ Depletions of Interconnected Surface Water

**TYPE** (check all that apply):  
- □ Water Supply Augmentation  
  - □ Surface Water  
  - □ Groundwater (Recharge)  
  - □ Recycled Water  
  - □ Transfer  
  - □ Stormwater  
  - □ Other  
  - Source of Outside Water (if applicable):  

- ■ Water Demand Reduction  
  - □ Conservation  
  - □ Land / Water Use Changes  
- □ Infrastructure / Capital Project  
  - □ Policy Project  
- □ Data Gap Filling / Monitoring  
  - □ Water Quality Improvement  
- □ Other:  

---

1 Please continue to next page or attach additional pages to this form as necessary
COSTS & FUNDING SOURCE(s):

<table>
<thead>
<tr>
<th>Capital / Up-front ($)</th>
<th>Source(s)</th>
<th>O&amp;M / On-going ($ per year)</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):

<table>
<thead>
<tr>
<th>Permits (name of authority, type of permit)</th>
<th>CEQA</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSA coordination</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

SCHEDULE / TIMING:

<table>
<thead>
<tr>
<th>Implementation Trigger(s)</th>
<th>Termination Trigger(s)</th>
<th>Timeframe to Accrue Expected Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>The policy may be implemented 3-5 years after the adoption of the GSP.</td>
<td>Remain indefinitely or until other programs are enacted.</td>
<td>1-3 years post implementation</td>
</tr>
</tbody>
</table>

ADDITIONAL DETAILS (as necessary):

The expected benefits would be tied to the Groundwater Extraction Quantification Method and Groundwater Allocation per Acre management actions. The expected benefits may mitigate local overdraft by incentivizing groundwater extractors to reduce pumping or pump groundwater supplies in a sustainable fashion. The ancillary benefits include additional funds for the GSA to invest in other projects and management actions.
**ARVIN-EDISON WATER STORAGE DISTRICT**  
**PROJECT / MANAGEMENT ACTION INFORMATION FORM**

<table>
<thead>
<tr>
<th>P/MA ID: 23</th>
<th>BASIN/MANAGEMENT AREA (if any): AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TITLE:</strong></td>
<td>Groundwater Extraction Quantification Method</td>
</tr>
<tr>
<td><strong>DESCRIPTION:</strong> The District may adopt a policy to specify the approved method or methods to quantify the individual and aggregate groundwater extractions for the required SGMA annual reporting. The District may consider a variety or combination of quantification methods including, but not limited to the following: 1. Irrigated Acreage determined by aerial flyovers or remote sensing 2. Irrigated area hybrid determined by annual crop survey alongside aerial flyovers or remote sensing of irrigation areas including crop coefficients 3. Calibrated energy records determined by energy records and meter calibrations 4. Volumetric flow measurement 5. Remote sensing of evapotranspiration 6. Other methods There are various advantages, disadvantages, and costs to all of these quantification methods. The District may consider exploring some of these methods with neighboring GSAs and basin wide for an aggregated approach and mutual cost savings.</td>
<td></td>
</tr>
<tr>
<td><strong>EXPECTED ANNUAL BENEFIT</strong> (demand reduction or supply augmentation, in acre-feet per year): N/A</td>
<td></td>
</tr>
</tbody>
</table>
| **AGENCY(s):** Primary/Lead: AEWSD  
Supporting: |
| **LOCATION:** Township / Range: N/A  
Coordinates (Latitude / Longitude): various  
Description: various |
| **AFFECTED SUSTAINABILITY INDICATOR** (check all that apply): ☐ Chronic Lowering of Groundwater Levels  ☐ Reduction of Groundwater Storage  
☐ Seawater Intrusion  ☐ Degraded Water Quality  
☐ Land Subsidence  ☐ Depletions of Interconnected Surface Water |
| **TYPE** (check all that apply): ☐ Water Supply Augmentation  
☐ Surface Water  ☐ Groundwater (Recharge)  ☐ Recycled Water  
☐ Transfer  ☐ Stormwater  ☐ Other  
Source of Outside Water (if applicable): |
| ☐ Water Demand Reduction  
☐ Conservation  ☐ Land / Water Use Changes  
☐ Infrastructure / Capital Project  ☐ Policy Project  
☐ Data Gap Filling / Monitoring  ☐ Water Quality Improvement  
☐ Other: |

1 Please continue to next page or attach additional pages to this form as necessary
<table>
<thead>
<tr>
<th>COSTS &amp; FUNDING SOURCE(s):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($)</td>
<td>25,000 - 1M depending upon chosen method</td>
</tr>
<tr>
<td>Source(s):</td>
<td>AEWSD</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year)</td>
<td>~$25,000 depending upon chosen method</td>
</tr>
<tr>
<td>Source(s):</td>
<td>AEWSD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits (name of authority, type of permit):</td>
<td>none</td>
</tr>
<tr>
<td>CEQA:</td>
<td>none</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCHEDULE / TIMING:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Trigger(s):</td>
<td>The policy may be implemented shortly after the adoption of the GSP.</td>
</tr>
<tr>
<td>Termination Trigger(s):</td>
<td>Remain indefinitely or until other programs are enacted.</td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits:</td>
<td>1 year post implementation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADDITIONAL DETAILS (as necessary):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The expected benefits would be tied to the Education of Groundwater Use per Acre and Groundwater Allocation per Acre management actions. The expected benefits may mitigate overdraft by improving the District’s knowledge of aggregate and individual groundwater extractions. The goal of this policy is to accurately and efficiently quantify groundwater extractions. This management action alone may not generate a quantifiable demand reduction, but it would benefit public education and outreach, and serve as a prerequisite to other management actions including groundwater marketing and trading, fees and subsidies, and pumping restrictions.</td>
<td></td>
</tr>
</tbody>
</table>
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>24</th>
<th>BASIN/MANAGEMENT AREA (if any):</th>
<th>AEWSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>Groundwater Allocation per Acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION:</td>
<td>The District may adopt a program which provides a finite groundwater allocation on a per acre basis. The policy would identify and forecast the demands associated with prior rights, domestic and environmental uses. The sustainable yield and ultimate groundwater allocation would take into consideration the existing water rights holders, disadvantaged communities (DACs), community service districts (CSDs), groundwater-dependent ecosystems (GDEs), and California Native American tribes. The District through collaboration with its users and beneficial users may consider whether an equal-, reduced-, or zero-allocation is given to lands with unexercised groundwater rights. The goal of the groundwater allocation are to ensure a fair groundwater allocation and extract groundwater in a sustainable manner. This management action alone may not generate a quantifiable demand reduction. However, it would serve other management actions and encourage growers to implement water conservation BMPs. Once an individual groundwater allocation is determined, the District may adopt a policy which provides a gradual “ramp-down” allocation decrease over time to arrive at the actual groundwater allocation to allow growers time to adjust to the concept of an allocation and, for some growers, a reduction in groundwater use. The policy would detail the number of years and amount of reduction each year. The District may adopt a policy which describes an &quot;adaptive management&quot; approach, whereby the groundwater allocation may be reviewed, changed, and reestablished every 5 years or during extreme drought as necessary to achieve long term sustainability. It is prudent for the District to acknowledge the current level of uncertainty in the available data and existing data gaps by providing flexibility in initial groundwater allocations as more data is gathered and analyzed in the upcoming years.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EXPECTED ANNUAL BENEFIT (demand reduction or supply augmentation, in acre-feet per year):

<table>
<thead>
<tr>
<th>AGENCY(s):</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary/Lead: AEWSD</td>
<td></td>
</tr>
<tr>
<td>Supporting:</td>
<td></td>
</tr>
</tbody>
</table>

LOCATION:

| Township / Range: | N/A |
| Coordinates (Latitude / Longitude): | various |
| Description: | various |

AFFECDT SUSTAINABILITY INDICATOR (check all that apply):

| Chronic Lowering of Groundwater Levels |
| Seawater Intrusion |
| Land Subsidence |

TYPE (check all that apply):

| Water Supply Augmentation |
| - Surface Water |
| - Groundwater (Recharge) |
| - Recycled Water |
| - Transfer |
| - Stormwater |
| - Other |

| Water Demand Reduction |
| - Conservation |
| - Land / Water Use Changes |
| - Infrastructure / Capital Project |
| - Policy Project |
| - Data Gap Filling / Monitoring |
| - Water Quality Improvement |
| - Other: |

1 Please continue to next page or attach additional pages to this form as necessary
**COSTS & FUNDING SOURCE(s):**
- Capital / Up-front ($): 25,000 - 100,000
  - Source(s): AEWSD
- O&M / On-going ($ per year): Not applicable
  - Source(s): Not applicable

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):**
- Permits (name of authority, type of permit): GSA coordination
- CEQA: None
- Other: None

**SCHEDULE / TIMING:**
- Implementation Trigger(s): The policy may be implemented shortly after the adoption of the GSP.
- Termination Trigger(s): Remain indefinitely or until other programs are enacted.
- Timeframe to Accrue Expected Benefits: 1-3 years post implementation

**ADDITIONAL DETAILS (as necessary):**
The expected benefits would be tied to the Education of Groundwater Use per Acre management action. The goals of the groundwater allocation per acre management action are to ensure a fair groundwater allocation, allow groundwater users time to adjust, and provide future flexibility in allocation determinations. The groundwater allocation management action alone may not generate a quantifiable demand reduction, but it would benefit public education and outreach, and serve as a prerequisite to other management actions including groundwater marketing and trading, fees and subsidies, and pumping restrictions.
ARVIN-EDISON WATER STORAGE DISTRICT
PROJECT / MANAGEMENT ACTION
INFORMATION FORM

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>25</th>
<th>BASIN/MANAGEMENT AREA (if any):</th>
<th>AEWSD</th>
</tr>
</thead>
</table>

**TITLE:** Groundwater Marketing & Trading

**DESCRIPTION:**
Once a groundwater allocation policy including individual allocations and chosen quantification method was adopted, the District would pursue a groundwater market and trading program to provide users and beneficial users more flexibility in utilizing their allocation. The District may adopt a policy to define groundwater allocation carryover provisions year-to-year and/or allow multi-year pumping averages. The inter-annual flexibility may be useful to growers who could change cropping patterns or fallow acreage. Though there is a risk that extreme drought may induce exceptionally high pumping in a single year, groundwater extractors may be able to strategize and better manage their assets. The District may adopt a policy to define groundwater banking program. The banking program would consider using surface water supplies when available in lieu of groundwater pumping. Though not feasible for all users, growers capable of surface water recharge on-farm may be able to percolate floodwater, or other transferred water, for recharge credits. There are many complexities and considerations required to initiate and successfully manage a banking program. The District should acknowledge and discuss any other water bank/credit systems in existence. The District may approve past replenishment projects and determine the timeframe for any banking efforts that took place prior to banking program adoption. The District may consider adjusting banking credits if future changes in sustainable yield and/or groundwater allocation require adjustment. The District may define a “leave-behind” amount for groundwater migration and operational and evaporative losses, as well as to buffer against impacts to neighboring wells. The District may consider finite timelines or expiration dates on banked water or ongoing “leave-behind” amounts.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

N/A

**AGENCY(s):**
Primary/Lead: AEWSD
Supporting: 

**LOCATION:**
Township / Range: N/A
Coordinates (Latitude / Longitude): various
Description: various

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):
- [ ] Chronic Lowering of Groundwater Levels
- [ ] Reduction of Groundwater Storage
- [ ] Seawater Intrusion
- [ ] Degraded Water Quality
- [ ] Land Subsidence
- [ ] Depletions of Interconnected Surface Water

**TYPE** (check all that apply):
- [ ] Water Supply Augmentation
  - [ ] Surface Water
  - [ ] Groundwater (Recharge)
  - [ ] Recycled Water
  - [ ] Transfer
  - [ ] Stormwater
  - [ ] Other
  
  Source of Outside Water (if applicable):

- [ ] Water Demand Reduction
  - [ ] Conservation
  - [ ] Land / Water Use Changes
- [ ] Infrastructure / Capital Project
  - [ ] Policy Project
- [ ] Data Gap Filling / Monitoring
  - [ ] Water Quality Improvement
- [ ] Other:

---

1 Please continue to next page or attach additional pages to this form as necessary
**COSTS & FUNDING SOURCE(s):**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($)</td>
<td>25,000 - 100,000</td>
<td>AEWSD</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year)</td>
<td>~25,000 - 50,000</td>
<td>AEWSD</td>
</tr>
</tbody>
</table>

**REGULATORY / LEGAL AUTHORITY REQUIREMENTS** (describe all that apply):

<table>
<thead>
<tr>
<th>Permits (name of authority, type of permit)</th>
<th>GSA coordination</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEQA:</td>
<td>none</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

**SCHEDULE / TIMING:**

<table>
<thead>
<tr>
<th>Implementation Trigger(s)</th>
<th>The policy may be implemented 3-5 years after the adoption of the GSP.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termination Trigger(s)</td>
<td>Remain indefinitely or until other programs are enacted.</td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits</td>
<td>1-3 years post implementation</td>
</tr>
</tbody>
</table>

**ADDITIONAL DETAILS** (as necessary):

The expected benefits would be tied to the Groundwater Extraction Quantification Method and Groundwater Allocation per Acre management actions. The groundwater marketing and trading management action alone may not generate a quantifiable demand reduction, but it would provide flexibility to groundwater extractors when other management actions are adopted such as groundwater fees and pumping restrictions.
**ARVIN-EDISON WATER STORAGE DISTRICT**  
**PROJECT / MANAGEMENT ACTION**  
**INFORMATION FORM**

<table>
<thead>
<tr>
<th>P/MA ID:</th>
<th>26</th>
<th>BASIN/MANAGEMENT AREA (if any):</th>
<th>AEWSD</th>
</tr>
</thead>
</table>

**TITLE:** Education of Groundwater Use per Acre

**DESCRIPTION**:  
The GSA may adopt a program which provides groundwater extractors their approximate groundwater extraction on a per acre basis for multiple years as an education tool prior to any enforcement action on a groundwater allocation. The goal is to provide education and promote awareness of the GSA overdraft condition particularly for those groundwater extractors who do not have meters. The annual educational letter may indicate the grower’s groundwater extraction, average crop demand, GSA average extraction, GSA overdraft, and remind pumpers of the GSA powers and authorities granted in SGMA. The GSA may consider multiple quantification methods for a consistent determination of groundwater extraction per acre. This management action alone may not generate a quantifiable demand reduction. However, it would serve as an educational tool which may change individual practices and encourage growers to implement water conservation BMPs.

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year):

100 AF/yr

**AGENCY(s):**  
Primary/Lead: AEWSD

**LOCATION:**  
Township / Range: various  
Coordinates (Latitude / Longitude): various  
Description: District wide

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):

- [x] Chronic Lowering of Groundwater Levels  
- [ ] Reduction of Groundwater Storage  
- [ ] Seawater Intrusion  
- [ ] Degraded Water Quality  
- [ ] Land Subsidence  
- [ ] Depletions of Interconnected Surface Water

**TYPE** (check all that apply):

- [ ] Water Supply Augmentation  
  - [ ] Surface Water  
  - [ ] Groundwater (Recharge)  
  - [ ] Recycled Water  
  - [ ] Stormwater  
  - [ ] Other  

  Source of Outside Water (if applicable):

- [ ] Water Demand Reduction  
  - [x] Conservation  
  - [ ] Land / Water Use Changes  
- [ ] Infrastructure / Capital Project  
  - [ ] Policy Project  
- [ ] Data Gap Filling / Monitoring  
  - [ ] Water Quality Improvement  
- [x] Other: Education

---

1 Please continue to next page or attach additional pages to this form as necessary
### COSTS & FUNDING SOURCE(s):

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($)</td>
<td>$10,000-$20,000</td>
<td>AEWSD</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year)</td>
<td>$5,000 bulk mailing</td>
<td>AEWSD</td>
</tr>
</tbody>
</table>

### REGULATORY / LEGAL AUTHORITY REQUIREMENTS (describe all that apply):

<table>
<thead>
<tr>
<th>Type of Permit</th>
<th>Authority Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits</td>
<td>none</td>
</tr>
<tr>
<td>CEQA</td>
<td>none</td>
</tr>
</tbody>
</table>

### SCHEDULE / TIMING:

<table>
<thead>
<tr>
<th>Trigger(s)</th>
<th>Timeframe to Accrue Expected Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Trigger(s)</td>
<td>1 year</td>
</tr>
<tr>
<td>Termination Trigger(s)</td>
<td></td>
</tr>
</tbody>
</table>

This program of Education of Groundwater Use per Acre must establish a uniform method or methods to quantify the groundwater extractions. The GSA may consider a variety of methods including, but not limited to 1) aerial flyovers or remote sensing of irrigated area 2) annual crop survey alongside aerial flyovers or remote sensing of irrigation areas including crop coefficients 3) energy records and meter calibrations 4) flow meter readings of pumped water 5) remote sensing of evapotranspiration 6) other methods. The goal is to accurately and efficiently quantify annual groundwater extractions in acre-feet.
Please continue to next page or attach additional pages to this form as necessary.

<table>
<thead>
<tr>
<th>P/MA ID: 27</th>
<th>BASIN/MANAGEMENT AREA (if any): Kern MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>Emergency 1,2,3-TCP Treatment at the Well No. 13 Facility</td>
</tr>
<tr>
<td>DESCRIPTION:</td>
<td>The Well No. 13 Facility is located on the south side of Sycamore Road approximately 2,350-feet east of Tower Line Road in Section 31, T31S, R30E, M.D.B.&amp;M. in Arvin, California. The well currently has 1,2,3-TCP levels that exceed the State of California maximum contaminant level of 0.005 ppb (MCL). The project involves the installation of emergency 1,2,3-TCP treatment at the well head. The work will include installation of a skid mounted treatment system with two Calgon Carbon Model 10 vessels each with 20,000 lbs of granular activated carbon media for the removal of 1,2,3-TCP, connection to the existing well discharge piping, installation of below ground and above ground influent piping and appurtenances, installation of below ground and above ground effluent piping and appurtenances, electrical and controls, and modifications to the existing well site PLC programming.</td>
</tr>
<tr>
<td>EXPECTED ANNUAL BENEFIT:</td>
<td>N/A</td>
</tr>
<tr>
<td>AGENCY(s):</td>
<td>Primary/Lead: Arvin Community Services District</td>
</tr>
<tr>
<td></td>
<td>Supporting:</td>
</tr>
<tr>
<td>LOCATION:</td>
<td>Township / Range: Section 31, T31S, R30E, M.D.B.&amp;M</td>
</tr>
<tr>
<td></td>
<td>Coordinates (Latitude / Longitude):</td>
</tr>
<tr>
<td></td>
<td>Description: South side of Sycamore Rd. approx. 2,350 feet east of Tower Line Road, Arvin CA</td>
</tr>
<tr>
<td>AFFECTED SUSTAINABILITY INDICATOR:</td>
<td>□ Chronic Lowering of Groundwater Levels  □ Reduction of Groundwater Storage  □ Seawater Intrusion  □ Degraded Water Quality  □ Land Subsidence  □ Depletions of Interconnected Surface Water</td>
</tr>
<tr>
<td>TYPE:</td>
<td>□ Water Supply Augmentation  □ Groundwater (Recharge)  □ Recycled Water  □ Source of Outside Water (if applicable):</td>
</tr>
<tr>
<td></td>
<td>□ Surface Water  □ Stormwater  □ Other</td>
</tr>
<tr>
<td></td>
<td>□ Water Demand Reduction  □ Land / Water Use Changes  □ Conservation  □ Policy Project  □ Infrastructure / Capital Project  □ Data Gap Filling / Monitoring  □ Water Quality Improvement  □ Other:</td>
</tr>
</tbody>
</table>
## Costs & Funding Source(s):

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital / Up-front ($)</td>
<td>$1.6 million</td>
</tr>
<tr>
<td>Source(s):</td>
<td>ACSD</td>
</tr>
<tr>
<td>O&amp;M / On-going ($ per year)</td>
<td>TBD</td>
</tr>
<tr>
<td>Source(s):</td>
<td>ACSD</td>
</tr>
</tbody>
</table>

## Regulatory / Legal Authority Requirements

<table>
<thead>
<tr>
<th>Permit Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits (name of authority, type of permit):</td>
</tr>
<tr>
<td>CEQA:</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

## Schedule / Timing:

<table>
<thead>
<tr>
<th>Trigger(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation: Underway</td>
</tr>
<tr>
<td>Termination: N/A</td>
</tr>
<tr>
<td>Timeframe to Accrue Expected Benefits:</td>
</tr>
</tbody>
</table>

## Additional Details (as necessary):
**ARVIN-EDISON WATER STORAGE DISTRICT**

**PROJECT / MANAGEMENT ACTION**

**INFORMATION FORM**

<table>
<thead>
<tr>
<th>P/MA ID: 28</th>
<th>BASIN/MANAGEMENT AREA (if any): Kern MA</th>
</tr>
</thead>
</table>

**TITLE:** Arsenic Mitigation Project – Phase II

**DESCRIPTION:**
The purpose of the project is to bring the District water system into compliance for Arsenic. All five of the District active wells exceed the maximum contaminant level (MCL) of 10 ppb for Arsenic. The project was separated into two phases. Phase II involves drilling three new wells, constructing a 1.0 MG storage tank and booster pumping plant, and connecting the facilities to the existing distribution system. The original five (5) water wells will then be abandoned and destroyed in accordance with Kern County Standards.

(see below for further details)

**EXPECTED ANNUAL BENEFIT** (demand reduction or supply augmentation, in acre-feet per year): N/A

**AGENCY(s):**
- Primary/Lead: Arvin Community Services District
- Supporting: ________________________________________________________________

**LOCATION:**
- Township / Range: T32S, R29E, Section 2; T31S, R29E, Sections 26, 35
- Coordinates (Latitude / Longitude): ___________________________________________
- Description: Multiple locations in vicinity of City of Arvin (see below for further details)

**AFFECTED SUSTAINABILITY INDICATOR** (check all that apply):
- □ Chronic Lowering of Groundwater Levels
- □ Seawater Intrusion
- □ Land Subsidence
- □ Reduction of Groundwater Storage
- □ Degraded Water Quality
- □ Depletions of Interconnected Surface Water

**TYPE** (check all that apply):
- □ Water Supply Augmentation
  - □ Surface Water
  - □ Transfer
  - Source of Outside Water (if applicable): _______________________________________
  - □ Groundwater (Recharge)
  - □ Stormwater
  - □ Recycled Water
  - □ Other
- □ Water Demand Reduction
  - □ Conservation
  - □ Land / Water Use Changes
  - □ Infrastructure / Capital Project
  - □ Policy Project
  - □ Water Quality Improvement
  - □ Data Gap Filling / Monitoring
  - □ Other: _____________________________

1 Please continue to next page or attach additional pages to this form as necessary
One of the well sites (Well No. 17) is located to the south of the City of Arvin near the northwest corner of the future intersection of Walnut Drive and Burkett Boulevard in Section 2, T32S, R29E, M.D.B.&M. The well is planned to be drilled to an approximate depth of 900-ft and will be equipped with a vertical turbine pump and vertical hollow shaft electric motor and variable speed drive. The site will be fenced with 6-ft tall chainlink fencing with vinyl slats. The well site will be surfaced with ¾” Class II aggregate base with the limits being the chainlink fencing. The well site will include an electrical meter main, motor control center, and PLC and will be installed on a concrete foundation with a steel shade structure. The well facility will also include a pad-mount emergency back-up generator. The well discharge piping will be 12-inch steel piping with a 3,000-gallon hydropneumatic pressure vessel. A 10-ft x 11-ft fiberglass building will be installed on a concrete foundation to house a 12.5% sodium hypochlorite storage tank and chemical feed pump. The well discharge piping will transition below ground and to 16-inch C905 PVC pipe prior to leaving the site. The 16-inch C905 PVC piping will be installed west along the Burkett Boulevard alignment approximately ¾-mile and then north along the Comanche Drive alignment to a point of connection with the existing ACSD distribution system.

One of the well sites (Well No. 16) is located to the south of the City of Arvin near the northwest corner of the future intersection of Walnut Drive and Millux Road in Section 35, T31S, R29E, M.D.B.&M. The well is planned to be drilled to an approximate depth of 900-ft and will be equipped with a vertical turbine pump and vertical hollow shaft electric motor and variable speed drive. The site will be fenced with 6-ft tall chainlink fencing with vinyl slats. The well site will be surfaced with ¾” Class II aggregate base with the limits being the chainlink fencing. The well site will include an electrical meter main, motor control center, and PLC and will be installed on a concrete foundation with a steel shade structure. The well facility will also include a pad-mount emergency back-up generator. The well discharge piping will be 12-inch steel piping with a 3,000-gallon hydropneumatic pressure vessel. A 10-ft x 11-ft fiberglass building will be installed on a concrete foundation to house a 12.5% sodium hypochlorite storage tank and chemical feed pump. The well discharge piping will transition below ground and to 12-inch C900 PVC pipe prior to leaving the site. The 12-inch C900 PVC piping will be installed west along the Millux Road alignment approximately ¾-mile to connect to the proposed 16-inch C905 PVC main in Comanche Drive and will also be installed east along the Millux Road alignment approximately ¾-mile to the existing Well No. 11 site and connect to fill the proposed 1.0 MG storage tank.

One of the well sites (Well No. 15) is located in the City of Arvin on the northwest corner of Walnut Drive and Sycamore Road in Section 26, T31S, R29E, M.D.B.&M. The well is planned to be drilled to an approximate depth of 900-ft and will be equipped with a vertical turbine pump and vertical hollow shaft motor and variable speed drive. The site will be fenced with 6-ft tall chainlink fencing with vinyl slats. The well site will be surfaced with ¾” Class II aggregate base with the limits being the chainlink fencing. The well site will include an electrical meter main, motor control center, and PLC and will be installed on a concrete foundation with a steel shade structure. The well facility will also include a pad-mount emergency back-up generator. The well discharge piping will be 12-inch steel piping with a 3,000-gallon hydropneumatic pressure vessel. A 10-ft x 11-ft fiberglass building will be installed on a concrete foundation to house a 12.5% sodium hypochlorite storage tank and chemical feed pump. The well discharge piping will transition below ground and to 12-inch C900 PVC pipe prior to leaving the site. The 12-inch C900 PVC piping will be installed across the street to a point of connection with the existing ACSD distribution system in Sycamore Road.

The 1.0 MG AWWA D100 welded steel storage tank and booster pump station is planned to be constructed at the existing ACSD Well No. 11 Facility located approximately 2,000-ft south of the intersection of El Camino Real and Meyer Street in Section 35, T31S, R29E, M.D.B.&M. The 1.0 MG storage tank will be filled by a dedicated pipeline from Well No. 10, a dedicated pipeline from Well No. 11, and then from the proposed 12-inch C900 PVC pipeline in Millux Road from Well No. 16 & 17 for blending purposes. The blended water in the 1.0 MG storage tank will have an Aspernic concentration below 8 ppb. The water from the storage tank will then be conveyed to the existing District distribution system by the booster pumping station and a 24-inch C905 PVC pipeline north along the Meyer Street alignment approximately 2,000-ft to a point of connection at El Camino Real Road. New PVC main lines will be installed along City road right-of-ways and private easements from the supply wells.

Upon completion of the project, the existing District Wells – Well No. 5, No. 6, No. 7, No. 8, and No. 9 will be destroyed in accordance with the Kern County Standards.
Appendix N

Board Resolution
BEFORE THE BOARD OF DIRECTORS OF
ARVIN-EDISON WATER STORAGE DISTRICT

IN THE MATTER OF:

RESOLUTION NO. 19-33

RESOLUTION APPROVING A MANAGEMENT AREA PLAN FOR THE
ARVIN-EDISON MANAGEMENT AREA

WHEREAS, the Kern Groundwater Authority (the “Authority”) is duly formed and
existing under and pursuant to that certain Second Amended and Restated Agreement
Joint Powers Agreement (the “JPA”), for the purposes of carrying out the Sustainable
Groundwater Management Act (Water Code § 10720 et seq.) (SGMA), including the
development, adoption and implementation of a Groundwater Sustainability Plan
(GSP) for lands within the boundaries of the Authority’s members and elsewhere
within the Tulare Lake Groundwater Basin;

WHEREAS, the District is a member of the Authority; and

WHEREAS, pursuant to Section 7.01 of the JPA, the District has exercised its
option under the JPA to develop a chapter governing SGMA implementation within the
boundaries of the District for inclusion in the Authority’s GSP, which is titled Management
Area Plan-Arvin-Edison Management Area (the “AEWSD MAP”); and,

WHEREAS, the District has conducted significant technical analysis using the best
available information and science to prepare the AEWSD MAP as required by SGMA;
and

WHEREAS, the District has coordinated with beneficial users of groundwater
including but not limited to the Arvin Community Services District, conducted public
outreach, solicited public input on, and, as appropriate, has responded and/or will respond
to public comments on the AEWSD MAP as required under SGMA; and

WHEREAS, following such outreach, solicitation and response, the District’s
Board of Directors reviewed and evaluated the AEWSD MAP.

NOW, THEREFORE, THE BOARD OF DIRECTORS OF THE ARVIN-EDISON
WATER STORAGE DISTRICT does hereby resolve, declare, and order as follows:

1) Each of the matters set forth above is true and correct and the Board so finds
and determines.

2) The Board finds that the AEWSD MAP is consistent with the requirements of
SGMA, and pursuant to Section 2.03(b) of the JPA approves the AEWSD MAP
for inclusion in the Authority’s GSP.

3) The Board hereby authorizes District staff to undertake such actions as are
necessary and appropriate to transmit the AEWSD MAP to the Authority and
to present the AEWSD MAP to the Authority’s Board of Directors for
consideration of inclusion in the Authority’s GSP.
All the foregoing being on motion of Director _____Johnston_____, seconded by Director _____Martinez_____, and authorized by the following vote, to wit:

AYES: Directors' Camp, Giumarra, Moore, Lehr, Johnston, Martinez, Yurosek, and Fanucchi.

NOES: None

ABSTAIN: None

ABSENT: Director Pascoe.

I HEREBY CERTIFY that the foregoing resolution is the resolution of said District as duly passed and adopted by said Board of Directors on the 10th day of December 2019.

WITNESS my hand and seal of said Board of Directors this 10th day of December 2019.

John C. Moore, Secretary-Treasurer of the Board of Directors